

Guided Surgery and Digital Prosthetic Crown Delivery in Single-Tooth Implant Placement

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Received: 30 Mar 2025; **Accepted:** 02 Apr 2025; **Published:** 10 Apr 2025

Citation: Rodrigues CLC, Santiago MJ, Claudino TD, et al. Guided Surgery and Digital Prosthetic Crown Delivery in Single-Tooth Implant Placement. Oral Health Dental Sci. 2025; 9(1); 1-5.

ABSTRACT

Guided implant surgery has revolutionized the field of implantology, enhancing precision and predictability in dental implant placement. This case report describes the immediate placement of a single implant in the maxillary premolar region using guided surgery. A 49-year-old female patient presented with a fractured tooth and underwent digital planning and surgical guide fabrication to optimize implant positioning. The procedure was successful, demonstrating the benefits of guided implant placement, including reduced surgical time, minimal invasiveness, and improved accuracy. This case highlights the advantages of guided surgery in maintaining bone integrity and achieving optimal esthetic and functional outcomes.

Keywords

Guided surgery, Single implant, Digital prosthetic crown, Implantology.

Introduction

Implant placement in modern dentistry demands high precision to ensure long-term success and esthetic outcomes. Traditional freehand implant surgery presents challenges, such as difficulty in achieving ideal angulation and depth, especially in anatomically constrained areas. Technological advancements, including Cone Beam Computed Tomography (CBCT) and intraoral scanning, have enabled the integration of digital planning and guided surgery

techniques. These methods allow for virtual preoperative planning and the fabrication of a surgical guide, which aids in precise implant positioning. This case report demonstrates the efficacy of guided surgery in a single implant placement procedure.

Case Presentation

A 49-year-old female patient presented to the Senac University dental clinic with a fractured second upper left premolar. Clinical and radiographic evaluation confirmed the need for extractions and implant placement. Given the limited remaining bone structure, guided surgery was selected to enhance predictability and minimize surgical trauma.



Figure 1.



Figure 2.

Figure 3.

Preoperative Planning

The digital planning process utilized Exoplan software (Exocad) to integrate CBCT data (DICOM format) with intraoral scan data (STL format). The final implant position was virtually planned, taking into account occlusion, bone availability, and prosthetic considerations. A 3D-printed surgical guide was fabricated to facilitate accurate placement.

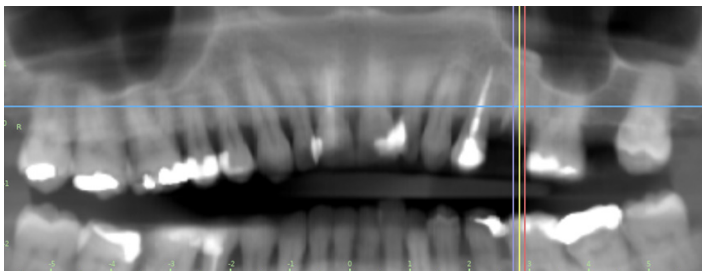


Figure 4.

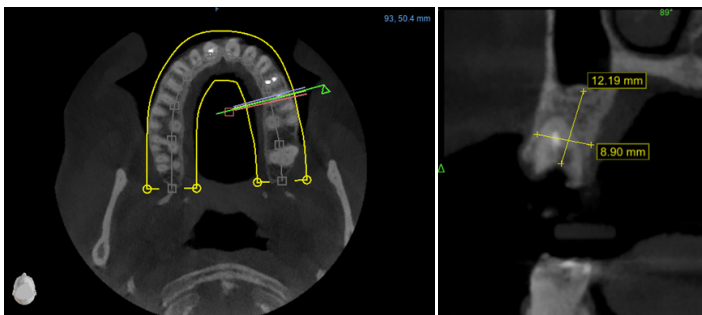


Figure 5.

Figure 6.

