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Case Report

Management of anchor loss with the use of infrazygomatic implants – A case series

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ABSTRACT

The mesial tipping of the first molar marks the onset of anchorage loss, and changes in the angulation of the first molar are closely related to anchorage loss. Despite the various treatment strategy, different patients show different tendencies towards anchorage loss, which influences the treatment results and must be managed. The quest for search for an ideal intraoral anchorage device has led orthodontists to micro-implants or temporary anchorage devices (TADs), which offer to solve one of the greatest dilemmas of "anchorage control. The use of miniscrews has been increased recently due to their ease of insertion and removal, reasonable cost, biocompatibility and capability to withstand orthodontic forces The introduction of the mini screw and infrazygomatic implant has provided orthodontists with a solution to the significant challenge of "anchorage control." This case series describes the successful management of anchor loss with the infrazygomatic implant(IZC) that occurred during premolar extraction space closure in a Class I and Class II malocclusion patients with severely proclined maxillary incisors.

1. Introduction

Anchor loss is a reciprocal response that might hinder the success of orthodontic treatment by complicating the anteroposterior correction of the malocclusion and potentially diminishing facial esthetics.[1] We can almost always get a space closed, but unless all the other teeth and the profile end up where we want them, the result cannot be considered successful. The precise estimation of anchorage loss during the closure of extraction spaces is of the greatest significance in the determination of treatment planning and the choice of appropriate mechanics.

In order to control anchorage loss, different methods such as incorporating multiple teeth (banding of second molars), use of headgear, face masks, chin caps, transpalatal arches including Nance buttons, lingual arches or intermaxillary elastics are used.[2] In most situations, the effectiveness of treatment may be compromised by the patient's unwillingness to comply or their discomfort with appliance use.[3–5] Adult patients typically refuse headgear, which provides extraoral anchorage, for aesthetic or functional reasons.[6,7]

However, in most cases even with reinforced anchorage, some amount of anchor loss and mesial movement of the upper molars are usually observed.[8] The tipping action built into anterior brackets in preadjusted appliances may produce problems of anchorage.

Numerous research have been conducted to investigate the phenomenon of anchorage loss during the process of incisor retraction subsequent to premolar extractions. It is expected that there will be a mean anchorage loss ranging from 1.6 to 4 millimeters in traditional anchorage.[9,10] According to the findings from a study

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conducted by Bakirly and his colleague's, it was determined that the use of TPA in conjunction with other standard anchorage methods, such as utility arch and headgear, did not yield adequate anchorage during the en-masse retraction of the anterior teeth when maximum anchorage is desired.[11]

Development of Frictionless mechanics occur from simple loops to more complex loop design.[12] Frictionless mechanics, often known as loop mechanics, include the fabrication of loops in either a sectional or complete arch wire. Loops are commonly employed to facilitate the closure of extraction spaces.[13] One notable benefit of loop mechanics is the absence of friction that occurs between the bracket and arch wire during the process of space closing.[14] Commonly used type of loops are T-loop (TL), Teardrop-loop (TD), and Keyhole-loop (KH).[15]

The quest for search for an ideal intraoral anchorage device has led orthodontists to micro-implants or temporary anchorage devices (TADs), which offer to solve one of the greatest dilemmas of "anchorage control. The use of miniscrews has been increased recently due to their ease of insertion and removal, reasonable cost, biocompatibility and capability to withstand orthodontic forces.[16,17]

The biomechanics involved in skeletal anchorage are slightly different from those in conventional sliding mechanics because of the absence of some reactive forces. The reliability of this "absolute" anchorage improves treatment efficiency and reduces treatment time.[18]

The case series presented below describes the successful management of anchor loss with the infrazygomatic implant(IZC) that occurred during premolar extraction space closure in a Class I and Class II malocclusion patients with severely proclined maxillary incisors who were treated with Double key hole loop and Three piece intrusion arch respectively.

2. Diagnosis and Treatment Plan

2.1. Case 1

A 17 -year- old female presented with the chief complaint of forwardly placed upper teeth. She had no significant medical or dental history. She had convex profile, posterior facial divergence and potentially competent lips with upper lip protrusion. Intraorally, Class I molar relationship and end on canine relationship were present bilaterally with overjet of 9.0 mm and overbite of 4.0 mm and buccal pit in 36 and 46 (Figure 1).

