

**Computer-Guided Immediate Implant Placement  
and Pre-Digitally-Designed Immediate Provisionalization**

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**Running Title**

Digitally-designed Immediate Implant placement and provisionalization

**Summary**

Digital planning allows guided immediate implant placement and immediate provisionalization with a digitally-pre-designed and pre-fabricated restoration

**Abstract**

**Introduction**

Implementation of digital technology in patient care has empowered us to deliver precise and personalized implant restorations with unprecedented speed. This case report demonstrates that through digital planning, successful placement of an immediate guided implant can be achieved including bone grafting and immediate provisionalization, using a pre-designed and pre-fabricated restoration.

**Case presentation**

A healthy 38-year-old female patient with high esthetic demands presented with an unrestorable maxillary left first premolar. The main challenges in this case included the presence of an impacted adjacent second premolar and the patient's desire 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, pre-surgically fabricated crown restoration.. 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. Following delivery of the final restoration and ten months of functional loading, evaluation of the implant and restoration revealed stable crestal bone levels with an esthetically pleasing result and high patient satisfaction.

**Conclusion**

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 pre-fabricated provisional restoration. Further studies are needed to optimize the generalizability of this approach.

**MeSH:** Dental Implants; Esthetics Dental; Dental Prosthesis, Implant supported; CAD/CAM

**Background**

Previously, implant therapy mandated multiple appointments and routinely involved submergence of the implant fixture followed by a prolonged healing before placing 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.<sup>1-3</sup> In addition, digital technology has facilitated precise immediate implant placement with the pre-determined ideal positioning and pre-fabrication of customized provisional restorations according to the patient's unique alveolar morphology, soft tissue profile and occlusal scheme.<sup>4,5</sup> Although the technology is available, only limited case reports demonstrate immediate delivery of a digitally planned and fabricated provisional restoration.<sup>4,5</sup>

The following case report describes an ideal indication for computer-guided implant placement to avoid 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 the digitally planned surgical and prosthetic protocols include ease of achieving the precise osteotomy location for immediate implant placement, shortened healing duration, proper management of anatomical challenges associated with an impacted tooth, and enhancement of the esthetic outcome through immediate provisionalization. The disadvantages are extra cost, additional pre-surgical planning time, and potential risk of midfacial peri-implant tissue recession.

### **Case Presentation**

A 38-year-old woman presented to the clinic at Harvard School of Dental Medicine on June 9<sup>th</sup>, 2014 with a chief complaint of repeated dislodgement of the crown on #13 (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 increasing the predisposition for furcation involvement, an implant-supported restoration was recommended and accepted 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 #14. Surgical extraction of this impacted tooth was not advocated due to the high risk of compromising #14. The potential risk of invading the dental follicle associated with #12 during implant placement was discussed with the patient and the plan was to closely monitor this impacted tooth. Hence, a CBCT scan was rendered to understand the 3-D orientation of #12 and to fabricate a surgical stent for fully guided implant placement. Immediate provisionalization was proposed, to accommodate the patient's high esthetic concern during the healing period. Quality alginate impressions and bite registration were made and, the casts were scanned and merged with the CBCT scan along with the proposed restoration design from the 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 DME file of the abutment<sup>+</sup>.

\*coDiagnostix, Dental Wings, Montreal QC

+ Variobase, Straumann LLC, Basel Switzerland

The lab used the surgical guide to place an analog in the cast to verify the contours and contacts of the restoration. Additionally, a safe distance (>2mm) 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 patient's arch alignment, contact point, soft tissue profile, and occlusal scheme (Fig 3). Immediately above the abutment platform, the emergence profile was under-contoured to enhance soft tissue healing and thickness. The cervical contour was increased to support the marginal tissue from collapsing. A slight over contour was added to make clinical adjustment easier compared to adding additional acrylic

material (Fig 3 E). After finalizing the digital design, the temporary was generated using CAD/CAM<sup>^</sup> on a stock abutment<sup>\*</sup>. The restoration was then milled out of PMMA and cemented in the lab.

During surgery, tooth #13 was extracted atraumatically and the dental implant placed according to the guided protocol and primary stability was achieved. (Fig 4A). Particulate bone graft<sup>%</sup> was placed to fill the socket gap and the pre-fabricated provisional crown was delivered with minimal adjustment (Fig 4C). The buccal cusp of the crown was shortened to minimize lateral occlusal interference.

