THE JOURNAL OF PROSTHETIC DENTISTRY

DENTAL TECHNIQUE

A digitally guided dual technique for both gingival and bone resection during crown lengthening surgery

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ABSTRACT

This paper presents a digitally guided dual technique that provides references for gingival and bone resection during crown lengthening surgery. The architecture of the teeth, gingiva, and alveolar bone is scanned and registered to design dual guides consisting of a gingivectomy guide and an alveolectomy guide that are used in periodontal surgery for esthetic rehabilitation. (J Prosthet Dent 2018;119:345-9)

Esthetics is an essential part of contemporary dental practice, and a pleasing smile depends on gingival tissue architecture and dental characteristics. The successful esthetic rehabilitation of patients with excessive gingival display and short clinical crowns often requires an interdisciplinary approach and close collaboration between a periodontist and prosthodontist.[1] Periodontal surgery is used to create gingival symmetry and harmony and therefore an esthetic outcome. Esthetics-related crown lengthening surgery aims to provide adequate clinical crown length and diminish gingival display.[2] A systematic review reported that prerestorative crown lengthening is a frequently performed periodontal surgery in which gingivectomy and alveolectomy are both typically involved.[3]

When a patient requests treatment in the maxillary anterior region, the treatment plan must begin with esthetic consideration.[4] Information on tooth esthetics and optimal gingival contours should be transferred to the surgeon when crown lengthening needs to be performed. Some authors suggest the use of diagnostic waxing to generate an acrylic resin or vacuum-formed surgical guide.[5-7] However, these devices are often imprecise.[8] Moreover, a 3-mm distance from the alveolar crest to the gingival margin on the facial aspect is necessary for periodontal health, allowing for 2 mm of biological width and 1 mm for sulcus depth.[9] The surgeon may anticipate the appropriate amount of alveolar bone to remove by visual examination. However, the lack of a guide for bone resection may result in unpredictable posttreatment esthetics.

The introduction of computer-aided design and computer-aided manufacturing (CAD-CAM) techniques has helped surgeons perform more precise and predictable surgery and contributed to improved esthetics. However, the authors are unaware of reports describing a digital guide for both gingival and bone resection in crown lengthening surgery. The present technique proposes a digitally guided dual technique for crown lengthening in esthetic rehabilitation.

TECHNIQUE

The patient required esthetic crown lengthening surgery from the maxillary right lateral incisor to the left central incisor to treat excessive gingival display and crowns on

Supported by Beijing Natural Science Foundation grant 7162204, and Peking University School and Hospital of Stomatology grant PKUSSNCT-16B03.
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Figure 1. Preoperative photograph. A, Smile view. B, Intraoral view.

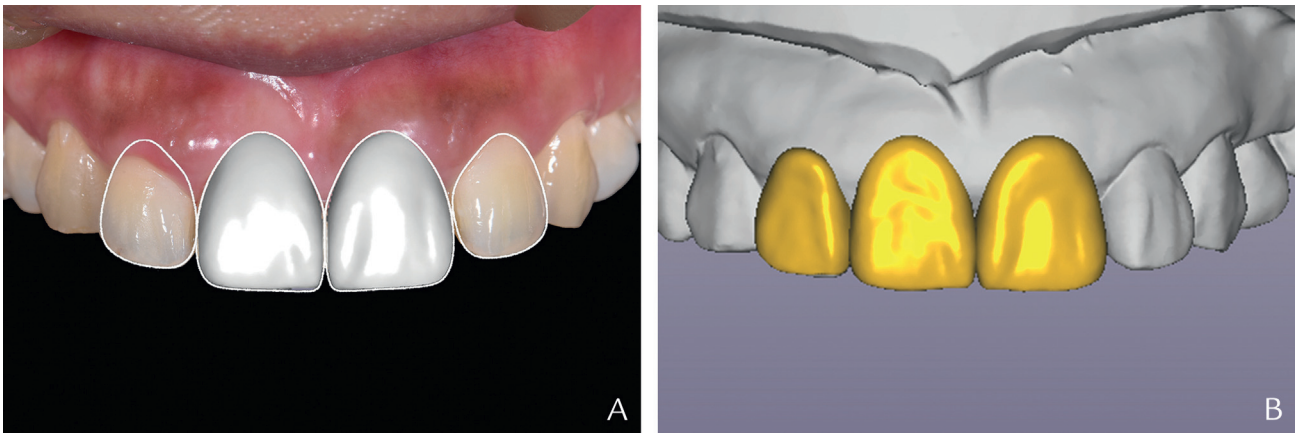

Figure 2. Design of tooth shape and gingival margin. A, In 2D clinical photography. B, In 3D digital model.

the maxillary central incisors to correct defective existing restorations. Use the following procedures to carry out this method (Fig. 1).

