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Sillas Duarte, Jr, DDS, MS, PhD
Editor-in-Chief

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¹Private Practice, New York, New York, USA.

²Assistant Professor, Division of Periodontics, University of Maryland School of Dentistry, Baltimore, Maryland, USA.

³Adjunct Clinical Professor, Ashman Department of Periodontology and Implant Dentistry/Department of Prosthodontics, New York University College of Dentistry, New York, New York, USA.

Correspondence to: Dr Hanae Saito, Division of Periodontics, University of Maryland School of Dentistry, 650 W Baltimore Street, Office 4211, Baltimore, MD 21201, USA. Email: hsaito@umaryland.edu

A close-up photograph of a dental implant restoration in the esthetic zone. The implant is a white, ceramic-like crown that blends seamlessly with the surrounding natural teeth. The background is a dark, blurred image of the oral cavity, highlighting the implant's placement and appearance.

The Use of Dual- or Co-Axis Macro-Designed Implants to Enhance Screw-Retained Restorations in the Esthetic Zone

Adam J. Mieleszko, CDT¹
Hanae Saito, DDS, MS, CCRC²
Stephen J. Chu, DMD, MSD, CDT³

Implant placement into postextraction sockets with a provisional restoration in nonfunctional occlusion (immediate tooth replacement therapy) in the maxillary anterior region has increased in use and clinical relevance since its introduction in the late 1990s.¹ Treatment procedures are condensed into fewer patient appointments, reducing overall treatment time and increasing patient comfort.²⁻⁴ Survival rates reported for immediate implant protocols are comparable to those for delayed procedures with or without provisional restoration and bone grafting.^{5,6} In addition, positive esthetic outcomes have been reported

regarding ridge collapse, midfacial recession, and tissue discoloration depending on implant position, immediate provisional restoration, and bone grafting.^{3,7-11}

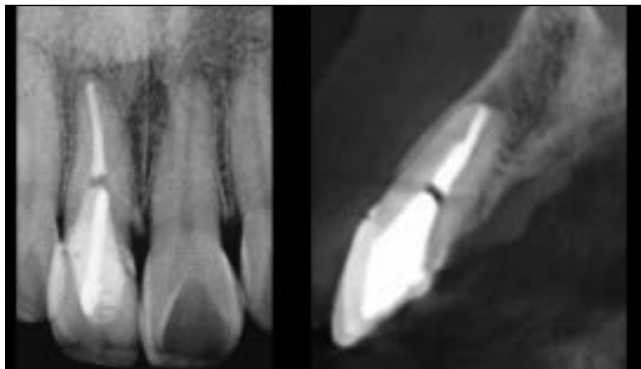
The dual-zone (tissue and bone zones) therapeutic concept, in which a hard tissue graft material is intentionally placed not only adjacent to the labial bone plate but also into the soft tissues, was introduced in 2012.^{2,3,10-13} The utilization of this technique has led to enhanced and consistent esthetic outcomes without employing supplemental connective tissue grafting.



1a



1b



2

Figs 1a and 1b Pretreatment extraoral smile and labial views of the maxillary right central incisor. The patient exhibits a high smile line. A 20-year-old porcelain-fused-to-metal crown and gingiva show discoloration due to a dark root after root canal treatment.

Fig 2 Pretreatment periapical radiograph and CBCT shows a thin labial plate, narrow socket dimension, and bone apical and palatal to the tooth root.

In addition, the use of macro changes in implant design, specifically angle correction or Co-Axis implants (Southern Implants), may minimize the need for custom abutments and cement-retained definitive restorations.¹⁴ It has been documented that remaining cement remnants in the soft tissues and surrounding the implant-abutment platform can lead to inflammation and resultant attachment loss.¹⁵

The following case illustrates the use of these techniques and implant macro design elements to minimize changes in ridge dimension, gingival recession, and tissue color while ensuring screw retention of the restoration associated with immediate tooth replacement therapy in the esthetic zone.