The panoramic radiograph showed that all teeth were present (Figure 1). Cephalometric analysis showed a Class I skeletal pattern with a dentoalveolar protrusion. The U1 to SN angle of 138° which reflected proclination of the maxillary incisors and resulted in an acute nasolabial angle of 93°. Based on these findings, the patient was diagnosed as skeletal Class I malocclusion with deepbite and upper anterior protrusion.

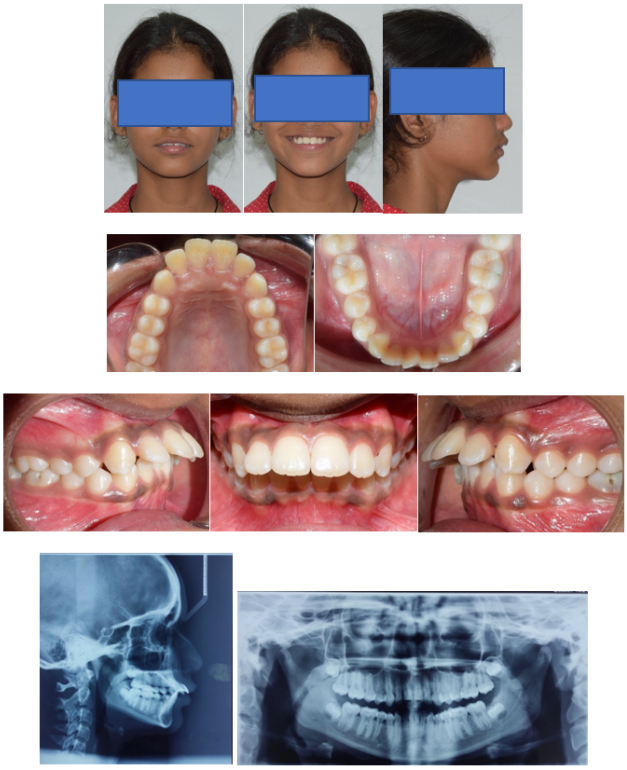

Figure 1: 14-year-old female patient with Class I molar relationship, protrusive lips, and protrusive upper and lower incisors

The treatment plan considered was extraction of all the first premolars, to address the severely proclined maxillary incisors and mild crowding along with the deep curve of spee present in the mandibular arch while maintaining Class I molar relationship bilaterally.

2.2. Treatment progress

Treatment was initiated with extraction of the upper first premolars. The upper arch was bonded with pre-adjusted edgewise appliance, MBT prescription (.022" x .028" slot, 3M Unitek). Both the first and second molars were banded, and a TPA was placed. Leveling and alignment started with 0.012" nickel titanium archwire (NiTi) (3M Unitek nitinol super elastic, USA), and progressed upto .016" x .022" nickel titanium archwire (3M Unitek nitinol super elastic, USA) (Figure 2 A).

During this period, the mandibular first premolars were extracted, followed by the lower arch bonding. An anterior bite plate was placed to facilitate lower arch bonding. The arch wires were cinched back in both arches to avoid maxillary and mandibular incisor proclination (Figure 2B).

After 6 months of leveling and alignment, space closure was initiated in the maxillary arch using frictionless mechanics. A double keyhole loop was used in the upper