1. Make intraoral digital scans of the maxilla, mandible, and maximal intercuspal position with an intraoral scanner (TRIOS; 3Shape). Save the digital scans as a .3ox file named File A. Scan the maxilla and mandible in the semi-open mouth position using cone beam computed tomography (CBCT; NewTom VG; Quantitative Radiology). Save the CBCT file as a digital imaging and communications in medicine (DICOM) file named File B.
2. Design the shape of the teeth and gingival contour in 2-dimensional (2D) clinical photography (Fig. 2A) based on facially generated treatment planning. From this, design the virtual restorations on a 3D digital model named File A (Fig. 2B), thereby producing a clear image of the intended esthetic restoration for the prosthodontist and periodontist.
3. Draw the tooth shape and gingival margin on File A to design a gingivectomy guide (Fig. 3A) and print it (Perfactory Desktop Digital Dental Printer; EnvisionTEC) (Fig. 3B).
4. Import File A, File B, and virtual restorations into digital dental software (Segma Dental CAD; Segma Dental). Use the best-fit algorithm to merge the 2 files by registering the clinical crowns into a single digital file, which is saved as File C (Fig. 4A). On this merged digital model, the dental technician can observe the relationship between alveolar bone and virtual gingival margin. Draw the prospective alveolar crest, which is 3 mm from the prospective gingival margin (Fig. 4B). Design the alveolectomy guide (Fig. 4C) on which the open window exposes the alveolar bone to be removed and print it (Perfactory Desktop Digital Dental Printer; EnvisionTEC) (Fig. 4D).
5. Make an internal bevel incision according to the gingivectomy guide (Fig. 5A), and carefully remove the collar tissue. Elevate the full-thickness flap on the labial side to expose the alveolar bone, leaving the papilla in situ (Fig. 5B). Remove the excess bone

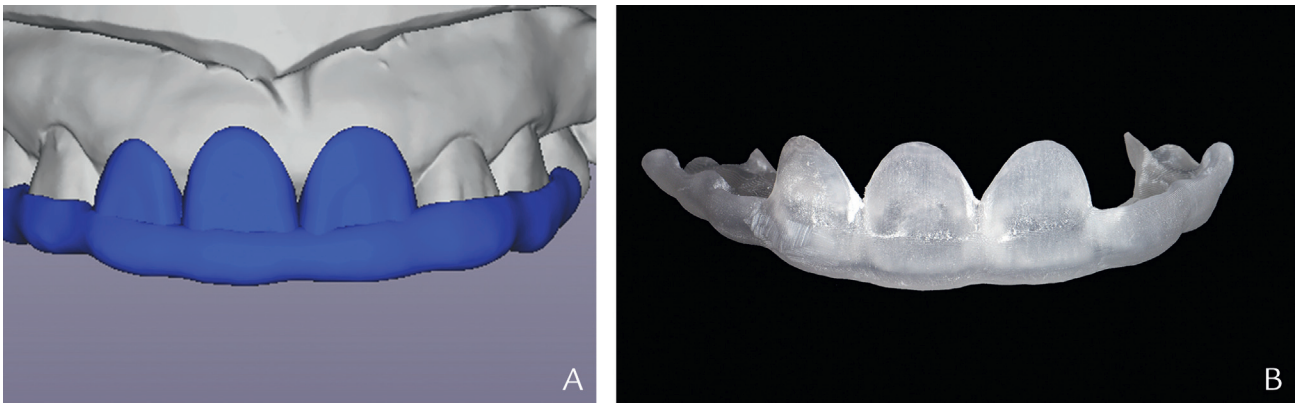

Figure 3. CAD-CAM gingivectomy guide. A, Designed guide on digital model. B, Printed guide. CAD-CAM, computer-aided design-computer-aided manufacture.

