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Infrazygomatic Crest: Bone Screws- A Review

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Abstract: Infrazygomatic crest (IZC) bone screws have gained widespread acceptance as an extra-alveolar skeletal anchorage system in orthodontics. Their strategic placement in the dense cortical bone of the infrazygomatic region allows clinicians to perform complex orthodontic movements with minimal reliance on dental anchorage or patient compliance. IZC bone screws are particularly advantageous for maxillary distalization, intrusion mechanics, and vertical control in patients with skeletal discrepancies. This review comprehensively discusses the anatomical considerations, screw design, biomechanical principles, clinical indications, placement protocols, success rates, complications, comparative advantages, and future perspectives of IZC bone screws, supported by current scientific evidence.

Keywords: Infrazygomatic crest, skeletal anchorage, bone screws, orthodontic miniscrews, extra-alveolar anchorage

I. INTRODUCTION

Anchorage control is a cornerstone of successful orthodontic treatment. Traditional anchorage methods, including headgear and intraoral appliances, often depend on patient compliance and may produce undesirable reciprocal tooth movement. The introduction of temporary anchorage devices (TADs) has revolutionized orthodontic biomechanics by providing stationary anchorage independent of the dentition.[1,2]

Among TADs, infrazygomatic crest bone screws represent a significant advancement due to their extra-radicular placement, allowing unrestricted orthodontic mechanics. Unlike interradicular miniscrews, IZC bone screws avoid root proximity, reduce the risk of root damage, and permit the application of higher orthodontic forces.[3] Their growing use in contemporary orthodontics warrants a detailed review of their biological foundation and clinical effectiveness.

II. ANATOMICAL CONSIDERATIONS OF THE INFRAZYGOMATIC CREST

The infrazygomatic crest is a bony ridge formed at the junction of the zygomatic buttress and the maxillary alveolar process. This region exhibits dense cortical bone capable of supporting orthopedic and orthodontic loads. CBCT-based anatomical studies have consistently demonstrated favorable bone thickness superior to the mesiobuccal root of the maxillary first molar.[4–6]

The recommended placement height ranges between 12 and 17 mm above the maxillary occlusal plane, depending on individual anatomy. Bone thickness varies with age, facial pattern, and ethnicity, emphasizing the importance of individualized imaging.[7] Proximity to the maxillary sinus is a critical consideration; however, limited sinus perforation has not been shown to significantly affect screw survival when adequate cortical engagement is present.[8]

III. DESIGN AND MATERIAL CHARACTERISTICS OF IZC BONE SCREWS

IZC bone screws are typically fabricated from titanium alloy or stainless steel. Titanium screws offer excellent biocompatibility and corrosion resistance, while stainless steel screws demonstrate higher fracture resistance under heavy orthodontic loading.[9–11]

Screw length (10–14 mm), diameter (1.8–2.0 mm), thread pitch, and taper influence insertion torque and primary stability. Extra-alveolar screws are longer than interradicular miniscrews to maximize cortical bone contact. Self-drilling designs are commonly preferred due to reduced surgical time and enhanced stability.[12]

IV. BIOMECHANICAL PRINCIPLES

The success of IZC bone screws depends largely on their biomechanical behavior under orthodontic forces. Primary stability is achieved through mechanical interlocking with cortical bone rather than osseointegration.[13]

Finite element analyses demonstrate that oblique insertion angles (55°–75° to the occlusal plane) increase cortical engagement and reduce stress concentration at the bone–screw interface.[14–16] The extra-radicular position allows force vectors to be applied closer to the center of resistance of the maxillary dentition, facilitating bodily tooth movement and minimizing unwanted tipping or extrusion effects.

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V. CLINICAL APPLICATIONS

A. *Maxillary Arch Distalization*

IZC bone screws are widely used for en-masse distalization of the maxillary dentition in Class II malocclusion cases. Clinical studies report distal movement of 4–5 mm with minimal anchorage loss and improved facial profile.[17,18] This approach eliminates the need for premolar extractions in selected cases.

B. *Vertical Control and Intrusion*

Vertical control is a major advantage of IZC anchorage. Posterior intrusion achieved through IZC screws is effective in managing anterior open bite and reducing excessive gingival display.[19,20] Intrusion of posterior teeth often results in counterclockwise mandibular rotation, contributing to improved facial esthetics.

C. *Anchorage for Complex Mechanics*

IZC bone screws are also used for asymmetrical mechanics, unilateral distalization, molar uprighting, and anchorage reinforcement in orthognathic surgery cases.[21]

VI. PLACEMENT PROTOCOLS AND IMAGING

Cone-beam computed tomography (CBCT) is considered the gold standard for evaluating bone thickness, insertion angle, root proximity, and maxillary sinus anatomy prior to placement.[22] Conventional radiographs may serve as adjuncts in low-risk cases.
Digital workflows, including virtual planning and 3D-printed surgical guides, have significantly improved placement accuracy and safety.[23] These advances reduce operator variability and enhance clinical predictability.

VII. SUCCESS RATES AND FAILURE FACTORS

Reported success rates of IZC bone screws range from 75% to 95%.[24,25] Prospective studies and systematic reviews identify poor oral hygiene, peri-implant inflammation, and inadequate cortical engagement as the primary causes of failure.[26]
Patient age, insertion angle, and minor sinus penetration do not consistently correlate with failure.[27] Operator experience and strict adherence to placement protocols play a crucial role in long-term stability.