CASE PRESENTATION

A 41-year-old Asian woman presented for treatment of the maxillary right central incisor (tooth 11) following traumatic insult (Figs 1a and 1b). The tooth had been previously treated endodontically due to trauma and restored with a full-coverage restoration. A cone beam computed tomography (CBCT) scan was taken preoperatively, and all

findings, treatment options, and risks were reviewed (Fig 2). The patient consented to immediate tooth replacement therapy (ITRT) using the dual-zone technique. Informed consent was obtained based on the Helsinki Declaration of 1975.

An irreversible hydrocolloid impression material (Jeltrate Alginate, Dentsply Caulk) was made, and an acrylic “egg-shell” was fabricated using the powder-liquid (Nealon) technique.¹⁶ Excess material was trimmed to create the final tooth form shell prior to relining it with a prefabricated gingival former device (i-Shell, Vulcan Custom Dental), which replicates the shape and dimensions of the extracted root at the cervical area and properly supports the subgingival mucosal tissues.¹⁷

After the administration of local anesthesia, the crown was removed, with sharp dissection of the supracrestal gingival fibers performed by means of a 15c scalpel blade. The tooth was extracted atraumatically with fine-tipped forceps (Fig 3). The labial soft tissue measured at 2 mm from free gingival margin (FGM) with rounded-end springless calipers (Iwanson Spring Caliper, Henry Schein) revealed a thickness of 0.5 mm (Figs 4a and 4b). After socket debridement with a surgical excavator, an intact buccal plate and soft tissue or type 1 socket was con-

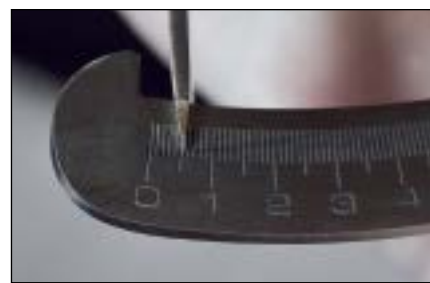


3

Fig 3 Extraction was performed in an atraumatic manner without flap elevation. An intact buccal plate was confirmed.



4a



4b

Figs 4a and 4b Buccal soft tissue thickness 2.0 mm below the free gingival margin was measured with an Iwanson rounded-end springless caliper. Thin buccal soft tissue of 0.5 mm was noted.

Fig 5 Osteotomy was done according to the manufacturer's recommendation, and the angulation of the implant followed the incisal edges of the adjacent teeth.



5

Fig 6 Implant driver showed an implant platform angle correction of 12 degrees, which enabled positioning of a screw-access hole at the cingulum area by macro implant design alone.



7

Fig 7 The angle correction or co-axis implant was placed approximately 3 to 4 mm below the buccal free gingival margin. Note that the external hex platform was now positioned at the cingulum.



6

firmed, and the site was prepared to receive an endosseous implant.¹⁸ The drilling protocol is consistent with cement-retained restorations, where the path of angulation is coincident with the incisal edge position of the adjacent teeth (Fig 5). The implant site preparation was consistent with the manufacturer's recommendations. A 5.0-mm-diameter textured and threaded implant design with variable platform switching and a 12-degree angle correction feature (Co-Axis, Southern Implants) was used and placed with 65 Ncm of insertion torque value (Fig 6). The implant position was set at approximately 3.0 to 4.0 mm in depth from the midfacial FGM, and leaving a "labial gap" to be filled with biomaterial (Fig 7).

