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Orthodontic Management Of Class II Division I Malocclusion Using Infrazygomatic Crest And Anterior Mini Implants: A Prospective Study.

Dr. Sika Kalpana[1], Dr. Mrudula Trehan[2], Dr. Sunil Sharma[3], Dr M.K. Sunil[4], Dr Anurag Tiwari[5]
[1]PhD scholar, Department of Orthodontics and Dentofacial Orthopedics, NIMS Dental College & Hospital. NIMS University, Jaipur, Rajasthan, India
[2]Professor, Department of Orthodontics and Dentofacial Orthopedics, Mahatma Gandhi Dental College and Hospital, Jaipur, Rajasthan, India
[3,4]Senior Professor, Department of Oral & Maxillofacial Surgery NIMS Dental College & Hospital. NIMS University, Jaipur, Rajasthan, India
[5]Associate Professor. Department of Orthodontics and Dentofacial Orthopedics, NIMS Dental College and Hospital, Jaipur, Rajasthan, India

Abstract

Background: *In Orthodontics Class II Division I malocclusion with excessive gingival display presents both functional and esthetic challenges. Traditional treatment approaches often involve extractions or surgical intervention with its own limitations. The use of infrazygomatic crest (IZC) implants combined with anterior mini-implants offers a non-extraction, non-surgical alternative for full-arch distalization and anterior intrusion of maxilla.*

Aim: *To evaluate the effectiveness of IZC and anterior mini-implants in achieving total maxillary arch distalization and incisor intrusion, and improvement in smile esthetics in Class II Division I malocclusion patients with gummy smile.*

Material and Methods: *A total of 20 patients aged 15–30 years with Class II Division I malocclusion and ≥2 mm gingival display on smiling were treated using IZC implants (2.0 mm × 12 mm) placed between the upper first and second molars and anterior mini-implants placed between the lateral incisor and canine. Immediate loading was applied using elastomeric chains. Pre- and post-treatment data were analyzed using cephalometric parameters and clinical photographs.*

Results: *Significant improvements were observed in molar distalization (4.6 mm), incisor retraction (4.5 mm), and incisor intrusion (3.6 mm). Overbite was reduced from 7.1 mm to 2.7 mm, and gingival display decreased from 4.4 mm to 0.45 mm. The nasolabial angle increased by 14.1°, indicating enhanced soft tissue profile. No major complications were reported aside from a few cases of minor implant mobility.*

Conclusion: *The combined use of IZC and anterior mini-implants is an effective and minimally invasive technique for managing Class II malocclusion and gummy smile. It provides excellent control over sagittal and vertical tooth movement, reduces treatment time, and delivers significant functional and esthetic improvements without requiring extractions or surgery.*

Keywords: *Class II malocclusion, gummy smile, Infrazygomatic crest implants, mini-implants, distalization, anterior intrusion, skeletal anchorage.*

INTRODUCTION

A sagittal disparity between the maxillary and mandibular dental arches, where the maxillary teeth are positioned noticeably forward in relation to the mandibular teeth, is the hallmark of class II Division 1 malocclusion, a common orthodontic anomaly.[1,2] The main causes of this condition are either a prognathic maxilla, a retrognathic mandible, or both. Proclined maxillary incisors and a deep overbite are frequently seen along with the increased overjet, which is one of its defining characteristics.[3-8] Concerns about appearance and functionality are common in patients with Class II Division 1 malocclusion. These could include a weakened facial profile, lip incompetence, trouble speaking, and a higher chance of trauma to the anterior teeth that protrude. A gummy smile is also frequently linked to this malocclusion, particularly when vertical maxillary excess is present, which adds to the unhappiness with appearance.[9-15]

