Computer-Guided Immediate Implant Placement and Predigitally Designed Immediate Provisionalization

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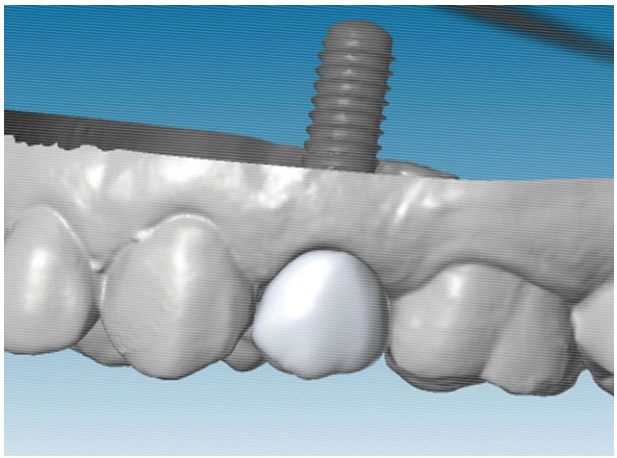

Introduction: Implementation of digital technology in patient care has allowed precise and personalized implant restorations to be delivered with unprecedented speed. This case report demonstrates that through digital planning, successful guided placement of an immediate implant can be achieved, including bone grafting and immediate provisionalization, using a predesigned and prefabricated restoration.

Case Presentation: A healthy 38-year-old female patient with high esthetic demands presented with an unrestorable maxillary left first premolar. Main challenges in this case included the presence of an impacted adjacent second premolar and the desire of the patient for a fixed provisional prosthesis. The treatment plan involved extraction of the tooth, computer-guided immediate implant placement, and immediate provisionalization with a digitally designed, presurgically fabricated crown. After immediate delivery of the provisional crown, which facilitated sculpting of the peri-implant soft tissue, minimal adjustment was required, and there was no need for suturing to seal the grafted socket. After delivery of the final restoration and 10 months of functional loading, evaluation of the implant and restoration revealed stable crestal bone levels with an esthetically pleasing result and high patient satisfaction.

Conclusions: Digital technology can play a significant role in implant therapy. Select cases can benefit from the digital workflow to facilitate guided immediate implant placement and delivery of a digitally prefabricated provisional restoration. Further studies are needed to optimize the generalizability of this approach. *Clin Adv Periodontics* 2018;8:39–44.

Key Words: Computer-aided design; dental implants; esthetics dental health services; guided surgery; implant supported; surgical guide.

Background

Previously, implant therapy mandated multiple appointments and routinely involved submergence of the implant fixture followed by a prolonged healing period before placement of the final restoration. It is now accepted that, with proper case selection and planning, immediate implant placement with provisionalization at the same appointment offers equivalent survival rates and success.[1–3] In addition, digital technology has facilitated precise immediate implant placement with the predetermined ideal positioning and prefabrication of customized provisional restorations according to the unique alveolar morphology, soft tissue profile, and occlusal scheme of the patient.[4,5] Although the technology is available, only limited case reports demonstrate immediate delivery of a digitally planned and fabricated provisional restoration.[4,5]

The following case report describes an ideal indication for computer-guided implant placement to avoid

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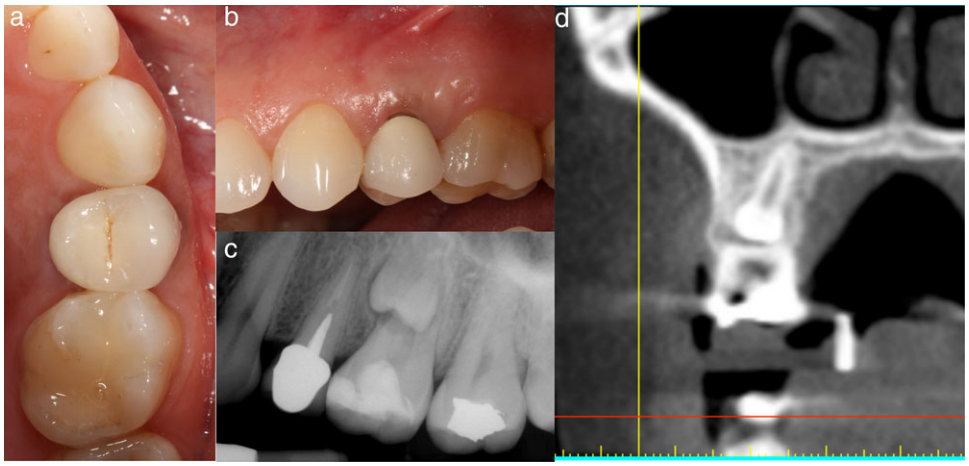