A screw-retained custom provisional restoration was fabricated using a preformed subgingival former acrylic shell or sleeve filled and connected to a polyether-ether-ketone polymer (PEEK) temporary cylinder with autopolymerizing resin (Super T, American Consolidation Manufacturing Co) (Figs 8 to 13). The provisional restoration was intentionally

positioned in labioversion to ensure nonocclusal loading during the healing phase. Prior to insertion of the custom provisional restoration, the subgingival surface of the abutment was steam cleaned for 20 seconds (Touchsteam, Kerr) to allow the provisional restoration to serve as a platform for initial peri-implant soft tissue healing.¹⁹ A tall and slender titanium healing abutment was placed to protect the prosthetic screw hole while small-particle (250 to 500 micron) corticocancellous bone allograft (Puros, Zimmer Biomet) was packed against the abutment into the buccal gap with an amalgam condenser (Fig 14a). The bone graft material occupied the bone zone as well as the tissue zone to the height of the FGM (Fig 14b). The healing abutment was subsequently removed, and the fabricated provisional restoration replaced and secured with a retaining screw that was hand tightened (Figs 15 to 17). The excess bone graft was removed. The patient was placed on a postsurgical broad-spectrum antibiotic and analgesic, as needed, and she was seen for follow-up at 1 week.



Figs 8a and 8b Prefabricated polymethyl methacrylate (PMMA) shell device was placed into the socket over the implant.

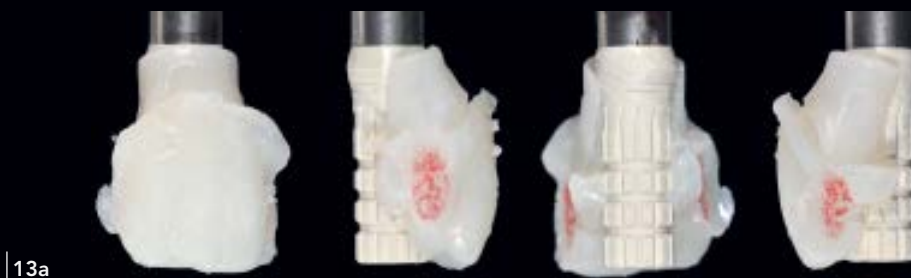
Fig 9 PMMA temporary abutment placed onto the implant. The platform angle correction enabled optimal angulation of the prosthetic abutment relative to the extraction socket.

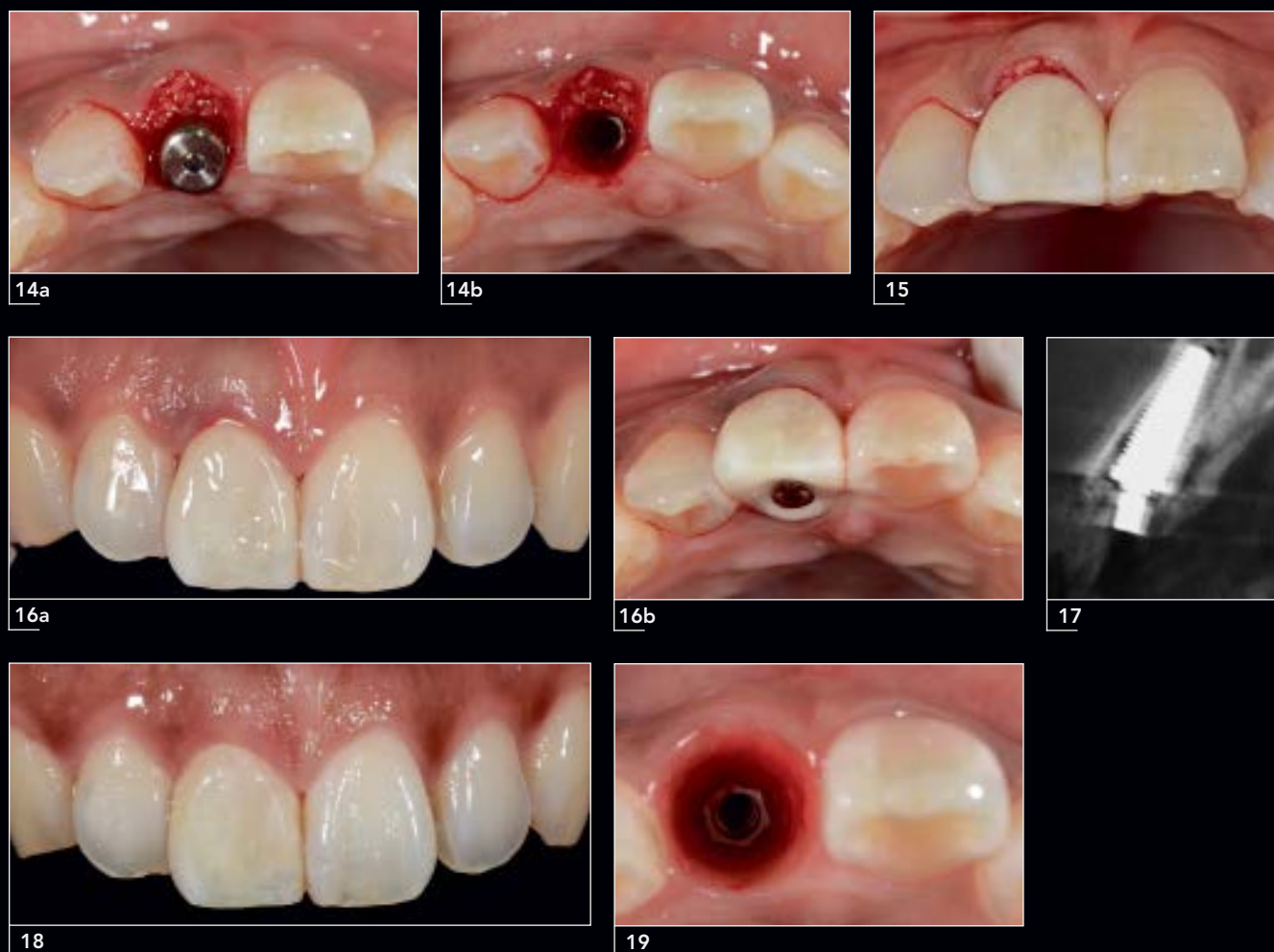
Figs 10a and 10b Palatal aspect of prefabricated shell device was modified to facilitate the temporary screw-retained cylinder.

