Content available at: https://www.ipinnovative.com/open-access-journals

Journal of Contemporary Orthodontics

Journal homepage: https://www.jco-ios.org/

Case Report

3D printed simplified guide design for Infra-zygomatic screws

Sandhra T Madhu[1], Rahul D Prabha[1*], Ajith V V[1]

[1]*Amrita School of Dentistry, Ernakulam, Kerala, India*

ARTICLE INFO

Article history:
Received 16-04-2024
Accepted 02-07-2024
Available online 08-02-2025

Keywords:
Implant guide
Guided implant
Infra-zygomatic crest screw (IZC)

ABSTRACT

Placement of infra-zygomatic crest screw (IZC) in patients with missing posterior teeth or low set sinus floor often presents as a clinical challenge. The ideal position of the bone screw was identified and pre-planned using CBCT images. The critical factors in placement position like the available bone thickness, proximity of sinus floor and adjacent root structures were evaluated. The 3D printed guide was designed for the precise insertion of the bone screw. A detailed protocol for designing and printing the implant guide along with additional features for accuracy of placement has been elaborated in this article.

1. Introduction

The introduction of temporary anchorage devices in orthodontics has dramatically increased the scope of correction of complex malocclusions with fixed appliance therapy.[1] The use of temporary anchorage devices not only eliminates the taxation of anchorage on the posterior teeth but also provides means of producing a wide range of force vectors.[2] Owing to its versatile nature of application, TADs can be used for orthodontic tooth movement in cases that require absolute anchorage.[1] Placement of infra-zygomatic crest screw (IZC) in patients with missing posterior teeth or low set sinus floor often presents as a clinical challenge.[3] The use of simple, customized 3D printed implant guides would be an optimal solution for placement of IZC in areas with unclear anatomical demarcation.[4] This article provides a detailed and step-wise protocol for the designing, printing and application of the implant guide.

1.1. Procedure

The first step in planning an IZC with implant guide is CBCT evaluation. An ideal slice was first selected on the basis of sufficient bone quality and proximity to the sinus floor. The desired position of the bone screw along with the path of insertion was identified and marked on the CBCT. The width and length of the bone screw (2mm x 14mm) is virtually replicated onto the CBCT slice selected. The critical factors in placement position like the available bone thickness, proximity of sinus floor and adjacent root structures were evaluated after designing the virtual bone screw. (Figure 1). The angulation of the implant is also planned such that the screw passes at an angle of 60° to the occlusal plane providing adequate bone-screw interface.

The 3D implant guide was designed using Materialise, Mimics 25.0 software (version 19.0; Materialise NV, Leuven, Belgium). The design (Figure 2) consisted of majorly two components; a) channel for screw placement b) bite plane. The inner diameter of the channel was kept at 5mm (to allow free passage of screw driver head and provide sufficient play for optimal angulation) while the outer diameter was kept at 8mm for sufficient rigidity of the channel.

* *Corresponding author*.
E-mail address: drsandhramadhu@gmail.com (R. D. Prabha).

https://doi.org/10.18231/j.jco.2025.018

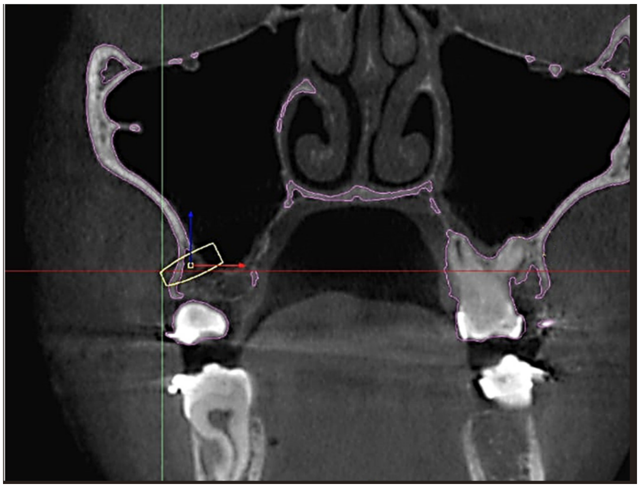

Figure 1: Axial CBCT planning for placement of implant.