FIGURE 1 Preoperative clinical and radiographic examination. Occlusal **(1a)** and buccal **(1b)** views. **1c** Periapical radiograph of tooth #12 with non-retainable porcelain-fused-to-metal crown and impacted tooth #13 (under tooth #14). **1d** Cone-beam computed tomography scan showing fully impacted tooth #13 under the furcation of tooth #14.

compromising an impacted tooth. It also describes prefabrication of a digitally designed provisional restoration for a patient who was highly conscious of esthetics and desired a fixed provisional restoration during the healing phase of implant therapy. The advantages of digitally planned surgical and prosthetic protocols include ease of achieving the precise osteotomy location for immediate implant placement, shortened healing duration, proper management of anatomic challenges associated with an impacted tooth, and enhancement of the esthetic outcome through immediate provisionalization. The disadvantages are extra cost, additional presurgical planning time, and potential risk of midfacial peri-implant tissue recession.

Clinical Presentation

A 38-year-old woman presented to the clinic at Harvard School of Dental Medicine, Boston, Massachusetts, on June 9, 2014, with a chief complaint of repeated dislodgement of the crown on tooth #12 (Fig. 1). Treatment options included a crown-lengthening procedure followed by fabrication of a new crown or extraction of the tooth followed by replacement with either a conventional bridge or placement of a dental implant. Given the limited amount of remaining tooth structure, an unfavorable crown-root ratio, and a relatively short root trunk that increased the predisposition to furcation involvement, an implant-supported restoration was recommended. The treatment plan was accepted to proceed and a written informed consent was signed by the patient.

Case Management

A significant surgical challenge in this case was the presence of an impacted premolar adjacent to the implant site (Figs. 1c and 1d), positioned below the furcation of tooth #14. Surgical extraction of this impacted tooth was not advocated due to the high risk of it being compromised. The potential risk of invading the dental follicle associated with tooth #13 during implant placement was discussed with the patient, and the plan was to closely monitor this impacted tooth. Hence, a cone-beam computed tomography (CBCT) scan was rendered to understand the three-dimensional orientation of tooth #12 and to fabricate a surgical stent for fully guided implant placement. Immediate provisionalization was proposed to accommodate the high esthetic concern of the patient during the healing period. Quality alginate impressions and a bite registration were made, and the casts were scanned and merged with the CBCT scan along with the proposed restoration design from the computer-aided design (CAD) software.[§] The final implant position was planned based on the future crown long axis and alveolar bone morphology (Fig. 2a), and a digitally designed restoration was planned using the data medium exchange (DME) file of the abutment.[‖]

The laboratory used the surgical guide to place an analog in the cast to verify the contours and contacts of the restoration. Additionally, a safe distance (>2 mm) was gauged from the dental implant to the impacted premolar (Fig. 2b). After superimposition of the cast, a screw-retained temporary prosthesis was planned (Fig. 2c). The provisional crown was designed taking into consideration the arch alignment, contact point, soft tissue profile, and occlusal scheme of the patient (Fig. 3). Immediately above the abutment platform, the emergence profile was undercontoured to enhance soft tissue healing and thickness. The cervical contour was increased to support the marginal tissue from collapsing. A slight overcontour was added to make clinical adjustment easier compared with adding additional acrylic material (Fig. 3d). After finalizing the digital design, the temporary prosthesis was generated using CAD/computer-assisted machining[¶] on a stock abutment.[#] The restoration was milled out of poly(methyl methacrylate) (PMMA) and cemented in the laboratory.