Fig 11 Space between the temporary abutment and shell device was filled with autopolymerizing resin.

Fig 12 The preoperative impression was used to form an "egg shell" in a powder-liquid (Nealon) technique and connected to the subgingival structure of the provisional restoration.

Figs 13a and 13b Removed provisional restoration before and after the custom characterization using Optiglaze color (GC America).





Figs 14a and 14b Healing abutment was placed into the implant to protect the screw access hole, and cancellous particulate allograft was placed up to the free gingival margin.

Fig 15 Provisional restoration was placed and excess bone graft was removed.

Figs 16a and 16b Buccal and occlusal views after the immediate tooth replacement therapy.

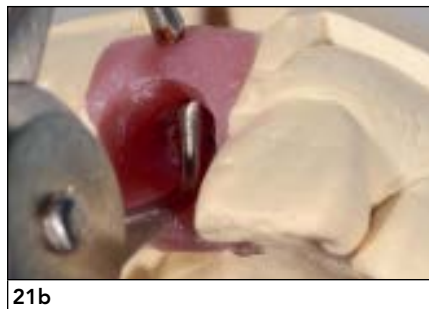
Fig 17 CBCT taken right after the immediate tooth replacement therapy showed platform angle correction and avoidance of apical perforation of the extraction socket with the co-axis implant design.

Fig 18 Five months after the ITRT, coronal migration of the facial mucosal margin was noted.

Fig 19 Bleeding, due to torn soft tissue fiber attachment from the peri-implant sulcus yet healthy, was noted at the first disconnection of the provisional restoration.

After 5 months of undisturbed healing, the custom provisional crown was removed (disconnection) for the first time to make an implant-level impression for fabrication of the definitive restoration (Fig 18). A 2.0-mm increase in buccal peri-implant soft tissue thickness was measured (Fig 19). The patient demonstrated good oral hygiene (eg, plaque-free score higher than 90%). Pattern resin (Pattern

Resin LS, GC America) was used to capture the subgingival soft tissue profile, and implant-level transfer copings were attached for an open-tray impression. The impression was made with a dual-viscosity (light syringe and heavy tray) monophasic polyvinyl siloxane material (Flexitime, Kulzer).