VIII. COMPLICATIONS AND THEIR MANAGEMENT

Common complications include soft tissue irritation, screw loosening, and inflammation. Soft tissue irritation can be minimized by proper placement depth and smooth screw head design.[28]
Radiographic sinus perforation is relatively common but does not necessarily compromise screw survival when adequate cortical anchorage is present.[29] Early detection and management of peri-implant inflammation are essential for preventing failure.

IX. COMPARISON WITH OTHER SKELETAL ANCHORAGE SYSTEMS

Compared with interradicular miniscrews, IZC bone screws offer greater freedom of tooth movement and reduced risk of root damage.[30] However, they require advanced anatomical knowledge and precise technique. Buccal shelf screws provide a comparable extra-alveolar anchorage option in the mandible.

X. FUTURE PERSPECTIVES

Future developments in IZC anchorage include artificial intelligence-assisted placement planning, customized screw design, and long-term outcome assessment using digital models. Multicenter prospective trials are needed to establish standardized clinical guidelines and optimize treatment protocols.

XI. CONCLUSION

Infrazygomatic crest bone screws provide a reliable, versatile, and efficient skeletal anchorage system in orthodontics. Their ability to support complex orthodontic mechanics with high success rates makes them a valuable tool in contemporary practice. Proper case selection, imaging, and biomechanical planning are essential for achieving predictable outcomes.

Table 1. Representative Studies on Infrazygomatic Crest Bone Screws

AUTHOR	STUDY DESIGN	MAIN FINDINGS
Liou et al	CBCT study	Adequate cortical bone thickness
Gill et al.	Prospective study	Oral hygiene affects failure
Patil et al	LPatil et al	Effective maxillary distalization
Nandan et al.	Systematic review	Failure rate evaluation
Park et al	Retrospective study	Retrospective study

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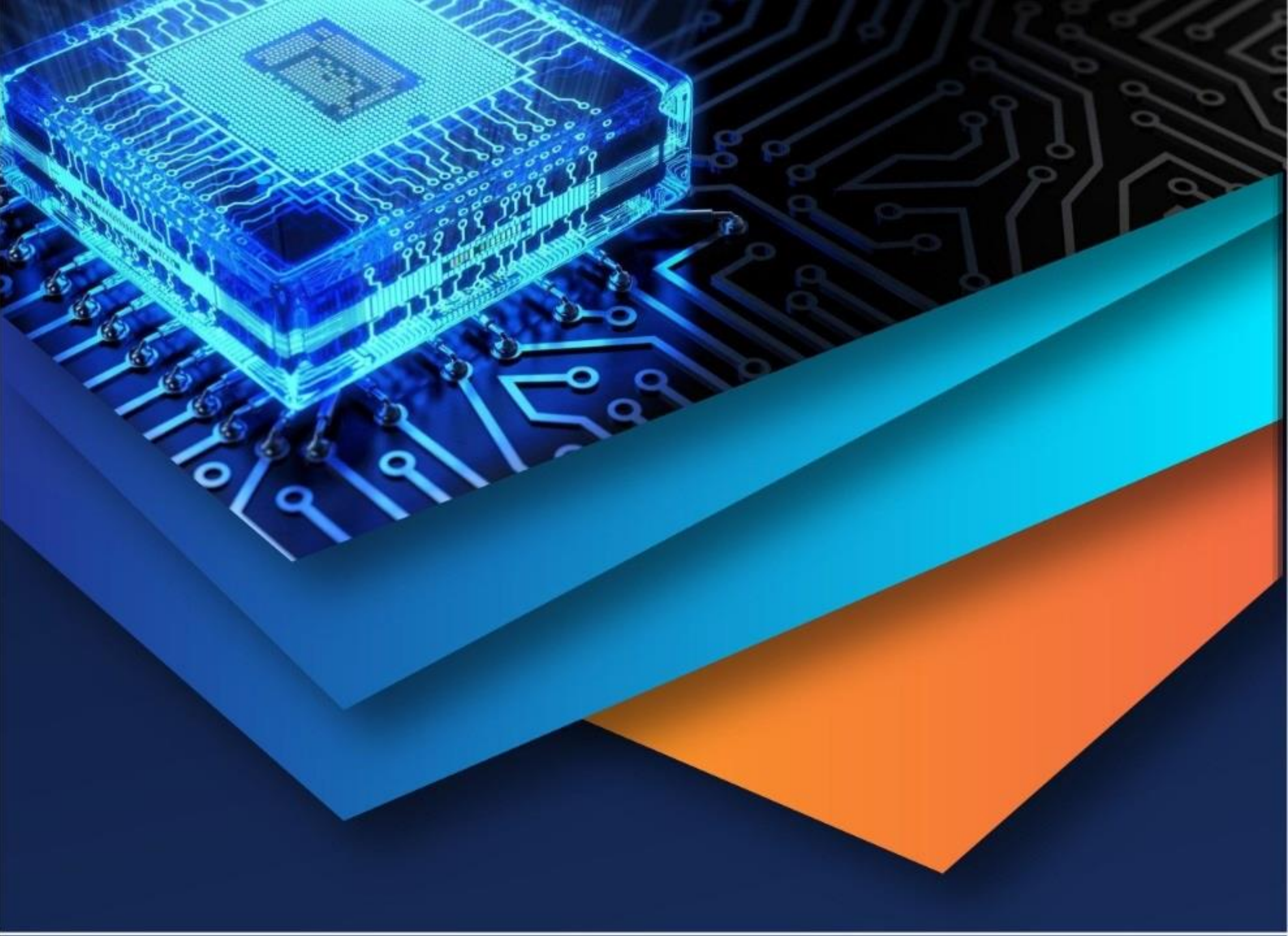

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