During surgery, tooth #12 was extracted atraumatically, the dental implant[**] was placed according to the guided protocol, and primary stability was achieved (Figs. 4a and 4b). Particulate bone graft[††] was placed to fill the socket

[§]coDiagnostix, Dental Wings, Montreal, QC.

[‖]Variobase, Straumann, Basel, Switzerland.

[¶]Straumann Cares Visual CAD Software/VHF 3 Axis Mill CAM, Straumann.

[#]Variobase, Straumann.

[**]4.1 x 10 mm BL SLActive guided implant, Straumann, Basel, Switzerland.

[††]Biomet 3i, Palm Beach, FL.

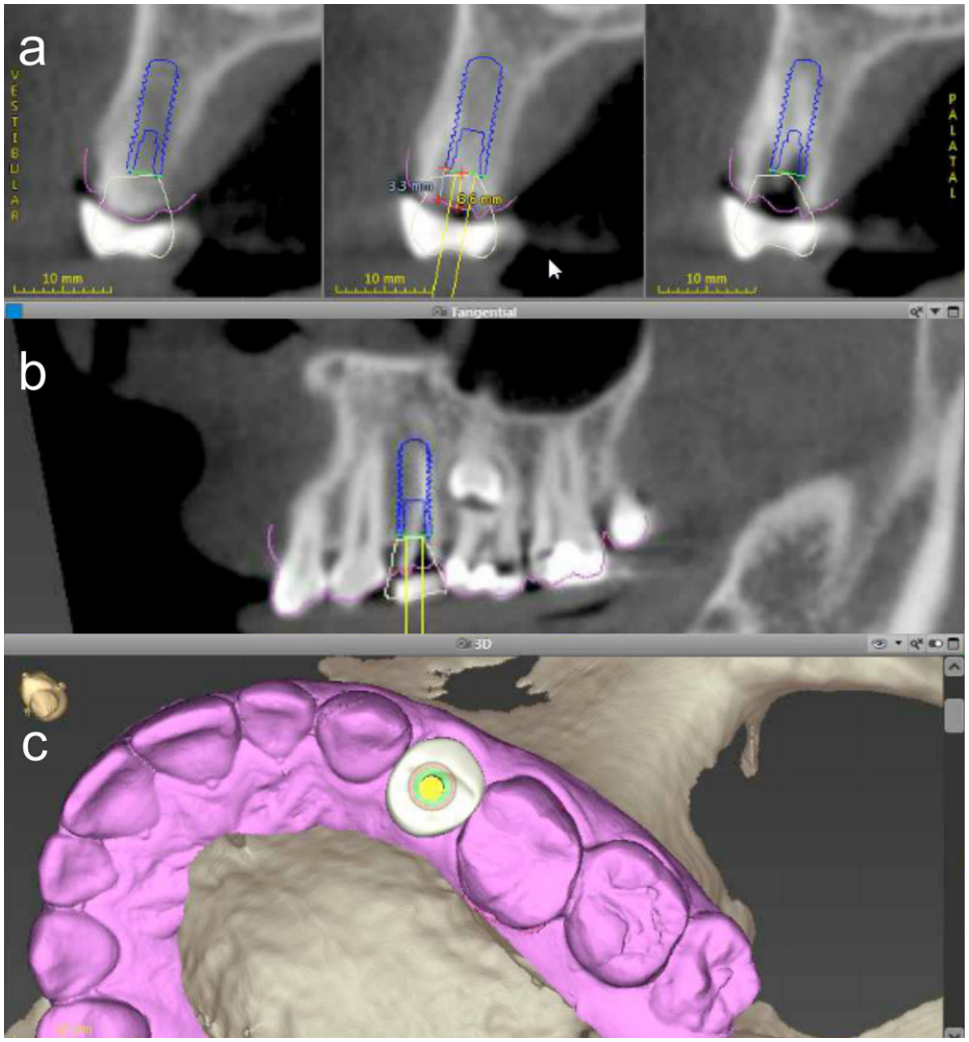

FIGURE 2 Digital planning of the dental implant position. **2a** CBCT image of the implant site with virtually planned implant position. **2b** The relationship of the proposed implant with respect to the adjacent teeth and tooth follicle of impacted tooth #13. **2c** Superimposition of the cast and virtual setup of the provisional restoration for a screw-retained prosthesis.