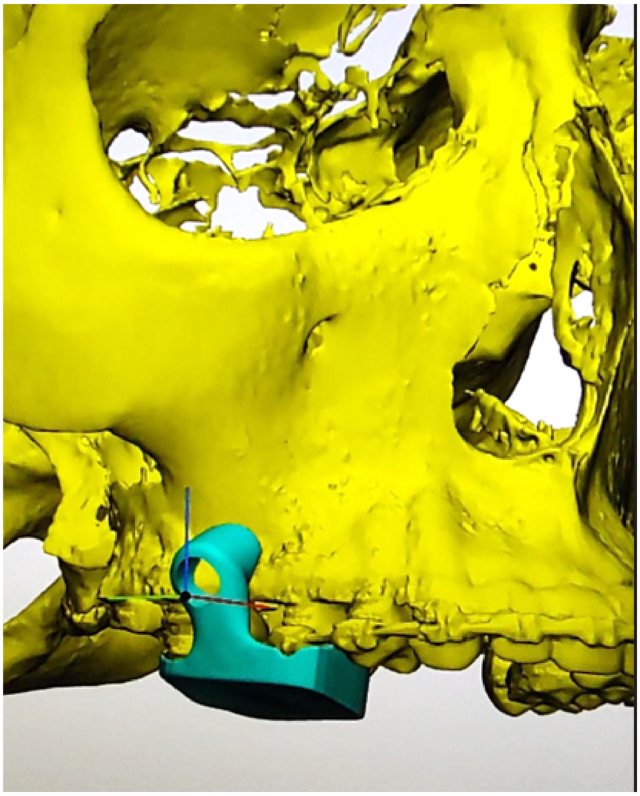

Figure 2: Implant guide designed on Materialise software.

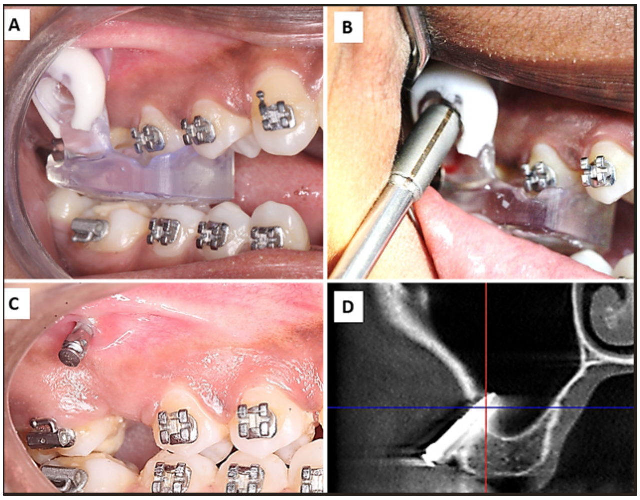

Figure 3: **A**. GIC coated implant guide., **B.** Guided bone screw placement.,**C.** IZC in place, after removal of the guide, **D.** CBCT image showing the IZC in planned position.

The base of the guide comprised of a bite plane which enabled the patient to comfortably bite on. The bite plane is customized to aid in creating clearance for visibility and ease of screw insertion. An occlusal extension was added on the buccal and palatal sides for snap fitting into the buccal tube and brackets, which resulted in enhanced retention (Figure 3 A). The 3D printed guide was fabricated using medical grade resin polymer; which is radiolucent. The outer ring of the guide was coated with glass-ionomer cement to improve radio-opacity during radiographic imaging (Figure 3 B). An RVG was taken to confirm the path of insertion before placing the IZC. After placing the implant, the guide was carefully removed by first disengaging the occlusal surface. (Figure 3 C, and D) The IZC once in place was stable and was angulated away from the buccal mucosa. Post-insertion CBCT showed that the position of the bone-screw was identical to the virtually planned path of insertion.

2. Discussion

Mini-implant assisted anchorage has revolutionized orthodontic practice. Conventionally, most clinicians made use of a direct manual method of insertion with aid of a 2D radiograph. This technique may have compromised on accuracy and at times lead to failure. Infrazygomatic crest screws placement is further challenging due to its close proximity to the sinus floor. Sinus penetration would reduce the osseous interface with the implant. Sinusitis could also be one of the reasons for mini-implant failure.[5] Infrazygomatic crest screws are typically positioned at or above the mucogingival junction. Additionally, the stability of the mini-implant may also compromised by implant being submerged by soft tissue.