**<sup>^</sup> Straumann Cares Visual CAD Software/VHF 3 Axis Mill CAM, Straumann LLC, Basel Switzerland**

**<sup>\*</sup> Variobase, Straumann LLC, Basel Switzerland**

**<sup>#</sup> 4.1 x 10 mm BL SLActive guided implant, Straumann LLC, Basel Switzerland**

**<sup>%</sup> Biomet 3i, Biomet 3i LLC, Palm Beach, Florida, USA**

The post-operative radiograph showed ideal implant positioning within a safe distance from the impacted premolar as planned pre-surgically (Fig 4D). No suture was placed after surgery and excellent soft tissue healing was observed at the two-week follow-up appointment. During the healing period, the patient was prescribed Amoxicillin 500 mg three times a day for 7 days and ibuprofen as needed.

### **Clinical Outcomes**

The final restoration was delivered 3.5 months after surgery. Clinical and radiographic evaluation following 10 months of functional loading revealed excellent esthetic outcomes with mid-facial peri-implant tissue stability (Fig 5A) and stable crestal bone levels with 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 3-D position of the implant pre-operatively <sup>7</sup> and the tooth-supported guided surgical stent offer precise delivery of the implant to avoid damaging the follicle surrounding the impacted premolar causing unwanted complications. <sup>8</sup> Scanning of the dental cast alleviates the process of intraoral scanning and reduces chair time for the patient. <sup>9</sup> Studies have shown that there is no clinically significant difference in precision between direct intraoral scanning and extraoral digitization of the cast models. <sup>9-11</sup>

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 a better blood supply to the implant site and reducing the likelihood of resorption. <sup>12,13</sup> 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. <sup>14-16</sup> Immediate provisionalization can help to contour and sculpt the

mucosal architecture surrounding the implant to enhance esthetic outcomes.<sup>17</sup> 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 immediate implants.

<sup>2,15,16,18</sup> Although laboratory fabricated provisional restorations may be more costly, it offers several advantages over chair-side provisional: First, it possess superior mechanical properties compared to provisional restorations made chair-side.<sup>2,18</sup> The 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 pre-fabricated provisional restorations can minimize the need for adjustment and help to avoid excessive manipulation and potential compromise to the primarily stability of the implant.<sup>6</sup> It also helps reduce clinical chair time, which adds to patient comfort and satisfaction.<sup>4</sup>

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 immediate final restoration.<sup>19</sup>

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?	<ul style="list-style-type: none"> <li>• Digital planing and guided implant placement allows pre-fabrication of a customized provisional restoration for immediate delivery</li> </ul>
What are the keys to successful management of this case?	<ul style="list-style-type: none"> <li>• Well-conceived digital treatment planning, guided implant placement protocol, and delivery techniques to achieve excellent primary stability</li> </ul>
What are the primary limitations to success in this case?	<ul style="list-style-type: none"> <li>• Additional cost and time in pre-surgical phase</li> </ul>

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**Figure of Legends**

FIGURE 1 Pre-operative clinical and radiographic examination. 1a Occlusal; and 1b buccal views. 1c periapical radiograph of #12 with non-retainable PFM crown and impacted #13 (under #14). 1d CBCT showing fully impacted #13 under the furcation of #14.

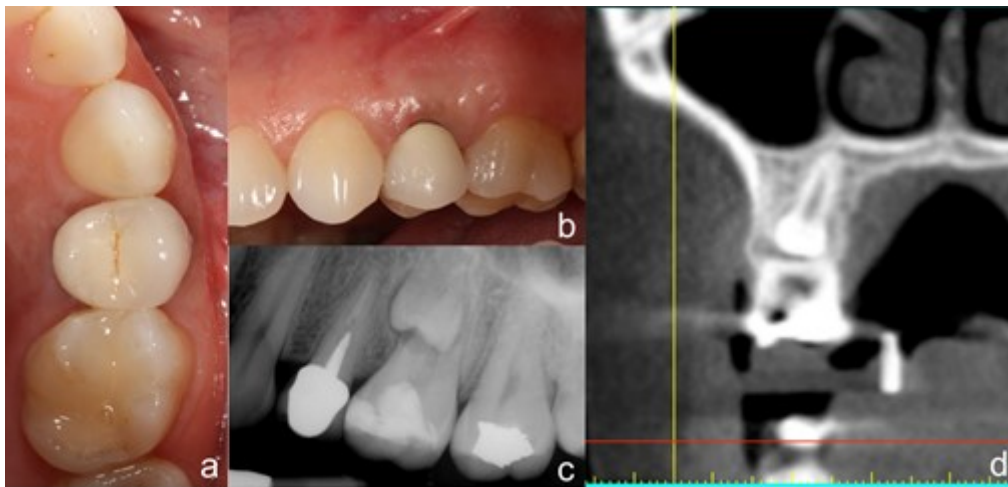


FIGURE 2: Digital planning of the dental implant position. 2a Cone beam computed tomographic image of the implant site with virtually-planned implant position. 2b The relationship of the proposed implant with respect to the adjacent teeth and the tooth follicle of impacted #13. 2c After superimposition of the cast model and the virtual set up of the provisional restoration for a screw-retained prosthesis.