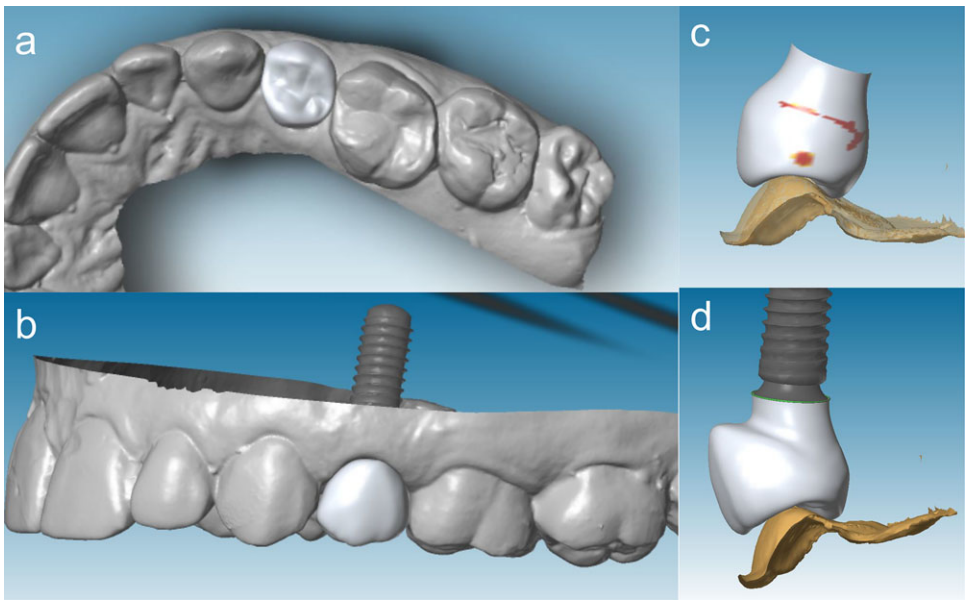

FIGURE 3 Digitally designed customized provisional crown. **3a** and **3b** Occlusal and buccal views of the customized provisional crown. **3c** The simulated contact point and soft tissue margin over the first prototype design (shown by red spot and line). **3d** Final design of the crown profile and its occlusal scheme.