Suzuki et al, created a 3D surgical guide with stainless guide tube that could orient the pilot hole drilling based on 2D radiograph. The guide was attached to the orthodontic appliance's main wire via a vertical metal arm. In contrast to the previous conventional implant guide designs, the 3D surgical guide with stainless guide decreased the possibility of mini-implant deviation during the insertion processes. Even though the procedure could identify the quantity and quality of bone at the implantation site, there still remained a chance of harming the surrounding anatomical structures.[6] CBCT imaging is presently a widely used tool for diagnosis and treatment planning in dentistry. Based on prosthetic implant guides designs, Kim et al merged CBCT pictures with implant planning for the first time to create mini-implant insertion guides that significantly increased the accuracy of implant placement. The limitations of this design include errors from the soft-tissue thickness variation which may affect the stability of screw.[7]

In order to create and manufacture guide templates, Qiu et al integrated CBCT pictures with 3D laser scanning models. Incorporation of mucosa morphology into planning, the guide design templates were found to be more accurate.[8]

In this case, we have described a stepwise protocol for the designing, printing and clinical application of a simplified 3D implant guide. Our implant guide design has the additional advantage of a bite plane and sufficient occlusal coverage for enhanced retention. This article is aimed to provide a simple guide design to clinicians for easy and precise insertion of bone screws.

3. Conclusions

1. CBCT guided implant placement using a 3D printed guide provides a more accurate method of placing bone screws.
2. The techniques described has additional advantage of accuracy of placement even in clinical scenarios with partial edentulous areas without proper anatomic demarcation.
3. The pre-determined path of insertion can be accurately achieved with ease on application of the implant guide.

3.1. Source of Funding

None.

4. Conflict of Interest

None.

References

1. Aphale H, Sharma S. Treatment of iatrogenic malocclusions using micro implants: A series of two case reports. *J Contemp Orthod*. 2017;1(1):49–57.
2. Shree NR, Raju AS, Reddy VP, Chandrashekar BS, Mahesh CM, Ansari N. Temporary anchorage devices-steering the treatment of borderline orthognathic case to an orthodontic approach. *J Contemp Orthod*. 2023;7(3):227–31.
3. Michiko A, Shirahama S, Shimizu A, Romanec C, Anka G. The Surgical Guides for TADs: The Rational and Laboratory Procedures. . *Appl Sci*. 2023;13(18):10332.
4. Jariyapongpaiboon P, Chartpitak J, Jitsaard J. The accuracy of computer-aided design and manufacturing surgical-guide for infrazygomatic crest miniscrew placement. . *APOS Trends Orthod*. 2021;11:48–55.
5. Kim MJ, Jeong JY, Ryu J, Jung S, Park HJ, Oh HK, et al. Accuracy of digital surgical guides for dental implants. . *Maxillofac Plast Reconstr Surg*. 2022;44(1):35.
6. Suzuki EY, Suzuki B. Accuracy of miniscrew implant placement with a 3-dimensional surgical guide. *J Oral Maxillofac Surg*. 2008;66(6):1245–52.
7. Kim SH, Choi YS, Hwang EH, Chung KR, Kook YA, Nelson G. Surgical positioning of orthodontic mini-implants with guides fabricated on models replicated with cone-beam computed tomography. *Am J Orthod Dentofac Orthop*. 2007;131(4):82–91.
8. Qiu L, Haruyama N, Suzuki S, Yamada D, Obayashi N, Kurabayashi T. Accuracy of orthodontic miniscrew implantation guided by stereolithographic surgical stent based on cone-beam CT-derived 3D images. *Angle Orthod*. 2012;82(2):284–93.

Author's biography

Sandhra T Madhu, PG Resident https://orcid.org/0009-0004-4599-5977

Rahul D Prabha, Professor & HOD https://orcid.org/0000-0002-7591-9287

Ajith V V, Professor

Cite this article: Madhu ST, Prabha RD, Ajith V V. 3D printed simplified guide design for Infra-zygomatic screws. *J Contemp Orthod* 2025;9(1):133-135.