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Case Report

Dentistry Section

# Emergence of Digital Workflow in Minimally Invasive Implant Surgery: A Case Report

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## ABSTRACT

In contemporary dentistry, computer-assisted implant planning has become a significant diagnostic and therapeutic tool. The present case study highlights the potential of modern implantology by integrating virtual implant planning, guided surgery with tooth-supported templates, implant placement with immediate loading and in-office milling. A straightforward approach was followed for the partially edentulous area related to the lower left back tooth region. The authors hereby present a case of a 36-year-old male patient, who presented with complaints of difficulty in eating due to a missing tooth in the lower left back tooth region. Based on clinical findings and detailed virtual Three-dimensional (3-D) implant planning, a surgical guide was fabricated with the help of rapid prototyping techniques and guided implant placement was performed using Computer-aided Design/Computer-aided Manufacturing (CAD/CAM). When compared to conventional implant placement, guided implant placement provides accurate positioning and angulation of implants, accompanied by better function and aesthetics, fewer visits, minimally invasive surgical procedures and immediate prosthesis.

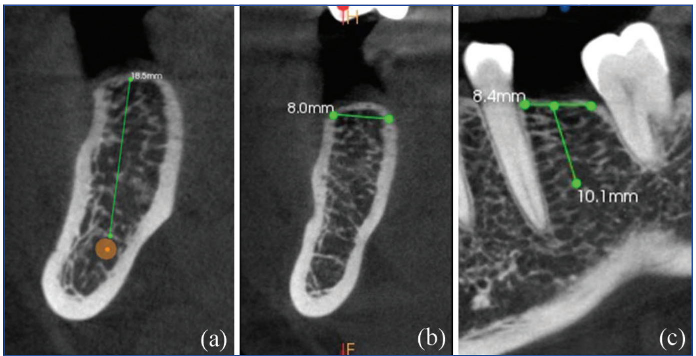

**Keywords:** Computer-aided design, Flapless, Virtual implant

## CASE REPORT

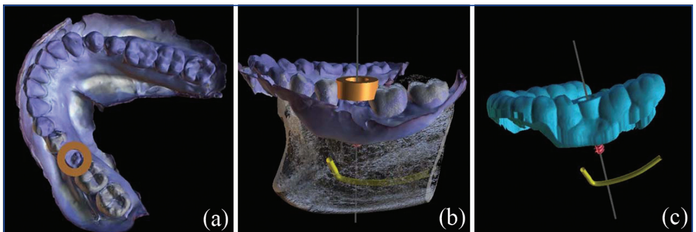
A 36-year-old male patient reported to the Department of Periodontics with complaints of difficulty in eating due to a missing tooth in the lower left back tooth region. The patient stated that the tooth was extracted two years ago due to caries and requested a fixed replacement for it. He was a non smoker with no significant medical history.

The intraoral examination revealed that periodontal health was in good condition. The remnant ridge was covered in healthy keratinised mucosa and had adequate mesiodistal and buccolingual width. Following the creation of diagnostic impressions [Table/Fig-1], the patient underwent Cone Beam Computed Tomography (CBCT) analysis, which revealed sufficient mesiodistal length and ridge height [Table/Fig-2a-c]. The diagnostic cast was scanned using a CEREC® digital intraoral scanner and the Blue Sky Plan® software program was executed for virtual implant positioning and autonerve canal detection [Table/Fig-3a-c]. The CBCT scan was then superimposed over the diagnostic cast to produce a 3-D guide or stent [Table/Fig-4a,b].

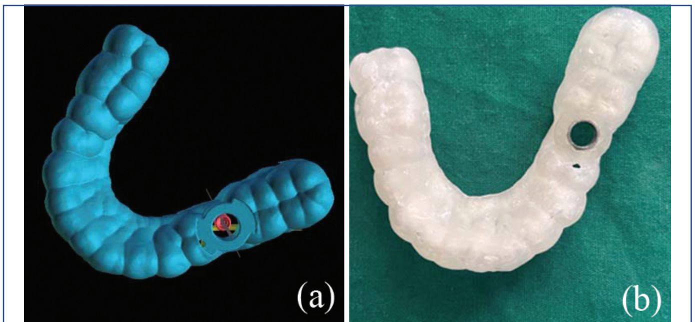
[Table/Fig-1]: Edentulous site showing adequate keratinised mucosa.