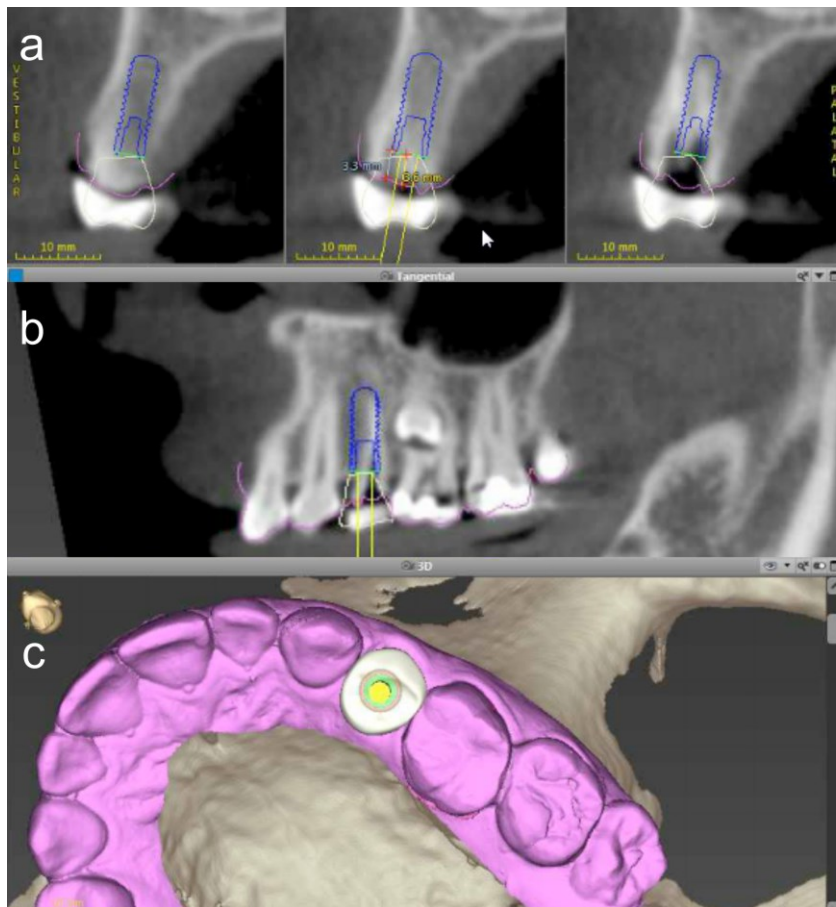


FIGURE 3: Digitally-designed customized provisional crown. 3a &b The occlusal and buccal view of the customized provisional crown. 3c The simulated contact point and soft tissue margin over the first prototype design (shown in red spot and line). 4d The final design of the profiling crown and its occlusal scheme.