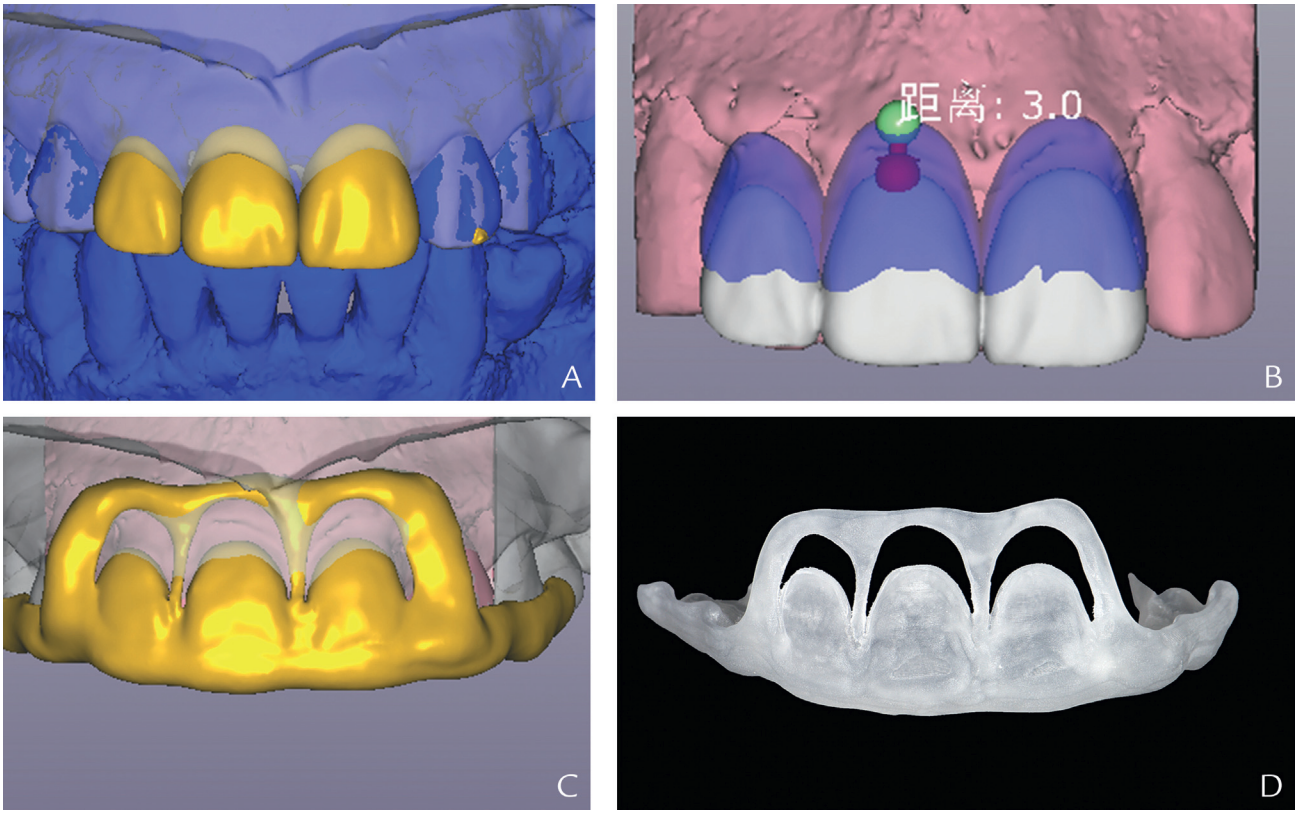

Figure 4. CAD-CAM alveolectomy guide. A, Digital model with virtual restoration and bone architecture. B, Drawing alveolar margin according to prospective gingival margin. C, Designed guide on digital model. D, Printed guide. CAD-CAM, computer-aided design and computer-aided manufacturing.

through the windows in the alveolectomy guide (Fig. 5C). Reposition and suture the flap (Fig. 5D).

6. Three months after surgery, when the soft and hard tissues have matured, restore the central incisors with ceramic crowns (TTZirconia; Upcera) (Fig. 6).

DISCUSSION

This digitally guided dual technique provides references for both gingival and bone resection during crown lengthening surgery, which facilitates the surgical procedure and increases treatment predictability. Within conventional freehand plastic surgery, the surgeon must anticipate the position of the final gingival and alveolar margin and assist visually with limited information to remove the appropriate amount of soft and hard tissue. This digital approach offers satisfactory esthetics and harmonious alveolar and gingival contours.

Moreover, templates generated using diagnostic waxing are usually 0.5- to 1-mm thick and remote from

Figure 5. Clinical application of dual surgical guide. A, Incision made according to gingivectomy guide. B, Full-thickness flap elevated after removing collar tissue. C, Excess alveolar bone removed according to alveolectomy guide. D, Flap repositioned and sutured.

Figure 6. After definitive restoration. A, Smile view. B, Intraoral view.

the bone architecture. Marking an incision line according to the traditional guide will lead to undesired outcomes attributed to parallax. Accordingly, the present gingivectomy guide and alveolectomy guide adhere firmly to the gingiva and bone, respectively, with the aid of the digital technique. Along with the reference margin of guides with appropriate thinness, any parallaxes and subsequent inaccuracy can be avoided.

In contrast with the conventional technique, the present clinical procedure allows for fewer surgical errors and more predictable gingival and alveolar margins, encouraging a harmonious relationship between teeth

and gingiva. The clinical workflow is straightforward and convenient for the surgeon. Although this technique requires additional time before surgery and increases the patient's cost, the benefits outweigh the limitations. Clinical studies are necessary to validate this technique's predictability.

SUMMARY

This article describes a digitally guided dual technique that allows the surgeon to perform gingivectomy and alveolectomy precisely in a straightforward and predictable manner.

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Acknowledgments
The authors thank Hong Mao from Segma Healthcare Company Ltd for assistance.