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IP Indian Journal of Orthodontics and Dentofacial Research

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Case Report

Unilateral maxillary distalization via infra-zygomatic crest TADS: Unlocking biomechanical strategy—A clinical case report

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Abstract

The ability of absolute anchorage systems to create skeletal anchorage has revolutionized the field of orthodontics over the past 20 years, turning cases that were on the verge of surgery into non-surgical ones, extraction cases into non-extraction cases, and even creating an aesthetic effect that was challenging for traditional mechanics to accomplish. Mini-implants or micro-screws, which have an inter-radicular site of placement, are the most often used skeletal anchorage devices. Early loosening during treatment is the most frequent drawback, while their major advantage is the simplicity and minimally invasive installation techniques. With the introduction of Orthodontic Bone Screw (IZC and Buccal shelf TADs), an appropriate balance was reached. These screws not only had an extra-radicular site of placement in the buccal shelf area of the mandible and the infra-zygomatic crest of the maxilla, but they also had significantly lower failure rates than standard mini-implants. The aim of this case report to overview IZC TAD and its efficacy for full arch distalization.

Keywords: Biomechanics of bone screws, Distalization, Infra-zygomatic crest, Micro-implants, Orthodontic bone screws

Received: 18-06-2025; **Accepted:** 22-09-2025; **Available Online:** 15-10-2025

1. Introduction

There have been many significant developments in orthodontics over the past century, but few can compare to the clinical impact of micro-implants and the newly released orthodontic bone screws. With the idea of absolute anchorage, micro-implants and orthodontic bone screws have revitalized orthodontics in the last ten years. When used by a skilled clinician, it can help them overcome new clinical obstacles and turn cases that are on the verge of surgery into non-surgical procedures without sacrificing the quality of the results. Nonetheless, the selection of cases continues to be crucial for therapeutic success.[1,2]

2. Distinction between Extra Radicular Bone Screws and Micro Implants

Micro-implants are typically positioned inter-radicularly between tooth roots, whereas bone screws are positioned away from the roots in the buccal shelf areas of the mandible and the infra-zygomatic areas of the maxilla. However, skeletal anchoring is the function of both of them.[3,4]

Size differences between micro-implants and bone screws While a micro-implant's typical dimensions are 6–11 mm in length and 1.3–2 mm in diameter, depending on the clinical scenario, bones screws are relatively larger, with a minimum diameter of 2 mm and a range of 10–14 mm in length. **(Figure 1)** Depending on the anatomic location and the clinical scenario, bone screws can be either short or long collared, similar to how micro-implants can have either a short or long head. Similar to micro-implants, their heads can have a variety of shapes, with the most frequent being mushroom-shaped.[4]

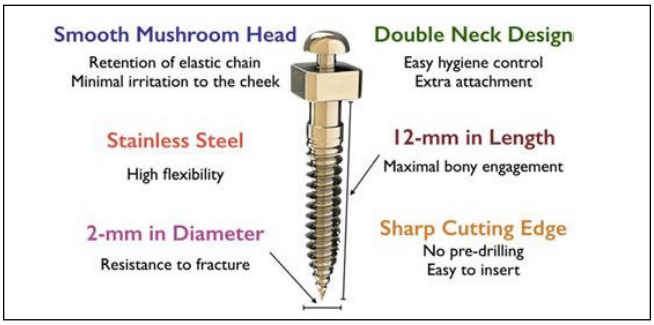

Figure 1: Design specification for IZC TADs

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https://doi.org/10.18231/j.ijodr.11873.1758608448

3. Variations in material selection between bone screws and micro-implants

The majority of micro-implants are composed of titanium, aluminum, and vanadium (Ti6 Al4 Va) alloys. Bone screws are also comprised of titanium, aluminum, and vanadium, but pure stainless steel is the preferred material. Since bone screws are typically inserted in DI (>1250 HU) quality bone (IZC region), they need to be more resistant to fracture. Stainless steel is the material of choice because it is more fracture resistant than Ti alloy.[5,6]

4. Sites for Placement of Bone Screws

The infra-zygomatic crest, which is higher and lateral to the first and second molar region in the maxilla, is the preferred location for bone screw placement. However, some authors (Lin) favor placing bone screws in the first and second molar region, while others (Liou) advocate for a more anterior placement that is closer to the first molar's MB root.[3,2] **(Figure 2)**

