Emergence Profile Index Implant Surgical Guide

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Introduction: This case series presents an innovative approach to fabricating an implant surgical guide to facilitate ideal implant placement.

Case Series: Three healthy, non-smoking patients with a partially edentulous ridge presented to a private practice. Informed consent for dental implant placement was attained from patients. Sequential three-dimensional (3D) surgical guides were fabricated before implant surgery using light-polymerizing material. These guides provided information to the surgeons on implant position in the bucco-lingual, mesio-distal, and apico-coronal directions.

Conclusion: With assistance of the proposed surgical guide, ideal 3D implant placement can be achieved so that future peri-implant complications can be minimized. *Clin Adv Periodontics* 2017;7:30-34.

Key Words: Dental implants; dental implants, single-tooth; dental prosthesis, implant-supported; mouth, edentulous; surgery, computer-assisted; technology, dental.

Background

A malpositioned implant increases a patient's chance of peri-implant marginal bone loss,[1] interdental papilla disappearance,[2] peri-implant mucosal recession,[3] and implant failure.[4,5] To achieve long-term success and esthetics with implant treatment, three-dimensional (3D) implant positioning (bucco-lingual, mesio-distal, apico-coronal) is crucial.[6] Based on the currently available literature, the ideal implant position is located at least 2 mm within buccal bone, 1 to 3 mm apical to the adjacent cemento-enamel junction (CEJ), and at least 1.5 to 2 mm away from adjacent teeth.[2,7]

A surgical guide is fabricated to facilitate ideal positioning and angulation of implants,[8] shorten surgical time,[9] and possibly decrease clinical and prosthetic complications.[8] This case series presents three patients receiving implant surgery using modified radiographic/surgical drill guides. The emergence profile index (EPI) implant surgical guide uses 3D implant position (bucco-lingual, mesio-distal, and apico-coronal directions) as the reference for ideal 3D implant position placement to ensure an esthetic emergence profile of the future implant crown or prosthesis. Apical extension of a fabricated surgical guide is one unique feature of this modified guide. This provides reference for clinicians for placing the implant in an ideal apico-coronal position in addition to the other two dimensions. Introduction of EPI could further assist clinicians in visualizing the ideal implant position when performing implant surgery.

Clinical Presentation

Three healthy non-smokers (2 males and 1 female, aged 48 to 59 years; mean age: 52.66 years) without a history of periodontal disease and in need of dental implants presented to a private practice in Taipei, Taiwan (M-HL). One patient had an edentulous mandibular left first molar site. Another patient presented with a missing tooth at the

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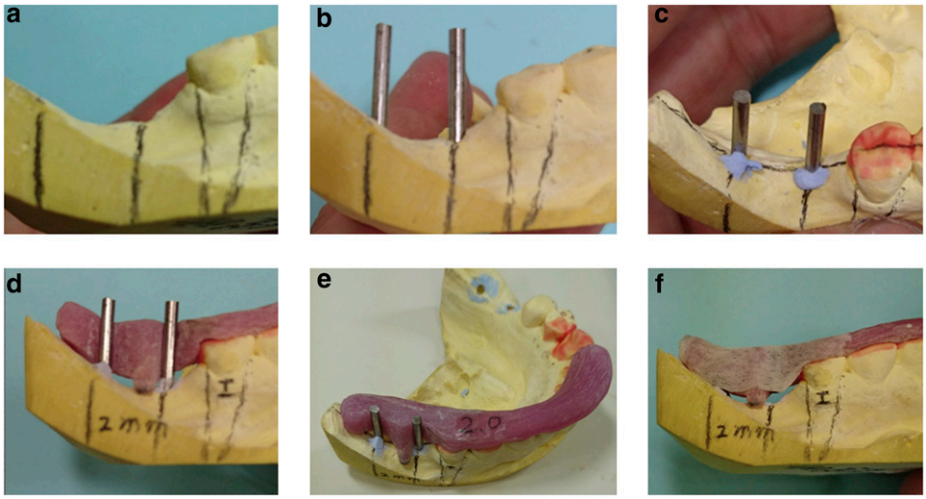

FIGURE 1a Planned implant angulations were marked on the cast. **1b** A drill blank (smooth-sided steel rod) of 2-mm diameter was placed in position. **1c** Occlusal view of drill blanks, indicating future implant angulation. **1d** and **1e** Light-polymerizing material was adapted to the cast and drill blank from the lingual aspect. Apical extension (EPI) at the buccal aspect of the guide was added on the side of the drill blank. **1f** Fabricated guide after polymerization of material.