Orthopedic intervention is limited in non-growing patients, making the correction of Class II Division 1 malocclusion a significant challenge. Orthognathic surgery, headgear, extractions, and functional appliances have all been used as treatment options in the past. However, the development of skeletal anchorage systems—such as mini-implants has completely changed how these malocclusions are managed, providing non-compliant and efficient substitutes for distalizing the maxillary arch and enhancing soft tissue aesthetics.[16-22] Treatment approaches for Class II Division I malocclusion depend on the patient's age, growth potential, and severity of the condition. Growth modification, camouflage treatment, and surgical intervention are common treatment strategies. Emerging technologies like temporary anchorage devices (TADs) offer innovative solutions to overcome traditional treatment limitations.[23-30] A comprehensive understanding of Class II Division I malocclusion is essential for developing effective treatment approaches that address its complex presentation. Class II div I with gummy smile patients were treated with premolar extractions, head gears, elastics, biteplates, high pull headgear, or by surgical procedures and cosmetic treatments for gingival contouring. These treatments had limitations such as relapses, instability, and discomfort to the patients.[31-35] With the implementation of implants, into orthodontics, it became an easy and effective way to treat class 2 malocclusion with a gummy smile. The results obtained from orthodontic treatment are mainly dependent on effective anchorage because it allows controlled and predictable tooth movements. In the case of Implant-supported anchorage, teeth can be moved by the anchorage provided from a stable point.[36,37]

This study explores the role of infrazygomatic crest (IZC) implants combined with anterior mini-implants in achieving full-arch distalization of the maxilla and reducing the gummy smile in patients with Class II Division 1 malocclusion.

Aim & Objectives

- Access the successfulness of infrazygomatic crest implants in the posterior maxilla for full arch distalization and the titanium mini-implants for intrusion of anterior maxilla to reduce the gummy smile simultaneously.
- Access their efficacy by using pretreatment and post treatment cephalometric parameters

MATERIAL AND METHODS

The study was conducted on 20 orthodontic patients at NIMS Dental College, Jaipur, selected based on specific inclusion criteria such as Class II division I malocclusion, age range of 15–30 years, presence of a gummy smile of 2 mm or more, and good general and oral health. Patients with a history of prior orthodontic treatment, trauma, Class III malocclusion, systemic diseases, poor oral hygiene, or habits such as smoking were excluded. Informed consent was obtained from all participants for the placement of infrazygomatic crest (IZC) and anterior mini-implants.

Sample Size Calculation

A study can be sufficiently powered with just 20 cases, given an expected mean difference of 5.1 between pre and postoperative measures, and standard deviations of 3.1 and 2.8 at baseline and endline, respectively. This assumes a 90% chance of detecting a significant effect and a 1% risk of type I error.

Calculation based on the formula:

$$n = \frac{2\,(z_\alpha + z_\beta)^2 (SD_1^2 + SD_2^2)}{MD^2}$$

Where Z= Z statistic at a level of significance

MD= Anticipated mean difference

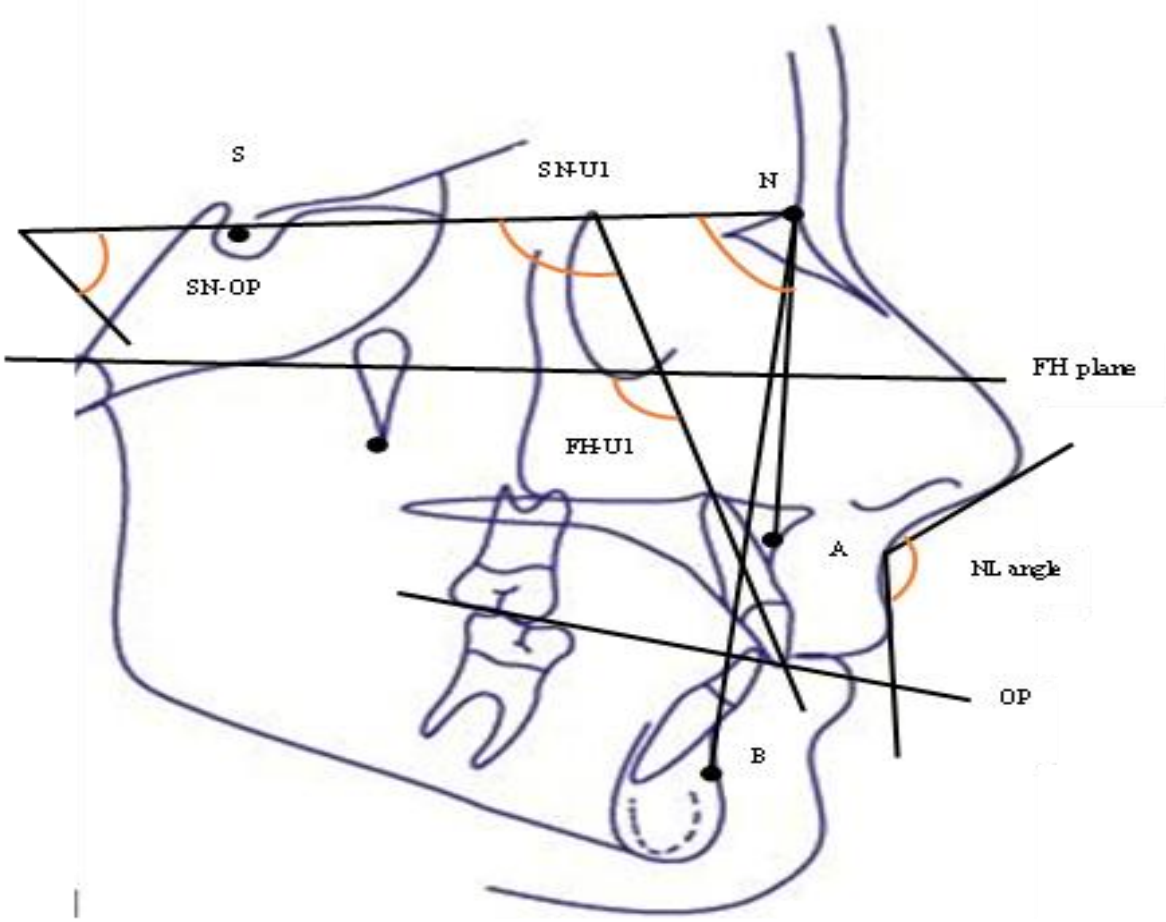
SD_1, SD_2= Anticipated Standard deviation at baseline &endline

Type of study: Prospective comparative study

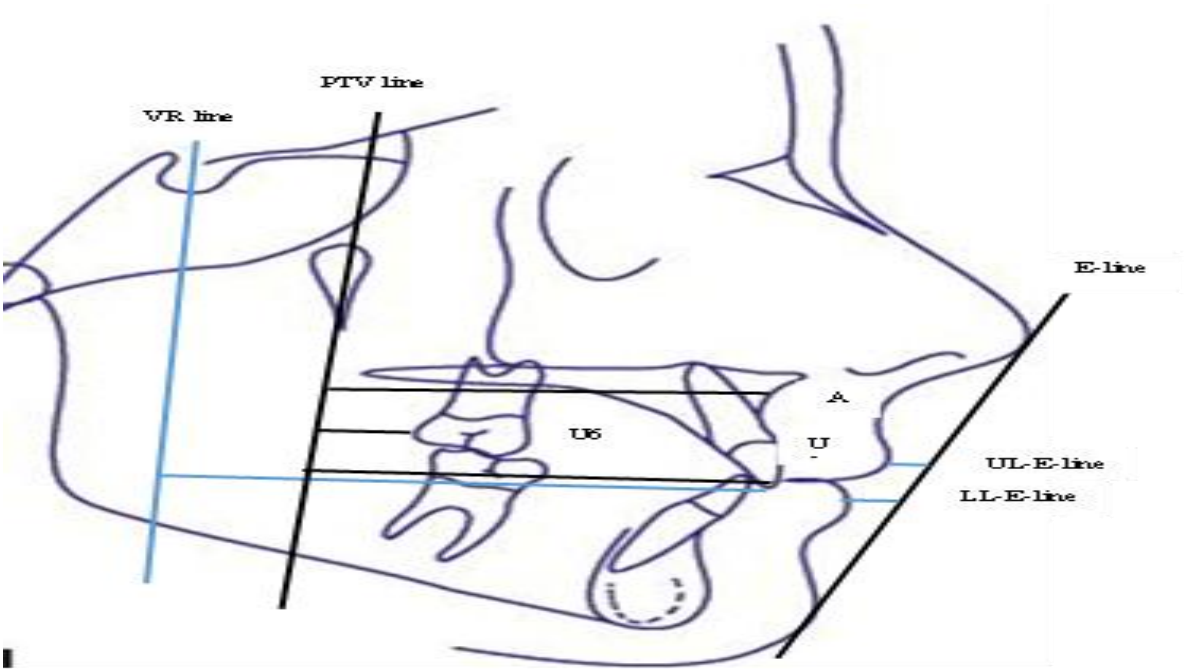
The diagnostic process included the collection of panoramic radiographs, lateral cephalograms, study models, and intraoral and extraoral photographs. A standard orthodontic protocol using a 0.022 MBT appliance system was followed. Initial alignment was achieved using a sequence of Niti and HANT wires, progressing to a 19x25 stainless steel (SS) wire. Molar banding and maxillary lingual arch placement were performed, and