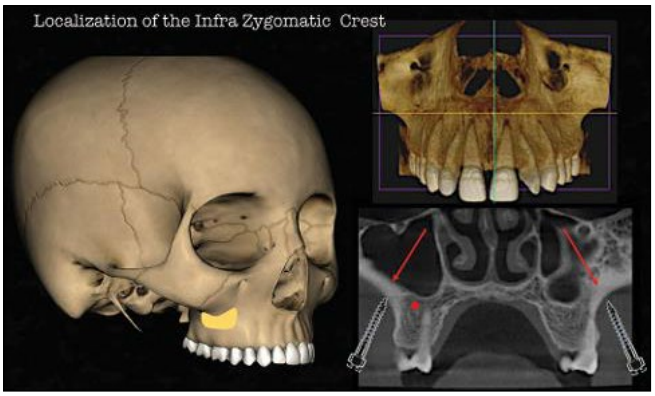

Figure 2 : Localization of IZC

5. Positioning of Bone Screws in the Infra-Zygomatic Crest

IZC screws can be placed on the cortical plate of both the first and second molars, typically at a higher position or slightly lateral to the molar, usually mesial to the mesiobuccal root of the molar. The initial point of insertion is located interdentally between the first and second molars, approximately 2 mm above the muco-gingival junction in the alveolar mucosa. An indentation should be created 14–16 mm above and perpendicular to the maxillary occlusal plane, aligning with the long axis of the tooth.

Insertion of the screw into the bone should commence 14–16 mm above the maxillary occlusal plane at a 90º angle relative to the occlusal plane. After a few turns, the screw handle should be adjusted to an angle of 55-70º, as recommended by Liou, to prevent damage to the molar teeth roots. Angles greater than 75º can make insertion challenging, increasing the risk of screw slippage, bone stripping, and potentially harming the mesiobuccal root of the molar. The screw should be advanced until only the head remains visible.

6. Biomechanical Insights and Arch Shape Factors for Retraction/Distalization using Bone Screws in IZC and Its Contrast with Micro-implant Supported Retraction

Regular micro-implants can distalize the entire arch, but this is limited because they are positioned interradicularly and unless segmental (two-step, first distalization, then screw repositioning for retraction) is done, the likelihood of root contact during the full arch distalization process is higher. Complete arch distalization is safer and more stable with extra-radicular bone screws. Clinicians may have different views on this matter, though. Compared to mini-implant retraction, retraction with bone screws has less adverse effects. such with the formation of anterior dee bite and posterior openbite Occlusal plane rotation, which is frequently linked to mini-implant aided retraction, is less likely because of the precise location of bone screws, which places the source of force application closer to and more parallel to the occlusal plane. The total control on the occlusal plane is still determined by the hook's height and the bone screw's force vector. Retraction supported by bone screws has significant ramifications for arch shape considerations. An extended arch form or a torque in the wire, whichever is appropriate for the clinical circumstance, must be used to compensate for the increased likelihood of molar rolling in due to the force applied by a more buccally positioned anchorage unit.[7]

7. Case Report

A 16-year-old male patient who arrived at the department with a chief complaint of unevenly positioned upper and lower front teeth without the pertinent medical or dental history. Extraoral examination revealed convex profile, Mesoprosopic facial form, no gross facial asymmetry is detected, posterior divergence, negative lip-step, competent lips, deep mentolabial sulcus, consonant smile arc. **(Figure 3)** The results of the intraoral examination showed Class II canine relations on right side Class I relation on left side, Class I molar relationships on the left side, and Class II molar relationships on the right side, with crowding in the upper and lower anterior regions. **(Figure 3)** Functional analysis shows nasal breathing, but there are no noteworthy TMJ findings.

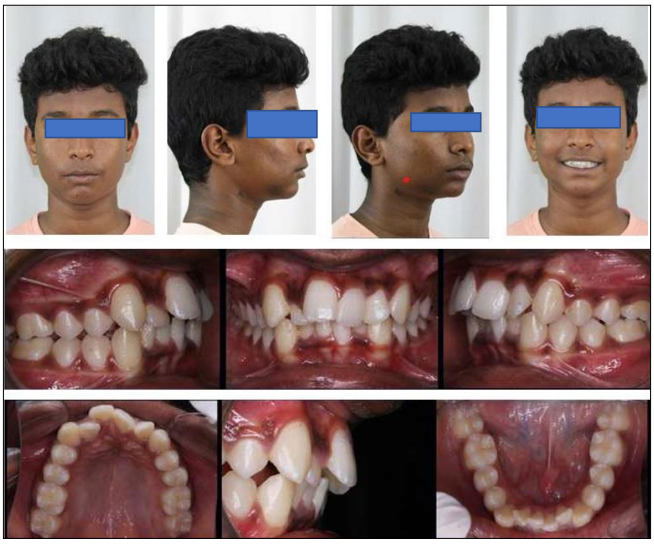

Figure 3 : Pretretment extraoral and intraoral photographs

6.1. Radiographic analysis

Lateral cephalogram - reveals Class I skeletal base was evident with orthognathic maxilla and orthognathic mandible with average to horizontal growth pattern. **(Figure 4)**

Figure 4: Pretreatment extra-oral radiographs

6.2. Diagnosis

A 16 years old male patient diagnosed as Angle's Class II subdivision malocclusion underlying a Class I skeletal base with orthognathic maxilla and mandible **(Table 1)**, convex profile, average growth pattern, upper and lower anterior crowding, Increased overjet and Midline was non-coincident.