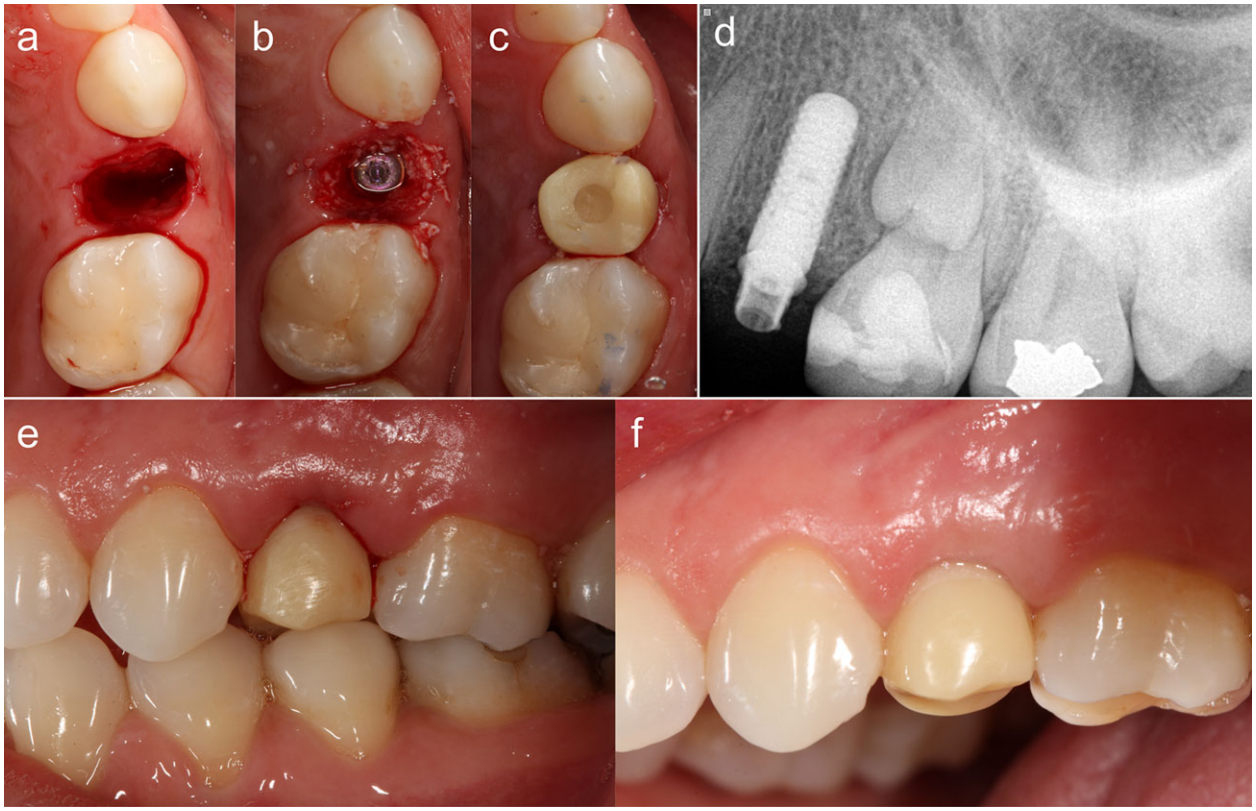

FIGURE 4 Immediate guided implant placement and provisionalization. **4a** through **4c** Occlusal view of the extraction, immediate guided implant placement, bone grafting, and provisionalization with a PMMA crown. Note that no suture is needed. **4d** Radiographic examination shows ideal implant position with safe distance to the impacted tooth. **4e** Clinical buccal view demonstrated adjusted cusp tip to avoid lateral interference and excessive loading. **4f** Postoperative follow-up after 2 weeks showed excellent healing.

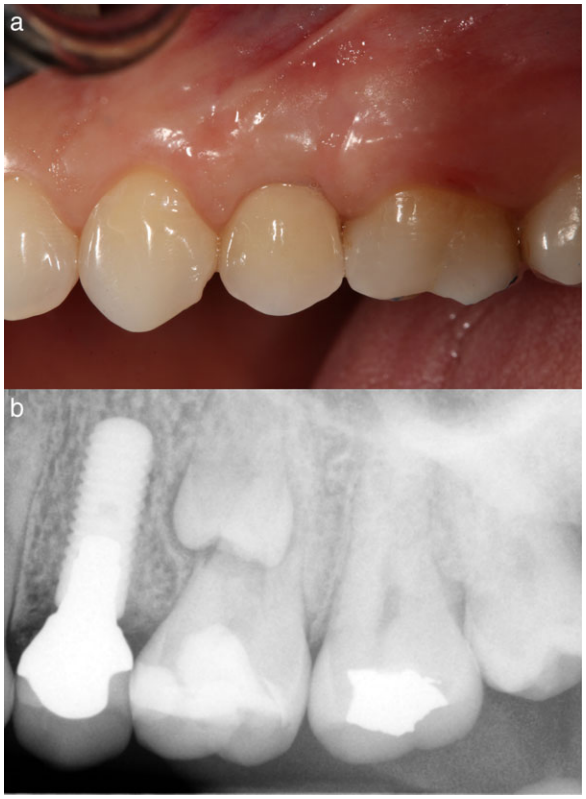

FIGURE 5 Excellent results 10 months after functional loading. Clinical **(5a)** and radiographic **(5b)** examination of the final restoration.

gap, and the prefabricated provisional crown was delivered with minimal adjustment (Fig. 4c). The postoperative radiograph showed ideal implant positioning within a safe distance from the impacted premolar, as planned presurgically (Fig. 4d). The buccal cusp of the crown was shortened to minimize lateral occlusal interference (Fig. 4e).