extractions were carried out when required. Crimpable hooks were placed in the reverse direction to support distalization mechanics.

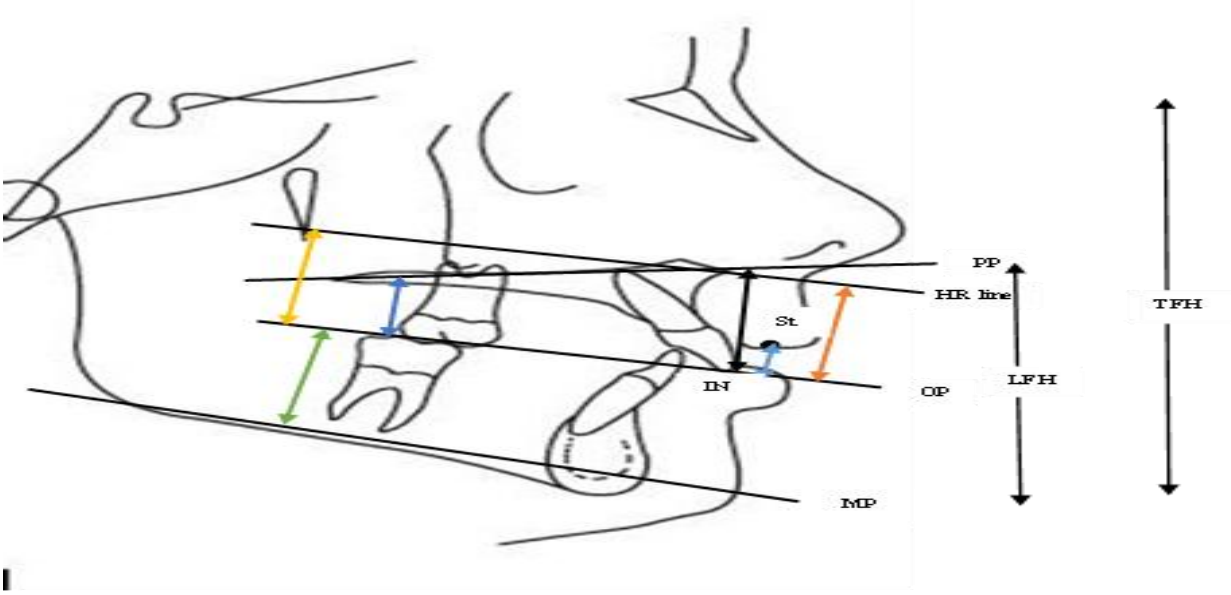
Distalization and intrusion of the maxillary dentition were accomplished using IZC and anterior mini-implants for anchorage. Surface anesthesia with Lidayn spray and infiltration with Lignox 2% were administered before implant placement. IZC implants (2 mm x 12 mm) were inserted above the first and second molars at an angle between 55° to 75° to engage the thick cortical bone while avoiding root damage. Two anterior mini-implants (1.4 mm x 6 mm) were placed for anterior anchorage. Immediate loading of implants was performed using elastomeric chains applying 100–200 grams of force per side. Postoperative orthopantomograms (OPG) were taken to verify implant positioning. Patients were monitored every four weeks for implant stability and healing, with re-implantation performed in cases of failure. Cephalometric analysis was conducted before and after treatment using standard reference lines and planes. Vertical reference line (VR)-A line drawn perpendicular to HR through the sella and horizontal reference line (HR)-were the standard reference lines used. Angular measurements (e.g., SNA, SNB, NL angle) and linear parameters (e.g., U1 to PTV, U6 to HR) and horizontal parameters were used to evaluate changes in maxillary position, intrusion, and facial height. Clinical parameters like overbite and gingival smile line were recorded before and after treatment. Pre- and post-treatment cephalograms were superimposed to determine the amount of distalization and intrusion achieved.