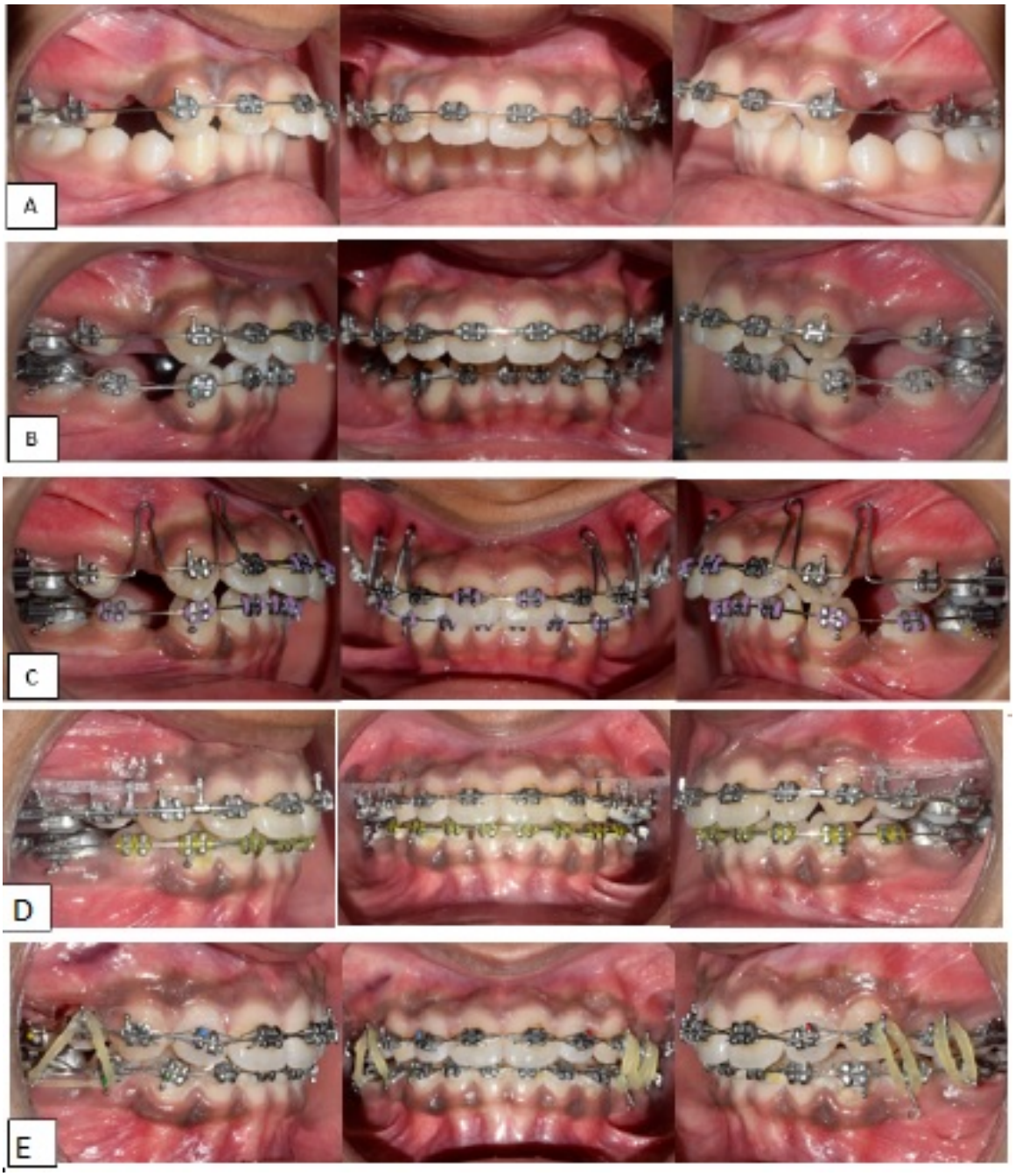

Figure 2: A): Upper bonding done with pre-adjusted edgewise appliance, MBT prescription (.022" x .028" slot, 3M Unitek); **B**): An anterior bite plate was placed in the upper arch; **C**): Retraction with Double Key hole loop (019×.025˝ stainless steel archwire); **D)**: Settling of both the arches was done on 014" Nickel Titanium archwire. **E)**: The extraction space had closed, and some amount of mesial movement of the upper molars could be seen, indicating anchor loss

arch for the retraction of anterior teeth. The loop was fabricated using a .018×.025˝ stainless steel archwire (SS American Orthodontics). The loop was activated by pulling the distal ends of the archwire behind the molar tube, opening the loops, and performing 2 mm of activation every 8 weeks (Figure 2 C).

After 10 months of treatment, the patient reported that all extraction spaces had closed and some mesial movement of the upper molars was observed, indicating anchor loss. After discussing with the patient, the treatment plan was modified to include the use of IZC screws for distalization of the mesially migrated molars.