[Table/Fig-2]: a) Distance b/w alveolar crest to the adjacent mandibular canal; b) Buccolingual width; c) Mesiodistal width.

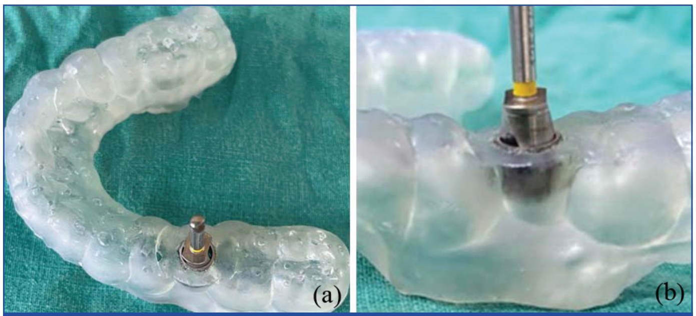



[Table/Fig-3]: a) Diagnostic cast was scanned using CEREC digital intraoral scanner and Bluesky software; b) Virtual implant position; c) Autonerve canal detection.



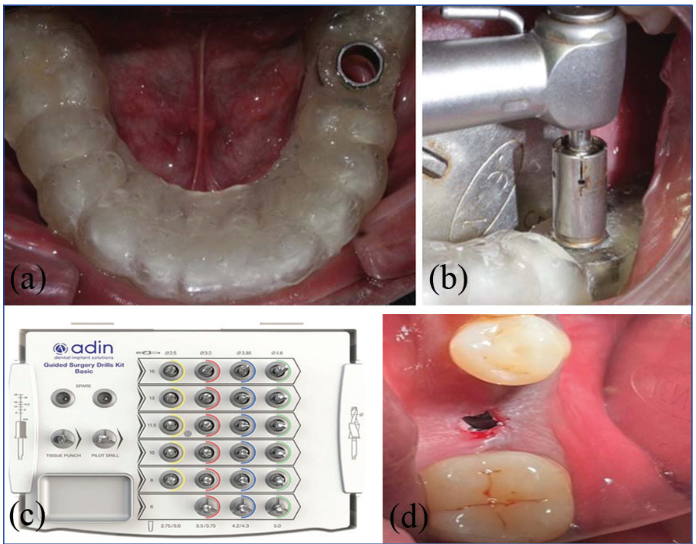

[Table/Fig-4]: a) 3-Dimensional guide or stent; b) 3-Dimensional guide.

The design of the surgical guide used in the present case report consisted of metallic sleeves and a fully guided implant (up to the insertion of the implant) [Table/Fig-5a,b]. The stent was trialed to check the snug fit of the appliance before starting the surgery. The surgical guide was prepared on the supporting surfaces, which were

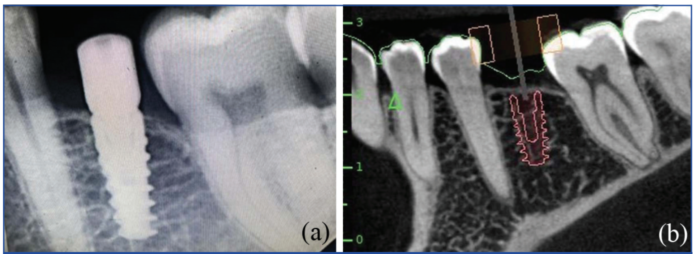



**[Table/Fig-5]:** a,b) Fully guided implant from different views.

tooth-supported guides used in the present case report [Table/Fig-6a]. After administering local anaesthesia and securing the stent, a tissue punch was utilised to reach the implant site. The dental implant drill guide is used to place the drill and comes in a variety of sizes. The stent was removed and tissue was scooped out using a spoon excavator. The osteotomy was performed using the surgical guide and the drilling procedure of the Adin guided surgical kit [Table/Fig-6b,c] and the implant was placed in relation to 36 [Table/Fig-6d,7a]. Calibration was done to check the virtual implant position against the clinically placed implant position [Table/Fig-7b].