Angular measurements:1. Sella Nasion-point A, 2. Sella Nasion- point B, 3. Point A-Nasion-Point B,4. Sella Nasion-occlusal plane angle, 5. Sella Nasion-Upper incisor, 6. Nasolabial angle, 7. Upper incisor –Frankfort horizontal plane.



Horizontal parameters used to determine distalization of maxilla. 1. PTV-incisal tip of U1, 2. PTV – distal point of U6, 3. PTV to point A, 4. VR-incisal tip of U1, 5. VR-distal point of U6, 6. Upper lip- E-line, 7. Lower lip-E-line



Intrusion was determined by using the following parameters: 1.HR -U1,2. HR-U6, 3. Incision to Palatal Plane (U1-PP), 4. Upper Molar to Palatal Plane (U6-PP), 5. Lower Molar to Mandibular Plane (L6-MP), 6. Incision to Stomion (In-Sto) , 7. Lower Facial Height to Total Facial Height Ratio (LFH/TFH).
distalization and gummy smile reduction (T2) were superimposed to determine the amount of distalization of the maxilla.

Statistical Analysis

Data were analysed using SPSS software v.23(IBM Statistics, Chicago, USA) and Microsoft office 2007. All characteristics were summarized descriptively. For continuous variables, the summary statistics of mean standard deviation (SD) were used. For categorical data, the number and percentage were used in the data

summaries and diagrammatic presentation. The difference of the means of analysis variables between two independent groups was tested by unpaired t test. The difference of the means of analysis variables between two time points in same group was tested by paired t test. The difference of the means of analysis variables between more than two independent groups was tested by ANOVA and F test of testing of equality of Variance. The Shapiro-Wilk test was used to determine if the sample data came from a normally distributed population, with the null hypothesis being that the data is normally distributed. If the p-value is more than a chosen significance level (e.g., 0.05), the null hypothesis is not rejected, suggesting the data is normally distributed. We check with the data and get p value of 0.875. If the p-value was < 0.05, then the results were statistically significant otherwise it was considered as not statistically significant.