Two stainless steel mini-screws (2x12mm length) were inserted, under local anaesthesia, at infrazygomatic crest area between the first and second permanent molars bilaterally, 2mm below the mucogingival junction. The miniscrews were fully inserted at a final angle of around 60 degrees. Distalization began in the upper arch using elastomeric power chains (American Orthodontics) attached from the miniscrews to the hooks on each quadrant on a .019" × .025" Stainless Steel archwire (SS American Orthodontics). Force of 350g per quadrant was applied to the upper arch for 8 months (Figure 2 D).

After 8 months, settling elastics were given using 0.014" Nickel Titanium archwire in both the arches for 2 months (3M Unitek nitinol super elastic, USA (Figure 2E).

Debonding was done after 26 months of overall treatment and fixed upper and lower lingual retainers were bonded at the end of treatment (Figure 3).

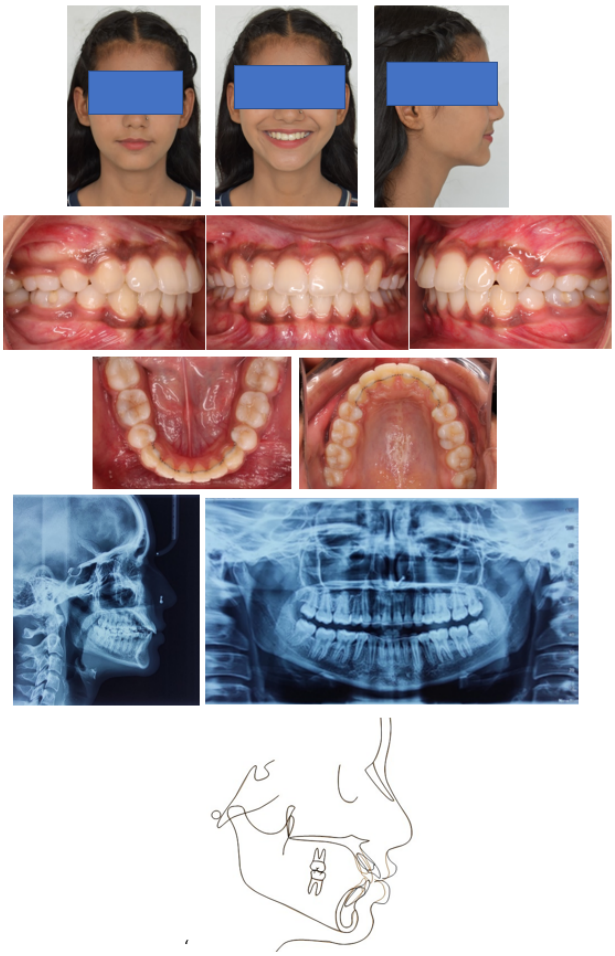

Figure 3: Patient after 26 months of treatment, pre (black) and post (red) superimposition

3. Result

The post-treatment extra oral photographs demonstrated a noticeable enhancement to the profile of the face. The severe proclination of the upper incisors was corrected, and a Class I molar and canine relationship was obtained bilaterally with ideal overjet and overbite and caries in respect to 36 and 46 was restored.

The posttreatment panoramic radiograph confirmed root paralleling (Figure 3). The overbite was decreased from 6 mm to 2 mm and the overjet from 9 mm to 2 mm. The U1 to SN plane was reduced from 138 degree to 101 degree (Table 1). The movement of the maxillary incisors improved the smile and profile of the soft tissues.

3.1. Case 2

A male patient, aged 20 years, approached with the chief complain of protruding upper teeth. He exhibited a convex facial profile, posterior divergence of the facial structure, and competent lips. Intraorally, he had Class II molar and canine relationship bilaterally. He had an overjet of 6mm with overbite of 3 mm and mild crowding in upper and lower teeth (Figure 4).

All the teeth were present in the panaromic radiograph (Figure 4). The cephalometric analysis revealed a Class II skeletal pattern with protrusion of the dentoalveolar region. The angle between the upper incisor and SN was measured to be 116°, indicating a forward inclination of the upper incisors and an nasolabial angle of 90° (Table 2). Skeletal Class II malocclusion with upper anterior protrusion was diagnosed based on the aforementioned findings.

The primary objectives of the treatment plan for this patient comprised achieving the ideal alignment of the dental arches, along with ideal overjet and overbite, while simultaneously enhancing the soft tissue profile.