Table 1: Functional analysis reveals nasal breathing with no significant TMJ findings

Parameter	Pre treatment	Post treatment
SNA	81'	81'
SNB	80'	80'
ANB	1'	1'
IMPA	5.5'	10'
Upper incisor tona	11 mm, 37'	6 mm, 35'
Lower incisor tona	3 mm, 24′	5 mm, 35'
Inclination angle	83′	82'
Mandibular plane angle	22'/30′	24', 32'

6.3. Treatment objectives

1. To align and level the upper and lower arch.
2. To obtain class I molar and canine relationship bilaterally.
3. To obtain optimum overbite and overjet.
4. To obtain balanced soft tissue profile.

6.4. Treatment plan

1. Align and level the arches
2. Unilateral distalization (Right side) of the maxillary arch using extra-radicular bone screws of the dimension 2×12 mm

6.5. Progress on the appliance and treatment

1. Both upper and lower arch teeth bonded with MBT 0.22 slot stainless steel brackets. **(Figure 5)**
2. Levelling and aligning was performed using 0.016 HANT wires in upper and lower arches.
3. Sequence of wires followed was 0.018 SS, 17 × 25 NiTi followed by 19 × 25 SS after 7–8 months since initiation of the treatment.
4. After 2 months of placement of 19 × 25 S.S in the upper and lower arches, Infra-zygomatic orthodontic bone screw of 12 mm length placed bilaterally in infra-zygomatic region and in order to prevent canting TADs were loaded on both side after 3 days of placement, using elastomeric chains. **(Figure 5)**
5. The unilateral distalization process was carried out on right sides until a Class I molar and canine relationship was achieved. The arch wire was regularly assessed for the transverse coordination of the arches and the arch was stabilized using continuous ligature wire.

Figure 5: Intra oral strap-up and loading of izc using elastomeric chain

7. Results

The final result of the case was a 2 mm overbite and normal overjet. At the conclusion of the procedure, the midlines of the upper and lower teeth matched. Both the left and right buccal segments concluded with a Class I canine and molar connection. At the conclusion of the procedure, all displacements had been fixed. Together with a straight facial profile, a consonant smile arc was attained and smile aesthetics was greatly enhanced. **(Figure 6)**

Figure 6: Post-treatment extraoral photos and intra oral photos

A post-treatment lateral cephalogram shows a straight face profile and nearly normal maxillary and mandibular incisor inclinations. The maxillary and mandibular dentition's strong root divergence on orthopantomography (OPG) is indicative of stable treatment outcomes and the absence of root resorption. **(Figure 7)**

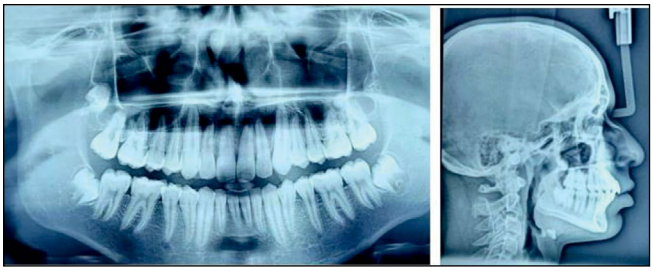

Figure 7: Post treatment extra-oral radiographs

Figure 8: Cephalometric superimposition of pretreatment, midtreatment, and posttreatment cephalograms

Cephalometric superimpositions revealed distalization of maxillary first molars(4 mm), which previously showed class II Molar relation (Rigth side) in the pre treatment cephalogram. **(Figure 8)**

8. Retention

A fixed lingual bonded retainer was positioned in anteriors from canine to canine in the lower arch and upper removable wrap-around retainer was given and recommended to get examination every six months for two years while wearing the retainers.

9. Complications and Success Ratio of Bone Screws as Compared to Micro-Implants

The complications associated with bone screws are slight bleeding during insertion and removal , When high-quality screws made of pure stainless steel are used, screw tip breakage is never an issue. Gingival overgrowth and early screw loosening are the most frequent complications linked to bone screws. Maintaining good dental hygiene is essential to preventing issues with gingival overgrowth. Screws with bigger heads are much less likely to cause gingival overgrowth. If the screw becomes loose too soon, it is best to replace it at a different location. Because bone screws are larger and have implantation locations with superior cortical bone quality, their stability and success rate are significantly higher than those of micro-implants. According to reports, the general failure rates for bone screws are IZC (7%), and micro-implants are 13.5%.[8]

10. Conclusion

As with infrazygomatic crest TADS (orthodontic bone screws) the goal of any new clinical procedure is to increase the quality of care provided while also adding precision, expanding treatment options, and increasing patient and medical professional compliance. When applied carefully, the distalization techniques with these extraradicular bone screws may assist overcome more recent obstacles and push the envelope in order to achieve the ultimate aim of "Clinical Excellence."

11. Source of Funding

None.

12. Conflict of Interest

None.

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Cite this article: Ahmed N, Kesari R, Younus AA, Aymen U, Niharika E. Unilateral maxillary distalization via infra-zygomatic crest TADS: Unlocking biomechanical strategy—A clinical case report. *IP Indian J Orthod Dentofacial Res.* 2025;11(3):226–229.