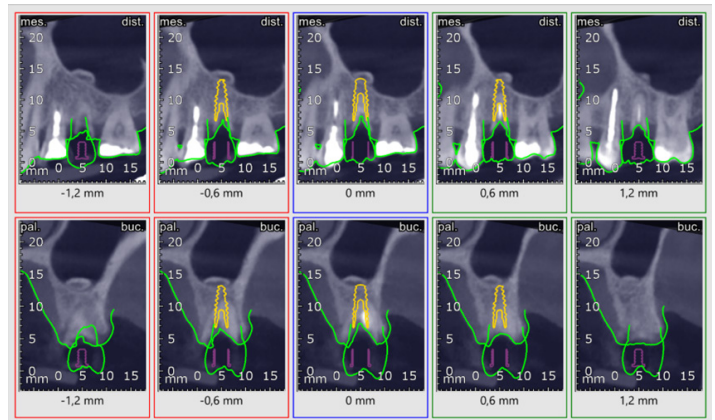


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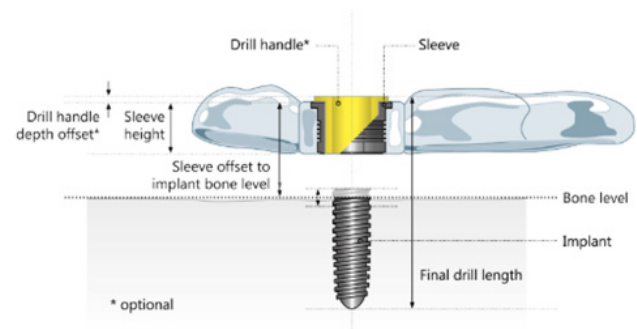


Figure 8.

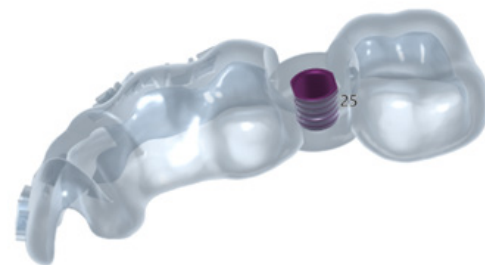


Figure 9.

Surgical Procedure

Under local anesthesia (4% articaine), the residual root of the second upper left premolar was atraumatically extracted. The surgical guide was positioned and secured, followed by sequential drilling using guided drills. A Neodent Drive GrandMorse 3.5 x 10 mm implant was placed with a torque of 30 Ncm. A xenograft bone substitute (Lumina Bone) was used to fill the gap between the implant and socket walls. The site was sutured, and postoperative care instructions were provided.



Figure 10

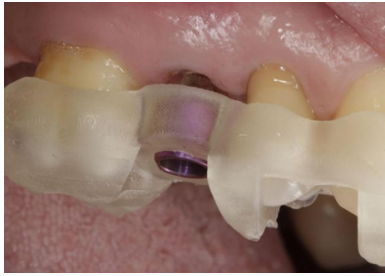


Figure 11



Figure 19



Figure 20.



Figure 21.



Figure 12



Figure 13

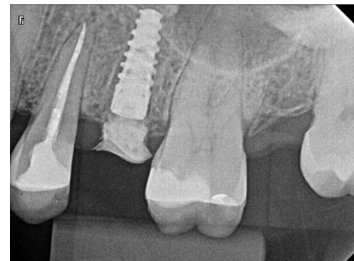


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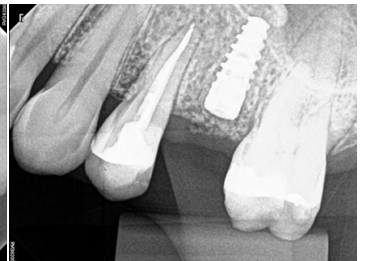


Figure 23.



Figure 14

Prosthetic Workflow

After confirming osseointegration at the 5-month follow-up, a provisional restoration was fabricated to shape the soft tissue and guide the emergence profile. The implant site was then scanned using a digital intraoral scanner, and the digital model was processed. A zirconia crown was designed and milled using CAD/CAM technology. The final prosthesis was delivered and evaluated for fit, occlusion, and esthetics.



Figure 15



Figure 16



Figure 24.



Figure 17

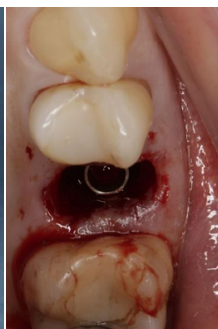


Figure 18



Figure 25.



Figure 26.



Figure 27.

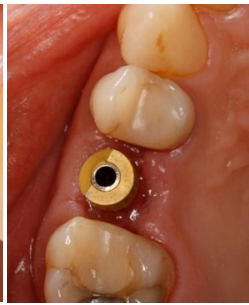


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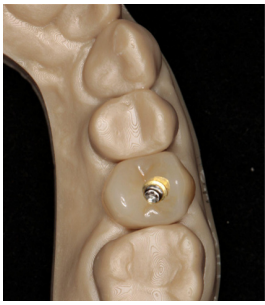


Figure 34.