The extraction of upper first premolars was evaluated as a treatment option to help resolve the severely proclined maxillary incisors and mild crowding present in the maxillary arch, and maintain Class II molar relationship bilaterally and achieve Class I canine relationship bilaterally.

Table 1: Cephlometric analysis

S. No	Measurements	Range	Actual	
			Pre-treat ment	Post-treat ment
Skeletal				
1	SNA	82°	79.5°	79.5°
2		80°	78°	78°
3	ANB	2°	1.5°	1.5°
4	N perpendicular to point A (N ⊥ Pt A)	0-1 mm	-2 mm	-1.5 mm
5	N perpendicular to Pogonion (N ⊥ Pog)	-4 to 0 mm	-5 mm	-5 mm
6	Mandibular plane angle (SN-Go-Me)	32°	30°	30°
7	Angle of inclination (Pal.plane to Pn ⊥)	85°	87°	87°
8	Y-axis {S-N to S-Gn (outer angle)}	66°	66°	66°
9	Facial axis angle {B-Na to Ptm-Gn (Inner angle)}	90°	91.5°	91.5°
10	Bjork sum (sum of posterior angle)	394° ± 6°	391°	391°
Dental				
11	U I to N-A(mm)	4mm	12 mm	5 mm
12	U I to N-A(angle)	22°	50°	34°
13	L I to N-B (mm)	4mm	5 mm	4 mm
14	L I to N-B (angle)	25°	26°	25°
15	U I to LI (Interincisal -angle)	131°	102°	121°
16	Upper incisor to S-N plane	102° ± 20	138°	120°
17	Upper molar to Ptv	Age + 3mm	15 mm	15 mm
18	L1 to A-Pog line distance	1± 2 mm	3 mm	2 mm
19	IMPA (Incisor mandibular plane angle)	90°	95°	93°
Soft tissue				
20	S line to Upper lip	0-2 mm	3 mm	1.5 mm
21	S line to Lower lip	0-2 mm	2 mm	1 mm
22	H angle	7° - 15°	20°	16°
23	Nasolabial angle	94° - 110°	93°	106°
24	Mentolabial sulcus	5mm ± 2	6 mm	5 mm

Table 2:

S. No	Measurements	Range	Actual	
			Pre-treat ment	Post-treat ment
Skeletal				
1	SNA	82°	82°	82°
2		80°	77°	77°
3	ANB	2°	5°	5°
4	N perpendicular to point A (N ⊥ Pt A)	0-1 mm	-2 mm	-2 mm
5	N perpendicular to Pogonion (N ⊥ Pog)	-4 to 0 mm	-9 mm	-9 mm
6	Mandibular plane angle (SN-Go-Me)	32°	28°	29 °
7	Angle of inclination (Pal.plane to Pn ⊥)	85°	88°	88°
8	Y-axis {S-N to S-Gn (outer angle)}	66°	67°	66°
9	Facial axis angle {B-Na to Ptm-Gn (Inner angle)}	90°	91°	91°
10	Bjork sum (sum of posterior angle)	394° ± 6°	380°	380°
Dental				
11	U I to N-A(mm)	4mm	7 mm	4 mm
12	U I to N-A(angle)	22°	31°	26°
13	L I to N-B (mm)	4mm	5 mm	6 mm
14	L I to N-B (angle)	25°	28°	30°

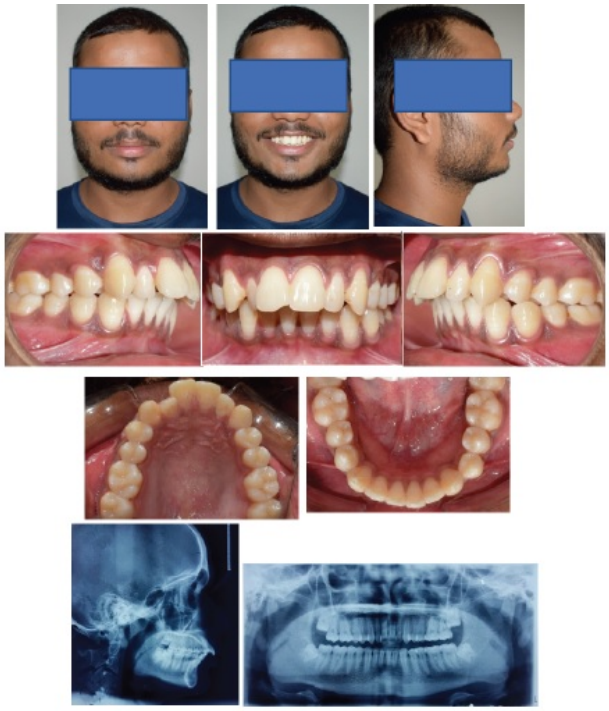

Figure 4: 20-year-old male patient with Class II molar and canine relationship bilaterally with upper anterior protrusion