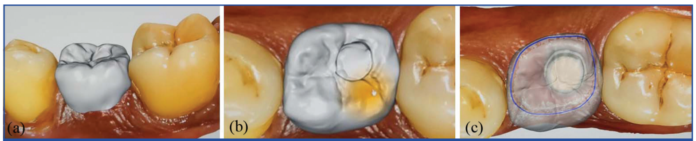

**[Table/Fig-6]:** a) Tooth supported guide; b) Osteotomy drill; c) Adin guided surgery drill kit; d) A 4.2×10 mm Implant placed with 36 with tissue punch technique.



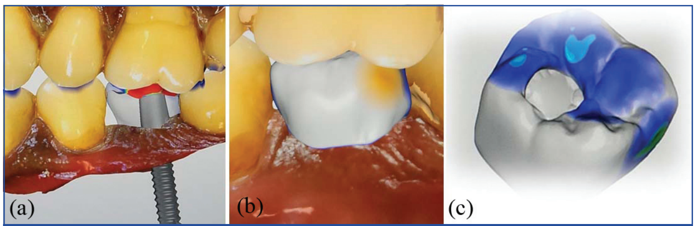

**[Table/Fig-7]:** a) Immediate Radiovisiography (RVG) with 36. b) Calibration was done to check the virtual implant position and clinically placed implant position.

Immediate loading was planned and with the help of the CEREC Omnicam digital intraoral scanner, scanning was performed with the scan body and a sandblasted hexed Ti-base abutment with dimensions of Length (L)=6.2 mm, Root Height (RH)=3.9 mm, Gingival Height (GH)=0.65 mm and Width (W)=0.6 mm was placed [Table/Fig-8]. The implant-supported prosthetic suprastructure was designed and fabricated [Table/Fig-9a-c]. The full-contour crown reconstruction was completed without the need for any interproximal or occlusal corrections, achieving a functional treatment outcome and a pleasing clinical appearance [Table/Fig-10a-c]. Shade selection was performed with the help of the software [Table/Fig-11]. Milling in the office was conducted using a monolithic zirconia block with the CEREC milling machine [Table/Fig-12a-d]. Sintering was performed at 1100°C for 26 minutes, followed by cooling for 20 minutes and