PATIENT PHOTOS

Fig:1 PRETREATMENT EXTRAORAL PHOTOGRAPHS

Fig:7: Pretreatment lateral cephalogram and OPG

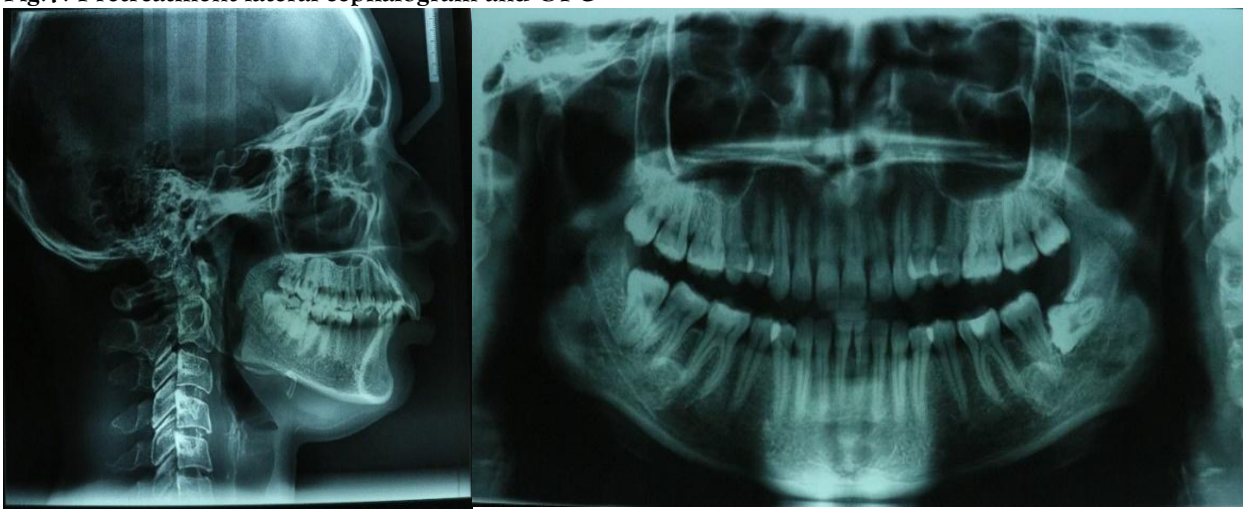


Fig:8: Lateral cephalogram after placement of implants

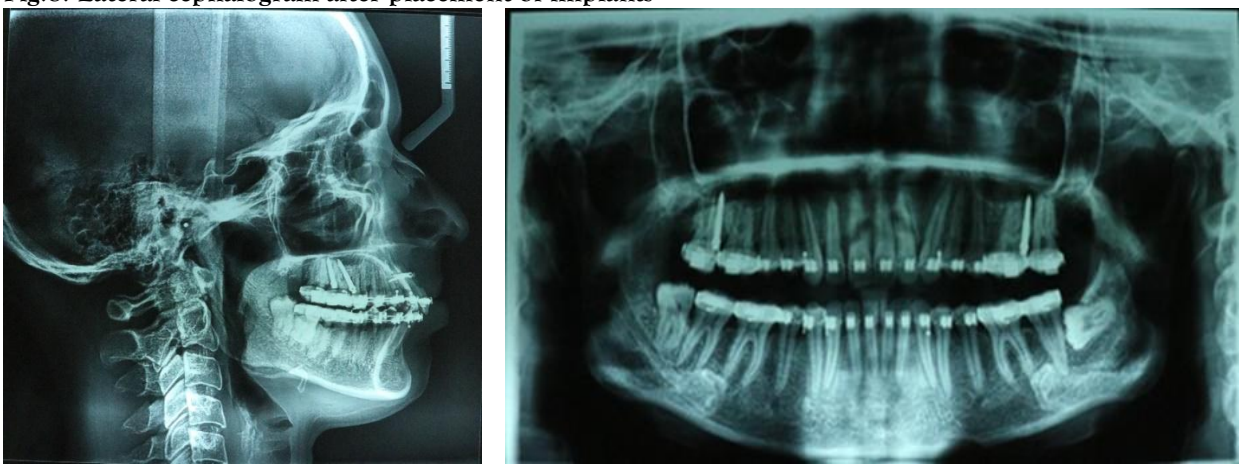
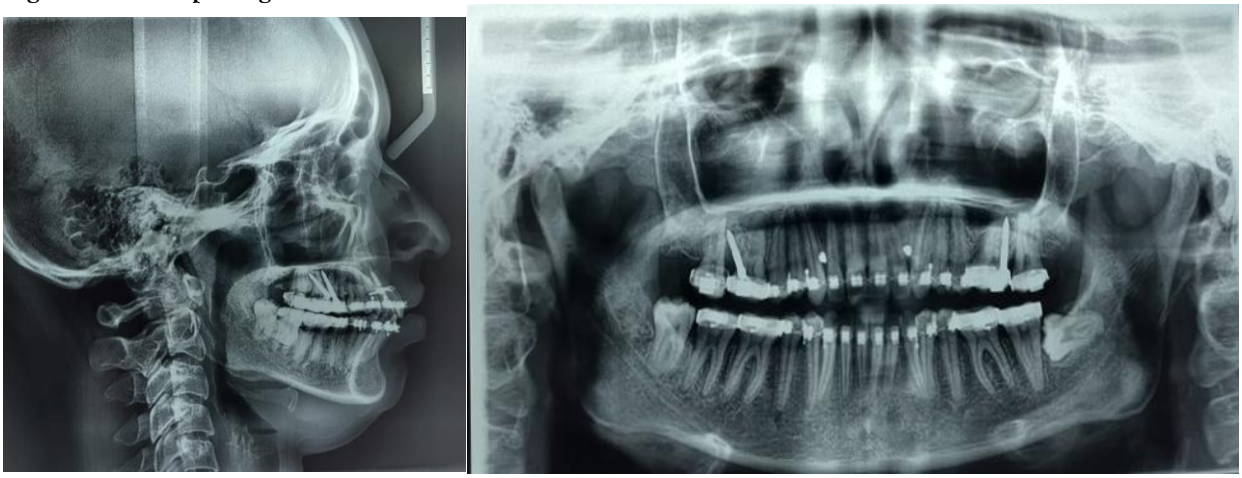