Figs 20a and 20b Shade selection using the shade tabs with regular and polarized photography.

Figs 21a to 21c Laboratory fabrication of the prosthetic screw-retained abutment/crown. (a) Soft tissue model, (b) which showed increase of buccal peri-implant soft tissue of 2.0 mm (net of 2.5 mm) from the initial thickness of 0.5 mm, and (c) metal prosthetic framework.

Fig 22 Incisal third of the restoration contains some grayish-violet to create the illusion of depth, and the gingival third has a more chromatic hue profile.

Fig 23 Segmental lateral buildup: Incisal third with grayish-violet to create the illusion of depth and gingival third with chromatic profile.

It is recommended that color matching be performed prior to impression-making to prevent false shades associated with tooth dehydration. Multiple shade guides and tabs (Vitapan 3D Master, VITA North America) are used in the shade communication photographs, which helps determine the variations in color, chroma, and value (Fig 20a). Polarized digital photography eliminates surface reflections and visually exposes internal characteristics, such as mamelons, deep translucencies, or craze lines, while providing

easier determination of color saturation when used with shade guides (Fig 20b).

The laboratory made a soft tissue cast that allowed fabrication of a screw-retained noble metal alloy restoration (Argedent 52SF Special, Argen) (Figs 21a to 21c). The framework was opaqued to create the base for color and fluorescence. The incisal third of the restoration required a slight grayish-violet tone to create the illusion of depth, while the gingival third contained a more saturated



24



25



26



27a



27b



27c



27d

Fig 24 Shade was verified using a polarized filter and the same shade tabs used for shade selection.

Fig 25 Gold powder applied to verify the texture and luster of the restoration independent of the shade.

Fig 26 Try-in of the final restoration. Modifications to the distal contour, chroma, and surface texture were required.

Figs 27a to 27d Fine tuning of the crown, fabricated of porcelain fused to gold-ceramic alloy, with additional texture, incisal transparency, and contour.

chromatic base color profile (Fig 22). A segmental lateral buildup technique using feldspathic ceramic powders (HeraCeram, Kulzer Dental US) was performed to achieve proper hue and translucency characteristics (Fig 23). Morphology of the restoration, including texture and surface luster, was achieved to create a lifelike definitive restoration. The final shade was verified using polarized filter photography and the same shade guide tabs that were used

for clinical shade selection (Fig 24). Gold powder (Benzer Dental AG) was applied to verify the surface texture and luster (Figs 25 to 27).

The screw-retained crown, fabricated of porcelain fused to gold-ceramic alloy, was delivered with 35 Ncm approximately 4 months after final impression-making (Figs 28 and 29). The definitive restoration 6 months after delivery is shown in Figs 30a to 30e.



28a



28b



28c



29

Figs 28a to 28c Screw-retained final restoration placed. (a) Labial view, (b) distal papilla, and (c) smile view. The patient was pleased with the result.

Fig 29 Periapical radiograph of the final restoration placed 9 months after the placement of a dental implant.



30a



30b



30c



30d



30e

Figs 30a to 30e (a) Occlusal, (b) smile, (c) distal papilla, (d) profile, and (e) polarized image views taken 6 months after the delivery of final restoration. Note maintained buccolingual ridge width and midfacial soft tissue height compared to contralateral tooth (maxillary left central incisor).

CONCLUSION

To achieve predictable esthetic success with ITRT, the critical clinical and laboratory steps outlined in this case report must be respected. These steps are helpful to limit the amount of buccal ridge dimensional change as well as midfacial peri-implant soft tissue recession of the implant and potentially enhance the thickness of the peri-implant soft tissues coronal to the implant-abutment interface as well as offering a screw-retained definitive restoration with a co-axis macro implant design.

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