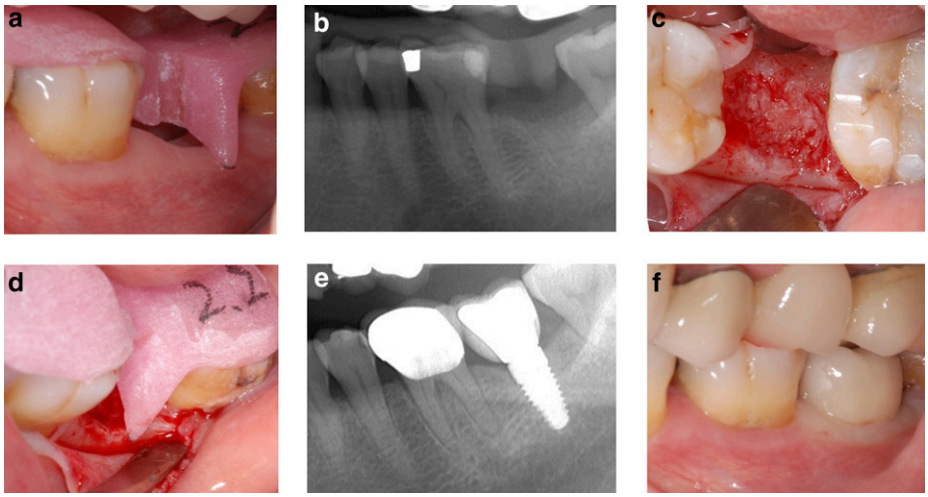

FIGURE 2 A 59-year-old female requested dental implant placement to replace the missing tooth #19. **2a** Fabricated surgical guide with EPI was placed before implant surgery. **2b** Periapical radiograph was taken to check the relationship between the EPI and the crestal bone level. **2c** A full-thickness periosteal flap was reflected. **2d** The surgical guide with EPI was placed. The EPI served as an index of the apico-coronal implant position. **2e** Radiograph 6 months after implant surgery showing the completed definitive crown. **2f** Clinical view of the definitive crown 6 months after implant surgery.

maxillary right lateral incisor site. The third patient was edentulous in the left maxillary second premolar to second molar sites. Written informed consent for dental implant placement was obtained from patients, and treatment was performed from July 2012 to December 2015.

Case Management

Irreversible hydrocolloid dental impressions,[§] panoramic radiographs, and periapical radiographs were taken and used to fabricate radiographic/surgical drill guides. Periapical radiographs were used to assess the CEJ position at adjacent teeth. Ideal implant position was determined and marked in the study cast. An appropriate implant position was designed to be at least 2 mm within buccal bone, 1 to 3 mm apical to the adjacent CEJ, and at least 1.5 to 2 mm away from adjacent teeth (3 mm away from adjacent implants). After determining the location(s) of the implant site(s) on the diagnostic cast, the cast was mounted on the surveyor table to a bench-top drill press, and a hole was drilled corresponding to the smallest implant surgical drill at the proposed implant location using the drill press.[‖] A same-sized drill blank (smooth-sided steel rod) was placed in the created hole. Light-polymerizing material[¶] was adapted to the cast and drill blank from a lingual aspect. Apical extension at the buccal aspect of the guide was added on the side of the drill blank. This extension (EPI) was made ≈1 to 3 mm apical to the adjacent CEJ based on information from radiographs. Material was polymerized for 4 minutes in a light-polymerizing unit[#] (Fig. 1).

Before surgery, the fabricated guides were sterilized with a 0.12% chlorhexidine solution for >10 minutes. During implant surgery, full-thickness flaps were elevated under local anesthesia, guides were placed on adjacent teeth, and implants were placed with the assistance of EPI. Definitive crown restoration was completed 6 months after implant surgery (Figs. 2 through 4).