Fig:9: Lateral cephalogram and OPG after distalization and intrusion of maxilla



RESULTS

The study evaluated the effectiveness of infrazygomatic crest (IZC) implants and anterior mini-implants in achieving maxillary arch distalization and anterior intrusion in 20 Class II malocclusion patients.

Among the angular parameters, SNA decreased significantly from 84.3° to 83.3° (p=0.026), indicating posterior maxillary movement. ANB also decreased (5.9° to 4.6°, p<0.001), while SN-U1 reduced significantly by ~9°, indicating substantial upper incisor retraction. The nasolabial angle (NL) increased markedly from 98.5° to 112.6° (p<0.001), suggesting lip retraction and improved profile. SN-OP and U1-FH also showed significant changes. Horizontal measurements showed notable retraction: PTV-U1 and PTV-U6 reduced by 4.5 mm and 4.6 mm respectively (both p<0.001), and PTV-Po A reduced from 54.2 mm to 52.1 mm (p<0.001), reflecting maxillary and molar distalization. The upper and lower lips (ULP-E and LLP-E) also showed retraction. Vertically, HR-U1 and HR-U6 showed significant intrusion (3.1 mm and 3.6 mm respectively), and U1-PP reduced from 34.4 mm to 30.8 mm (p<0.001), indicating upward movement of incisors. However, changes in U6-PP and L6-MP were statistically insignificant. The IN-STO measure (incisor to stomion) decreased significantly, indicating improved incisor position, while LFH/TFH ratio remained stable. Clinically, gingival smile line reduced from 4.4 mm to 0.45 mm, and overbite from 7.1 mm to 2.7 mm, both statistically significant (p<0.001), confirming aesthetic and functional improvements. Overall, the treatment protocol using IZC and anterior mini-implants was highly effective in achieving full arch distalization, anterior intrusion, overbite correction, and gummy smile reduction with high patient acceptance. (tab:1,2,3)

Table 1: Comparing the pre and post Angular measurement values after distalization of complete maxillary arch and intrusion of anterior segment

Parameters	Pre		Post		t value	p value
	Mean	SD	Mean	SD		
Angular measurements						
SNA	84.3	1.4	83.3	1.5	2.3	0.026*
SNB	78.6	1.2	78.3	1.2	0.8	0.446
ANB	5.9	0.8	4.6	1.2	3.8	<0.001*
SN-OP	20.8	0.2	21.3	0.5	-3.5	0.001*
SN-U1	111.9	4.1	103.2	2.4	8.3	<0.001*
NL angle	98.5	8.3	112.6	6.8	-5.9	<0.001*
U1-FH	106.5	3.8	101.2	1.2	0.6	0.032*

Note: * significant at 5% level of significance (p<0.05)

Table 2: Comparing the pre and post Horizontal measurement values after distalization of complete maxillary arch and intrusion of anterior segment.