3.2. Treatment progress

Treatment was initiated with the extraction of the upper first premolars followed by bonding of upper arch with pre-adjusted edgewise appliance, MBT prescription (.022" x .028" slot, 3M Unitek) (Figure 5 A). Both the first and second molars were banded, and a transpalatal arch was placed. Leveling and alignment started with .012" nickel titanium archwire (NiTi) (3M Unitek nitinol super elastic, USA), and progressed upto .016" x .022" nickel titanium archwire (3M Unitek nitinol super elastic, USA).

After 6 months of levelling and alignment, three piece intrusion arch consisted of an anterior segment of .019" x .0 25" stainless steel wire and two bilateral .017" x .025" TMA tip back springs were constructed. A rigid anterior wire segment comprised of.019" x.025" stainless steel wire was placed into the anterior brackets. This anterior wire was raised distal to the canine to avoid interference with the brackets on these teeth during intrusion and retraction. This anterior portion was extended 2-3 mm distal to the anterior teeth's center of resistance. Bilateral tip back bend was applied mesially to the first molar on a posterior segment 0.017x0.025 TMA wire, which helped to intrude the anteriors. 30 grams of intrusive forces were applied to both the right & left sides, and a little distal force was added by connecting an elastomeric chain from the molar to the wire's anterior part. (Figure 5 B).

After 8 months, when the patient reported, the extraction space had closed and deep bite was corrected but some amount of mesial movement of the upper molars could be seen, indicating anchor loss (Figure 5 C). To resolve this, after discussion with the patient, the treatment plan was modified, and distalization of the mesially migrated molars, using IZC screws was decided.

The process of distalization was subsequently began in the upper arch by employing elastomeric powerchain (American Orthodontics) that was engaged from the mini-screws to two hooks on each quadrant. These hooks were positioned on a .019" × .025" Stainless Steel archwire (American Orthodontics) for a duration of 8 months (Figure 5 D).

The settling of both arches was performed using a .014" Nickel Titanium archwire (3M Unitek) for a duration of 2 months (Figure 5E).

Debonding was performed after 24 months of treatment, and fixed lingual retainers were bonded on both the upper and lower arches (Figure 5 F).

4. Result

The post-treatment photographs exhibited a significant improvement in the patient's facial profile. The upper incisors' significant proclination was addressed, and a Class II molar relationship and a Class I canine relationship were obtained bilaterally, with normal overjet and overbite (Figure 6).

The post treatment panoramic radiograph confirmed root paralleling (Figure 6). The overjet was lowered from 86 to 2 mm, and the overbite from 4 to 2.0 mm. The distance between the upper incisor and the SN plane was reduced from 116 to 109.5 (Table 2).

5. Discussion

Extraction of premolar teeth along with labial segment retraction is commonly indicated when there is obvious protrusion, deep bite and curve of spee as seen in our case. Creekmore indicated that when first premolars are extracted, the posterior teeth will shift forward approximately one-third of the space, leaving the remaining two-thirds for crowding relief and incisor retraction. Therefore, maximum anchorage of this posterior teeth is essential not only to permit adequate retraction of the anterior teeth, but also to increase the potential for straightening the profile by diminishing facial convexity.[19] A loss in molar anchorage not only compromises correction of the anterior–posterior discrepancy, but also has an impact on the overall vertical dimension of the face.[20]

There has been constant discussion on the optimal approach to achieve adequate retraction while maintaining maximum anchorage in patients undergoing first premolar extraction. Profit and Fields[21] recommended