Clinical Outcomes

Two patients had single implant placement and restoration (Figs. 2 and 3), and another patient had multiple implant treatment (Fig. 4). Clinical and radiographic outcomes were satisfactory, and ideal 3D implant positioning was achieved with the aid of EPI for single and multiple implant placement.

Discussion

Ideal implant position often leads to better long-term implant success, esthetics, and stability. Cooper and Pin-Harry[7] recommended the following for implant placement in the esthetic zone: 1) 6 mm of interradicular space; 2) 6-mm bucco-lingual osseous dimension; 3) 6-mm minimum length; and 4) implant/abutment interface located 3 mm apical and displaced 2 mm palatal to the gingival zenith of the planned crown. Similarly, Su et al.[6] reported guidelines for implants placed in anterior and posterior regions. The goal of these proposed placement guidelines is to minimize future peri-implant bone loss.

[§] Jeltrate Plus, DENTSPLY, York, PA.
[‖] RYOBI Technologies, Anderson, SC.
[¶] Triad, DENTSPLY.
[#] Triad 2000, DENTSPLY.

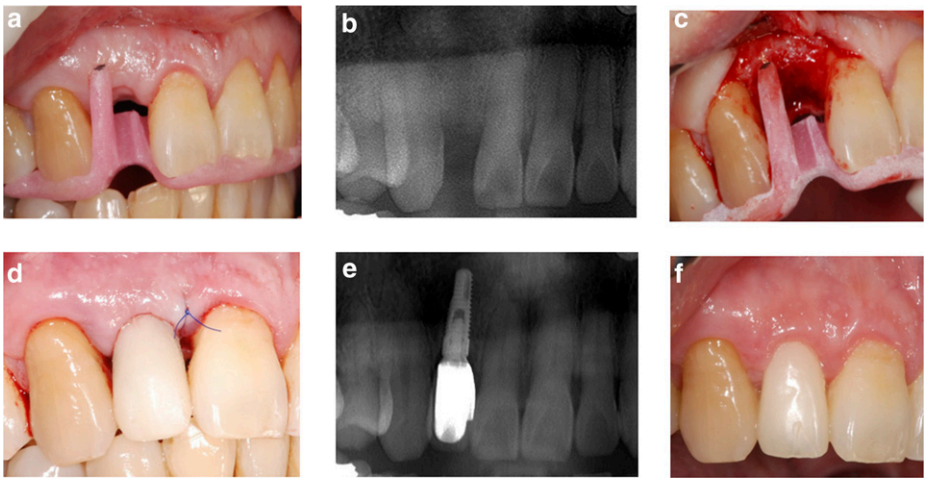

FIGURE 3 A 48-year-old male presented with a missing tooth #7. **3a** The fabricated surgical guide with EPI was placed before implant surgery. **3b** A periapical radiograph was taken, and limited mesio-distal space was noted. **3c** A full-thickness periosteal flap was reflected with the surgical guide in place. The EPI served as an index of the apico-coronal implant position. **3d** Immediate provisionalization of the dental implant in site #7 was performed. **3e** Radiograph 6 months after implant surgery showing the completed definitive crown. **3f** Clinical view of the definitive crown 6 months after implant surgery. An esthetic outcome was achieved.