**[Table/Fig-8]:** Digital intraoral scanning.

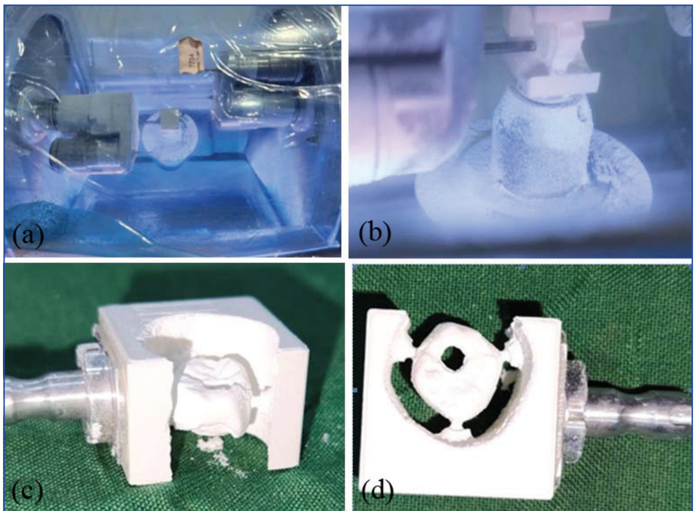



**[Table/Fig-9]:** a-c) Implant-supported prosthetic suprastructure were designed with screw hole.



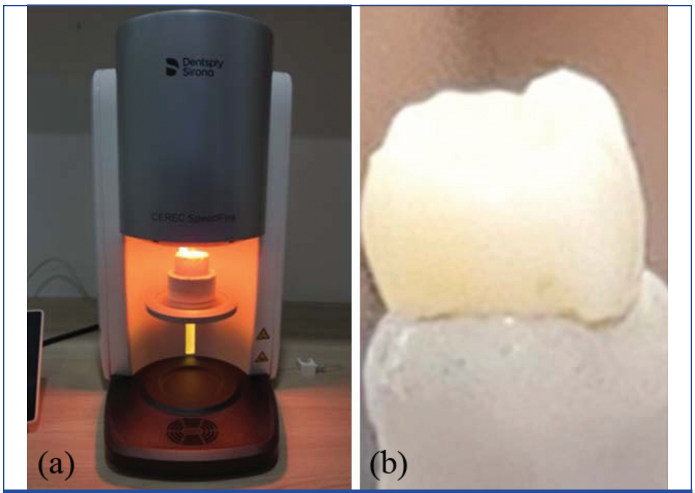

**[Table/Fig-10]:** a-c) Implant level bite impressions and checking the occlusal high points with opposing tooth.


**[Table/Fig-11]:** Shade selection was done with help of the software.

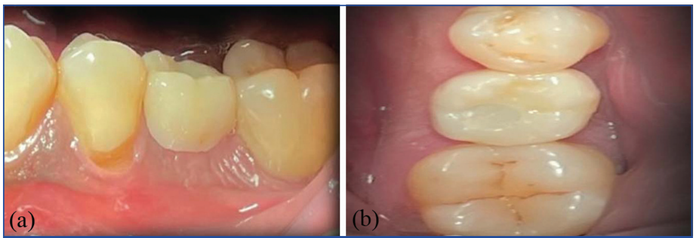



**[Table/Fig-12]:** a-d) Dry milling in office was done with monolithic zirconia block using CEREC milling machine.

glazing was done using universal spray glaze fluo [Table/Fig-13a,b]. The CAD/CAM fabricated screw-retained monolithic implant crown was placed on the sandblasted Ti-base abutment and the screw hole was restored with composite restoration [Table/Fig-14a,b]. The Radiovisiography (RVG) was taken after three months to check for stable bony conditions and any active disease around the implant site [Table/Fig-15].




**[Table/Fig-13]:** a) Sintering; b) Glazing.




**[Table/Fig-14]:** a) Monolithic zirconium crown placed with 36.; b) Screw hole restored with composite restoration.

**[Table/Fig-15]:** Three-months postoperative RVG with 36.

## DISCUSSION

Guided implant surgery is an emerging field of dentistry aimed at achieving ideal implant placement to favour good aesthetic and prosthetic outcomes, optimal occlusion and the maintenance of peri-implant tissue health [1]. Improper implant positioning may result in biological issues due to prosthesis changes and difficulties in maintaining oral hygiene. Precise preoperative planning for the prosthetic and functional elements of implants leads to long-term success and survival [1]. Guided implant surgery enables accurate and precise implant placement, a less intrusive surgical approach with decreased patient morbidity and the avoidance of harm to critical anatomical structures. Guided implants allow us to avoid a second-stage implant surgery, as immediate loading of the implant has been made possible through the use of surgical stents, correct positioning and achieving primary stability, thus requiring less treatment time for the procedure [2].

There are two types of surgical guides: static and dynamic real navigation. The static approach does not allow intraoperative modification of the implant position. However, using dynamic navigation systems, the operator can change the implant position during surgery without the need to restrict any instruments [3]. Surgical guides can be fabricated using model-based or rapid prototyping techniques. Nowadays, rapid prototyping and Stereolithographic (STL) methods are preferred due to their limited manual steps [4]. Flapless procedures can be performed with the help of computer-assisted implant surgery [5]. CAD/CAM technology provides for immediate loading and milling in the office. The use of surgical guides minimises surgical time, trauma, discomfort and swelling, shortens recovery time, ensures proper transfer from virtual to clinical settings, improves prosthetic outcomes and allows for quick loading and flapless surgery in certain circumstances [6].