No suture was placed after surgery, and excellent soft tissue healing was observed at the 2-week follow-up appointment (Fig. 4f). During the healing period, the patient was prescribed amoxicillin 500 mg three times daily for 7 days and ibuprofen as needed.

Clinical Outcomes

The final restoration was delivered 3.5 months after surgery. Clinical and radiographic evaluation after 10 months of functional loading revealed excellent esthetic outcomes with midfacial peri-implant tissue stability (Fig. 5a) and stable crestal bone levels with an asymptomatic impacted premolar (Fig. 5b). The patient was very pleased and satisfied with the treatment outcomes.

Discussion

The proposed digital planning protocol helps to obtain an accurate three-dimensional position of the implant preoperatively,[6] and the tooth-supported guided surgical stent offers precise delivery of the implant to avoid

damaging the follicle surrounding the impacted premolar and‘ causing unwanted complications.[7] Scanning of the dental cast alleviates the process of intraoral scanning and reduces chair time for the patient.[8] Studies have shown that there is no clinically significant difference in precision between direct intraoral scanning and extraoral digitization of casts.[8–10]

Peri-implant soft tissue is an important determinant of esthetic outcomes, and every attempt was made in the present study to optimally manage the soft tissue, such as using a flapless surgical approach, immediate placement, bone grafting, and immediate provisionalization. Using a flapless surgical technique contributes to reduced postoperative discomfort and may help in the preservation of the peri-implant tissues. This technique avoids disruption of the periosteum, thereby maintaining better blood supply to the implant site and reducing the likelihood of resorption.[11,12] Placement of narrow-diameter implants may also reduce the rate of buccal plate resorption. Studies have demonstrated that bone grafting during implant placement and immediate restoration result in greater peri-implant soft tissue height and thickness.[13–15] Immediate provisionalization can help to contour and sculpt the mucosal architecture surrounding the implant to enhance esthetic outcomes.[16] It has been documented that there is an average increase in tissue height, decrease in midfacial recession, and better predictability of papilla height maintenance for immediately provisionalized implants.[2,14,15,17] Although laboratory-fabricated provisional restorations may be more costly, they offer several advantages over chairside provisional restorations. First, they possess superior mechanical properties compared with provisional restorations made chairside.[2,17] Adjustment of the provisional restoration is important to avoid traumatic occlusal loading and irritation to the soft tissue. It also facilitates sculpting of the soft tissue to enable a healthy emergence profile. Digitally prefabricated provisional restorations can minimize the need for adjustment and help to avoid excessive manipulation and potential compromise to the primary stability of the implant.[18] It also helps reduce clinical chair time, which adds to patient comfort and satisfaction.[4]

Although immediate permanent restoration is plausible, immediate functional loading has always been controversial. Further prospective, longitudinal, and controlled clinical trials are necessary before justifying the predictability of the immediate final restoration.[19]

The use of digital technology may soon become routine to implant dentistry. This report demonstrates the advantages of a digital platform for implant treatment planning, guided placement, and immediate restoration to overcome anatomic and esthetic challenges. The limitation of this case report is the relatively short-term follow-up time and the inability to determine the generalizability of this approach. A prospective clinical trial with long-term follow-up is warranted to further optimize and validate both the predictability and generalizability of this approach.■

Summary

Why is this case new information?	■ Digital planning and guided implant placement allow prefabrication of a customized provisional restoration for immediate delivery.
What are the keys to successful management of this case?	■ Well-conceived digital treatment planning, guided implant placement protocol, and delivery techniques to achieve excellent primary stability
What are the primary limitations to success in this case?	■ Additional cost and time in presurgical phase

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