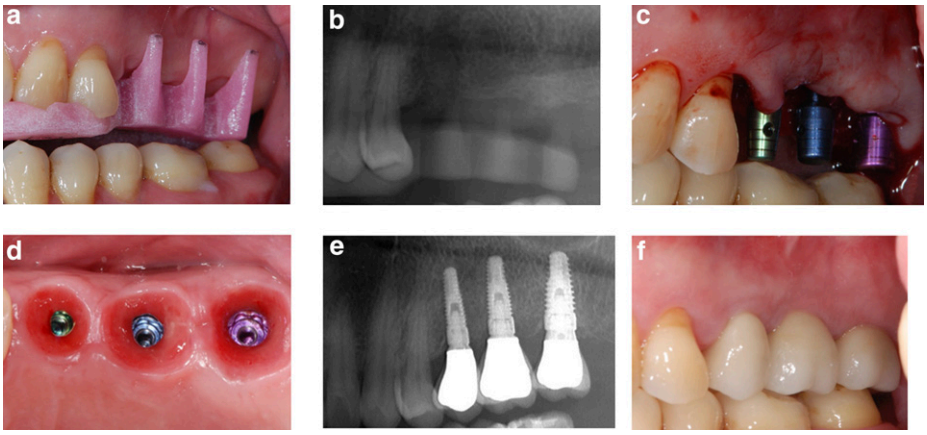

FIGURE 4 A 51-year-old male presented with an edentulous region in sites #13 through #15. **4a** The fabricated surgical guide with EPI was placed before implant surgery. **4b** A periapical radiograph was taken to evaluate the relationship between the EPI and the crestal bone level. **4c** A full-thickness periosteal flap was reflected, and three dental implants were placed with the assistance of surgical guides. **4d** Six months after implant surgery, peri-implant soft tissue appeared healthy and firm with the presence of papillae. **4e** Radiograph 6 months after implant surgery showing the completed definitive crowns. **4f** Clinical view showing the definitive crowns 6 months after implant surgery. Ideal implant position and esthetic outcomes were achieved.

This case series describes a modified method to fabricate radiographic/surgical drill guides to facilitate ideal implant placement based on a previous study.[10] The original guide uses light-polymerized composite material and drill blanks placed in a prosthodontically driven implant position. Surgical guides for each implant drill are constructed on the diagnostic cast. However, this specific guide has two drawbacks: 1) apico-coronal implant position cannot be determined and 2) there is lack of direct visualization of the relationship between the adjacent CEJ and the bone crest at the implant site. Therefore, this case series proposed a modification of this fabrication process using EPI to serve as a reference point to determine future implant platform levels. Through EPI, clinicians can easily predetermine the apico-coronal implant level in relation to adjacent teeth/implants. This guide could also benefit the decision-making process of clinicians if further adjustment of 3D implant positioning is needed. However, further investigations are required to validate the accuracy of this proposed guide with EPI compared with stereolithic guides.

The influence of different levels of implant platform positions on peri-implant marginal bone loss has been investigated.[11,12] Koutouzis et al.[11] reported that implants placed 2 mm subcrestally maintained the greatest subcrestal position. Implants placed 1 and 2 mm subcrestally demonstrated a greater percentage of implant surfaces with bone coronal to the implant platform compared with implants placed at bone level. Similarly, Linkevicius et al.[12] reported different bone loss patterns in relation to supracrestal/crestal implant placement and initial peri-implant tissue thickness. Although vertical implant position might have an impact on peri-implant bone remodeling, the decision of implant platform location should be determined based on the clinical presentation of each case. For example, in the esthetic zone, it is suggested that a platform located 3 to 4 mm apical to the adjacent CEJ facilitates a better esthetic emergence profile. In the posterior region, an implant platform placed 2 mm apical to the adjacent CEJ with the use of a polished-collar implant system could facilitate oral hygiene more easily than a subcrestal implant placement with the use of a bone-level implant.[6]

Although the proposed EPI implant guide is similar to a previously proposed guide system,[10] the addition of EPI not only serves as a reference for accurate implant 3D positions with strong emphasis on the apico-coronal position, but also offers a reference when performing an adjustment of the implant platform location, clinically, if needed. Future studies should include using an EPI guide for flapless implant surgery to ensure implant esthetics. ■

Summary

Why are these cases new information?	■ An innovative method is introduced to fabricate 3D implant surgical guides using light-polymerized composite material and drill blanks. ■ With use of a proposed EPI and fabrication protocol, clinicians can easily predetermine bucco-lingual, mesio-distal, and apico-coronal implant levels in relation to adjacent teeth/implants.
What are the keys to successful management of these cases?	■ It is important to plan treatment properly and perform implant surgery scrupulously based upon available clinical and radiographic information.
What are the primary limitations to success in these cases?	■ It could not be used to assist treatment planning for fully edentulous patients. ■ It takes extra time and expense to fabricate EPI surgical guides.

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○ indicates key references.