In the present case study, immediate loading and milling in the office were performed using CAD/CAM in accordance with the case selection criteria established by Chackartchi T et al., [7]. They state that for immediate and early loading, there should be primary stability, no persistent infection/inflammation, 10 mm long implants, no parafunctional habits, no systemic illness and D1 and D2 bone density. In the present case report, a fully digital prosthetic project can be seamlessly executed within the planning software itself or by aligning a digital wax-up in STL format with the corresponding Digital Imaging and Communications in Medicine (DICOM) file [7]. Conversely, in a ‘non fully digital’ protocol, the traditional diagnostic wax-up can be transferred alongside the CBCT examination, thus achieving integration without relying entirely on digital means [8]. This approach ensures a comprehensive evaluation of both the anatomical structure and the desired prosthetic outcomes.

In the current case report, Ti-base abutments were sandblasted to increase retention, following the methodology outlined by Moilanen P et al., [8]. The findings indicated that screw-retained monolithic zirconia crowns featuring titanium base abutments, whether partially stabilised or fully stabilised, exhibited markedly higher strength compared to screw-retained zirconia crowns lacking a titanium base.

Champleboux G et al., stated that the flapless technique using guided surgery offers tremendous advantages over conventional techniques. It maintains periosteal attachment and blood supply to the bone of immediate/early loaded implants, does not alter the gingival contour and minimises surgical trauma and patient morbidity in the immediate postoperative period [9]. Additionally, computer-assisted surgery reduces the possibility of intraoperative complications, allowing for ideal prosthetic-driven implant surgery. According to Nickenig HJ et al., the accuracy of implant placement following virtual planning using CBCT data and surgical stents is high and substantially more accurate than traditional freehand insertions [10]. Pozzi A et al., noted that when treatment planning was done utilising CBCT scanning and 3D implant design software, postoperative discomfort and oedema were higher at locations treated with the free-hand traditional approach, as flaps were elevated more frequently [11]

In the present case report, a static guide was used, which aligns with the findings of Beretta M et al., [12]. They noted that the static approach is used more frequently than the dynamic approach and is associated with fewer errors. Dynamic navigation systems remain expensive and complicated [12].

The surgical guides utilised in this case study were designed with metallic sleeves because they required a broader mesiodistal gap, which was roughly 9 mm in our case [13]. The guide design used was tooth-supported due to its high accuracy compared to other guide designs, as concluded by a systematic review from the Fifth International Team for Implantology Consensus Conference [14]. In the present case report, immediate loading was performed in accordance with Wu H et al., [15]. They stated that immediate loading over conventional loading has certain advantages, such as reduced time of edentulous span, minimised fibrous tissue formation, reduced woven bone formation and promotion of lamellar bone maturation [15].

However, there are still inherent deviations and problems when employing computer-guided implant devices, which might harm critical anatomical structures or lead to prosthetic mismatches. There is a scarcity of research examining the discrepancies between anticipated and actual implant locations using surgical guidance.

Preoperative communication between the dentist and the technician during the decision-making and planning phases was crucial for the clinic's accurate scheduling, ensuring maximum surgical and prosthodontic performance accuracy in this particular case. The present case report emphasises the importance of immediate loading, optimal implant placement and minimally traumatic or flapless surgery.

## CONCLUSION(S)

Accurate implant location and angulation, as well as, improved function and aesthetics, are now possible. Thanks to advancements in implant insertion techniques and computer-guided surgery. As a result, treatment planning and dental implant placement can be accomplished using both radiographic CBCT images and surgical stents.

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- Manual Googling: Jun 24, 2024
- iThenticate Software: Jun 26, 2024 (12%)

**ETYMOLOGY:** Author Origin

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