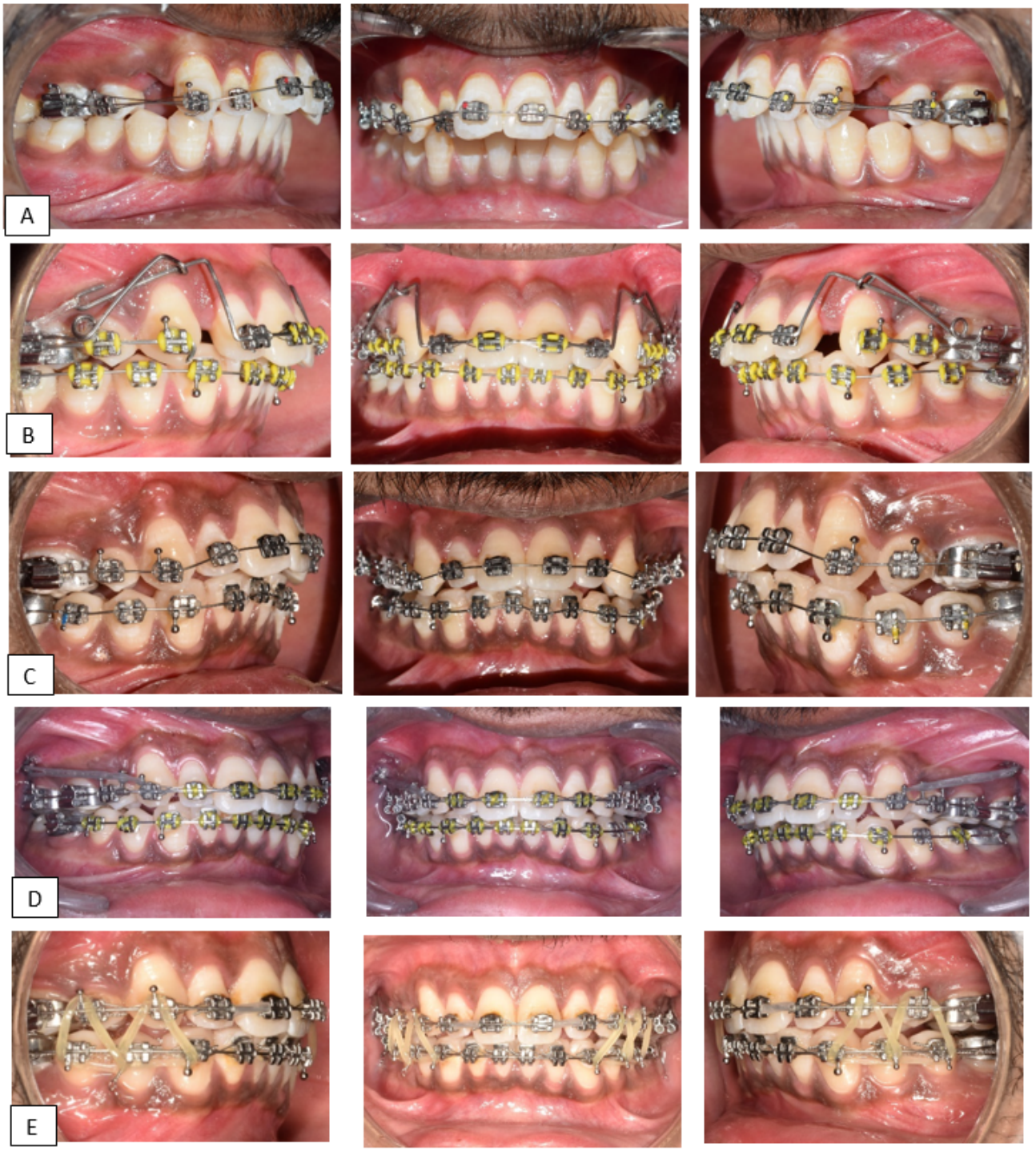

Figure 5: A): The upper arch was bonded with pre-adjusted edgewise appliance, MBT prescription (.022" x .028" slot, 3M Unitek); **B**): Three piece intrusion arch in upper arch for intrusion and retraction; **C**): Mesial movement of the upper molars could be seen, indicating anchor loss; **D**): Distalization was then initiated in the upper arch, using elastomeric powerchain; **E)**: Settling of both the arches was done on .014 Nickel Titanium archwire (3M Unitek nitinol super elastic, USA);