Parameters	Pre		Post		t value	p value
	Mean	SD	Mean	SD		
Horizontal measurements						
PTV-U1	57.2	4.4	52.7	2.7	3.9	<0.001*
PTV-U6	20.1	2.1	15.5	1.9	7.3	<0.001*
PTV-po A	54.2	1.0	52.1	0.5	1.3	<0.001*
VR-U1	61.7	1.8	57.6	1.7	1.1	<0.001*
VR-U6	34.6	3.1	30.8	2.3	0.9	<0.001*

ULP-E LINE	2.3	2.1	0.4	1.8	3.0	0.004*
LLP-E LINE	2.7	1.9	0.7	1.7	3.5	0.001*

Note: * significant at 5% level of significance (p<0.05)

Table 3: Comparing the pre and post Vertical measurement values after distalization of complete maxillary arch and intrusion of anterior segment

Parameters	Pre		Post		t value	p value
	Mean	SD	Mean	SD		
Vertical measurements						
HR-UI	34.2	1.9	31.1	1.5	5.8	<0.001*
HR-U6	46.3	3.1	42.7	3.0	3.7	0.001*
U1-PP	34.4	2.9	30.8	2.1	4.5	<0.001*
U6-PP	41.9	32.5	41.1	31.9	0.1	0.933
L6-MP	30.8	11.3	29.3	11.9	0.4	0.685
IN-STO	6.4	0.5	3.1	0.4	25.2	<0.001*
LFH/TFH	63.9	1.1	63.8	1.1	0.3	0.784

Note: * significant at 5% level of significance (p<0.05)

DISCUSSION

This study evaluated the clinical efficacy of infrazygomatic crest (IZC) implants in conjunction with anterior mini-implants for achieving full-arch distalization and anterior intrusion in patients with Class II Division I malocclusion and excessive gingival display. The IZC region, characterized by its dense cortical bone and favorable anatomical location, provided stable skeletal anchorage without interfering with adjacent dental roots.[38-42] The implants used in this study (2.0 mm × 12 mm stainless steel screws) enabled the application of immediate orthodontic forces, eliminating the need for patient-dependent appliances or surgical intervention. The results demonstrated significant improvements in both skeletal and dental parameters, including 4.6 mm of molar distalization, 4.5 mm of incisor retraction, and 3.6 mm of incisor intrusion. Additionally, there was a marked reduction in overbite (from 7.1 mm to 2.7 mm) and gingival smile line (from 4.4 mm to 0.45 mm), accompanied by a 14.1° increase in the nasolabial angle, indicating substantial enhancement in soft tissue profile and facial esthetics. These findings align with and, in some cases, surpass outcomes reported in previous literature, demonstrating the biomechanical advantage of IZC anchorage in managing both sagittal and vertical discrepancies. The strategic positioning of IZC implants, coupled with anterior mini-implants placed near the center of resistance of the anterior dentition, allowed for true intrusion without flaring, controlled distalization, and improved occlusal plane stability.[43-52] The extra-alveolar placement also minimized the risk of root resorption and soft tissue interference.[53,54] Patient-reported outcomes further supported the approach, with a significant decrease in discomfort over a 12-month period (VAS score reduced from 4.2 to 2.1). While a few implant failures were noted, primarily related to poor oral hygiene and immediate loading in lower-density bone, they were not statistically significant and did not compromise overall treatment success. Some limitations include anatomical variability, soft tissue complications, and the need for clinician expertise in implant placement. Nonetheless, the approach demonstrated predictable, stable, and esthetically favorable outcomes. In conclusion, the combined use of IZC and anterior mini-implants provides a highly effective, minimally invasive, and non-extraction-based solution for managing Class II malocclusion with vertical maxillary excess. The technique offers precise biomechanical control, reduced treatment duration, and improved patient comfort and satisfaction. Further long-term studies and larger sample sizes are warranted to validate these findings and optimize protocols for diverse populations.

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