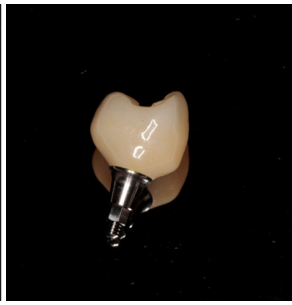


Figure 35.



Figure 29.



Figure 30.



Figure 36.



Figure 37.

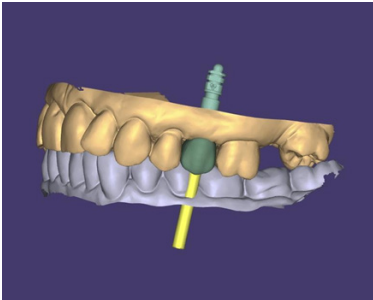


Figure 31.

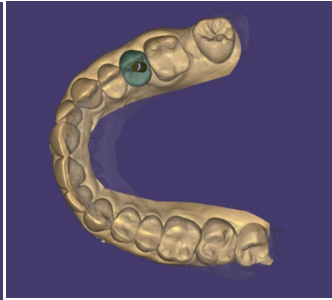


Figure 32.



Figure 38.



Figure 39.



Figure 40.

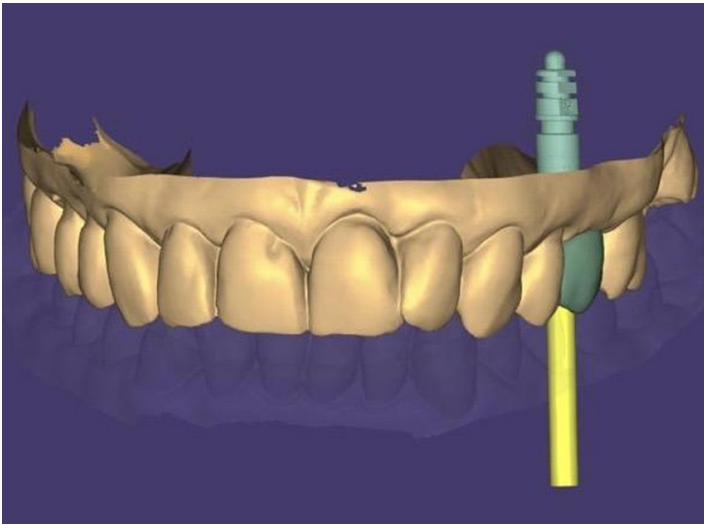


Figure 33.



Figure 41.



Figure 42.

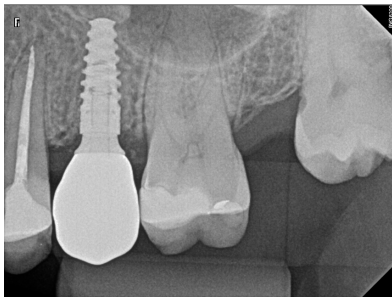


Figure 43.

Discussion

Guided implant surgery has demonstrated significant advantages over conventional freehand techniques, particularly in cases with compromised bone volume. Studies have shown that guided techniques improve implant positioning accuracy, reduce surgical time, and enhance patient comfort.

According to Vercruyssen et al., guided implant surgery increases precision and reduces invasiveness [1]. Greenberg highlighted the importance of digital planning in improving prosthetic outcomes [2]. Gargallo-Albiol et al. reviewed the advantages and challenges of guided surgery, emphasizing its role in reducing surgical complications [3]. Shi et al. provided evidence of the high accuracy of digital guides in implant placement [4]. Lops et al. demonstrated that even less experienced clinicians could achieve favorable outcomes when using guided techniques [5]. Lastly, Ebiary et al. showed that guided immediate implant placement, combined with bone grafting, enhances soft tissue support and esthetic results [6]. While guided surgery offers substantial benefits, potential challenges include guide stability, fabrication accuracy, and the inability to adjust implant positioning intraoperatively. However, these limitations can be mitigated with thorough preoperative planning and clinician expertise. Research supports that static guided surgery maintains high precision, with deviations in implant position typically within clinically acceptable ranges.

Conclusion

This case illustrates the clinical benefits of guided surgery in single implant placement. The use of digital planning and a surgical

guide facilitated accurate implant positioning, reduced surgical invasiveness, and ensured favorable healing. Guided surgery continues to be a valuable tool in implant dentistry, particularly in complex cases requiring precise implant placement.

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