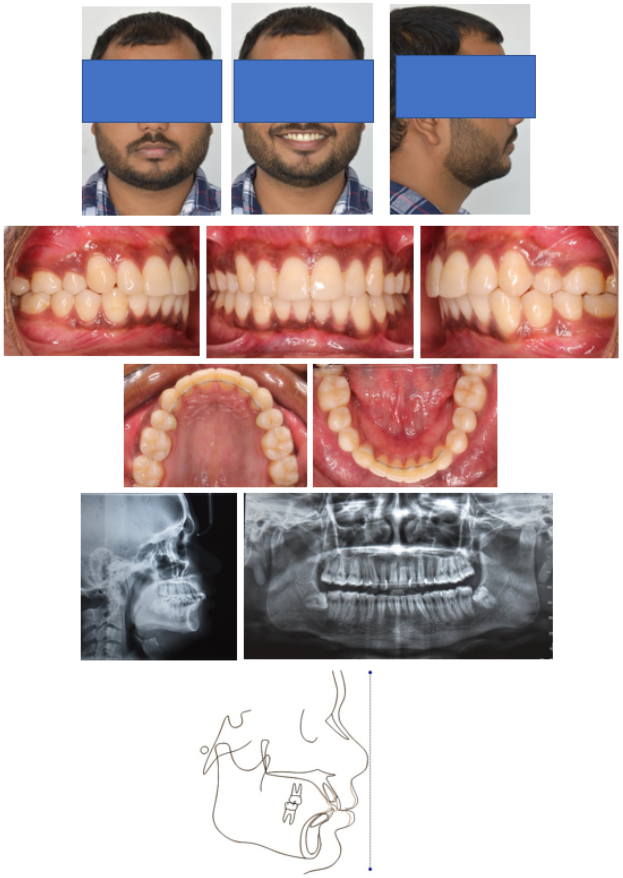

Figure 6: Patient after 24 months of treatment, Pre(black) and Post (red) Superimposition

canine retraction followed by incisor retraction for maximal anchorage, stating that this procedure would reduce the load on the posterior teeth. Staggers and Germane,[22] however, characterized anchorage as "being taxed twice with a two-step retraction, as opposed to once with en mass retraction." Hence, studies were done to compare both techniques. The discussion was concluded when no statistically significant disparities were observed in the extent of anterior teeth retraction and the level of anchor loss between the two procedures.

In both cases, the maxillary anterior teeth were retracted sufficiently to close the extraction space. The maxillary posterior teeth, on the other hand, revealed a significant amount of mesial movement of molars in both the cases. It's concerning because even though orthodontists use modern tools and equipment to manage anchorage, different patients react differently to the same treatment. Indeed, it has been seen that in certain individuals, the upper molars exhibit minimal mobility during the course of therapy, while in others, the upper molars display a quick forward tipping motion at the onset of treatment,[8] as was observed in both of our cases. During orthodontic treatment, it is observed that the maxillary first molars have a tendency to mesially tip, and this is a type of anchorage loss that orthodontists ought to be aware of. Despite the use of the Double key hole loop and Three piece intrusion arch, respectively, anchorage loss occurred in both the cases, which was later managed with the use of an infrazygomatic implant that provided adequate anchorage to retract the entire dentition distally without patient compliance or extraoral appliances.

Anchorage loss is more prevalent among particular groups, including teens, males, individuals with class II malocclusion, and those who underwent maxillary premolar extraction. Unwanted anchor loss is an unfortunate consequence of leveling and aligning, overjet reduction or space closure and is usually greater in the maxillary than mandibular arch.[8]

The complexity of treatment is heightened in cases where anchorage preparation is insufficiently planned, necessitating molar distalization as part of the treatment. In order to minimize the potential loss of anchorage and provide a customized treatment, orthodontists should use strategies to prevent iatrogenic complications and build individualized treatment plans for these patients.

6. Conclusion

Friction and frictionless mechanics have their own merits and demerits. There is no such thing as the best method of space closure. In spite of numerous conventional methods for anchorage control, undesirable anchor loss can occur in cases of severe overjet or premolar extraction, which can now be managed with orthodontic mini-implants or infrazygomatic implants.

7. Source of Funding

None.

8. Conflict of Interest

None.

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