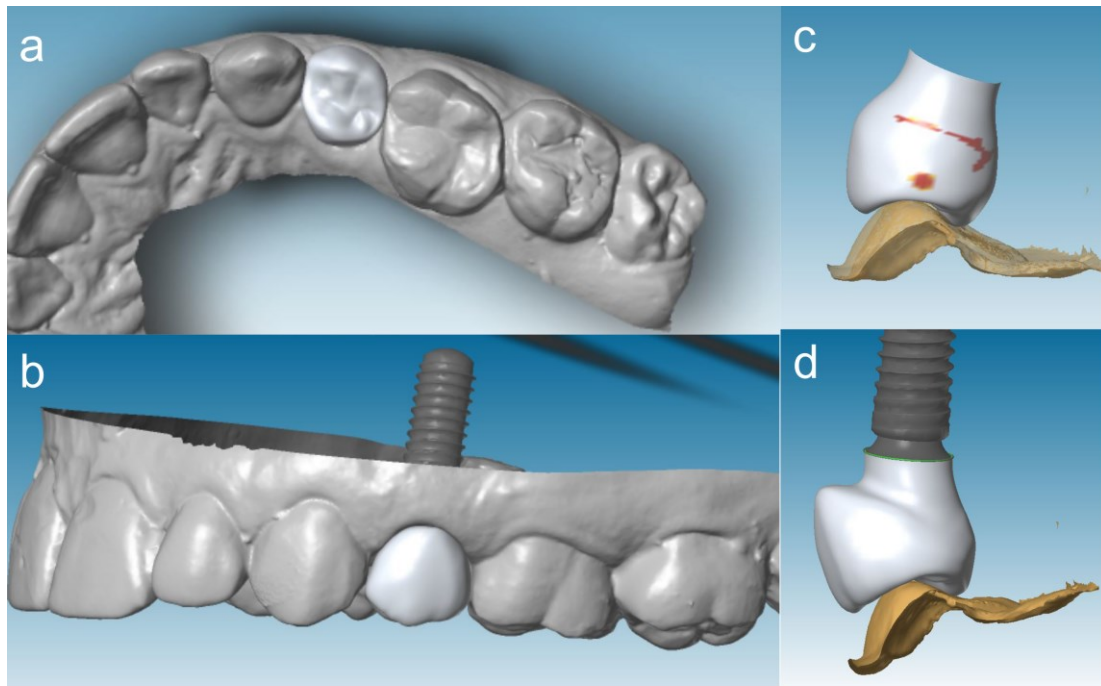


FIGURE 4: Immediate guided implant placement and provisionalization. 4a, b, & c Occlusal view of the extraction, immediate guided implant placement, bone grafting and provisionalization with PMMA crown. Note that no suture is needed. 4d Radiographic examination show ideal implant position with safe distance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

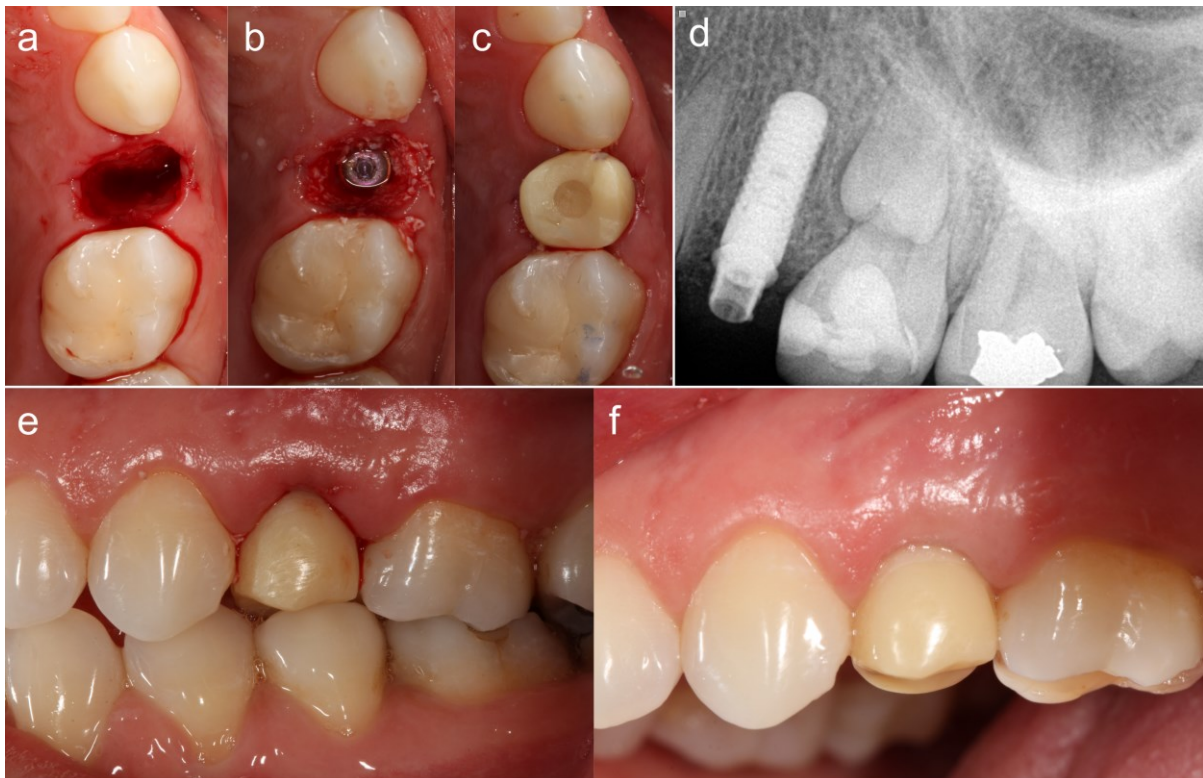


FIGURE 5: Excellent results 10 months after functional loading. 5a Clinical; and 5b radiographic examination of the final restoration.

