



# USE OF PREFABRICATED TITANIUM ABUTMENTS AND CUSTOMIZED ANATOMIC LITHIUM DISILICATE STRUCTURES FOR CEMENT-RETAINED IMPLANT RESTORATIONS IN THE ESTHETIC ZONE

**Wei-Shao Lin, DDS,<sup>a</sup> Bryan T. Harris, DMD,<sup>b</sup> Amirali Zandinejad, DDS, MSc,<sup>c</sup> William C. Martin, DMD, MS,<sup>d</sup> and Dean Morton, BDS, MS<sup>e</sup>**

School of Dentistry, University of Louisville, Louisville, Ky; College of Dentistry, University of Florida, Gainesville, Fla

This report describes the fabrication of customized abutments consisting of prefabricated 2-piece titanium abutments and customized anatomic lithium disilicate structures for cement-retained implant restorations in the esthetic zone. The heat-pressed lithium disilicate provides esthetic customized anatomic structures and crowns independently of the computer-aided design and computer-aided manufacturing process. (J Prosthet Dent 2014;111:181-185)

Customized anatomic abutments are often provided to improve or optimize esthetic outcomes in implant dentistry. The esthetic improvement is associated with the color of the material in the submucosal periimplant region and improved periimplant emergence profile. In addition, appropriately contoured abutments can reduce the likelihood of complications associated with residual luting agent by improving cement margin accessibility.<sup>1</sup> Abutments with customized periimplant emergence form and color can be fabricated from zirconia and with computer-aided design/computer-aided manufacturing (CAD/CAM) technology.<sup>2,3</sup> A systematic review<sup>4</sup> concluded that implant-supported zirconia restorations in the esthetic zone should be used with caution, because limited clinical evidence of their performance is available.<sup>5,6</sup> The use of CAD/CAM technology can improve the speed, simplicity, and efficiency of manufacture of zirconia abutment components.<sup>7</sup>

Zirconia also has limitations. These include the material's inherent opacity and the consequent higher value of these restorations when compared with

the adjacent teeth and the restorations supported.<sup>8</sup> To provide consistent esthetic properties on implant restorations supported by zirconia abutments, various attempts have been made to create a tooth-colored zirconia abutment that more closely mimics the shade of natural teeth.<sup>4</sup> Coloring metal oxides can be added into zirconia ceramic before the sintering process.<sup>7,9</sup> In addition, adding heat-pressed fluorapatite glass ceramic to the subgingival portions of zirconia abutments may provide improved esthetic outcomes in the event of periimplant soft tissue recession.<sup>8,10</sup>

An experimental customized anatomic abutment design combining gold alloy and lithium disilicate was proposed and had significantly higher fracture load when compared with commercially fabricated zirconia abutments.<sup>11</sup> However, the design with pressed lithium disilicate ceramic (IPS e.max Press; Ivoclar Vivadent) around the anatomic gold alloy abutment may be cost-inhibitive in a clinical setting because of material cost (Type IV gold alloy).<sup>11</sup>

This report describes a technique for the fabrication of customized

anatomic lithium disilicate structures luted onto prefabricated 2-piece titanium abutments. The combination provides esthetic abutments (titanium/lithium disilicate) and is designed to support cemented restorations in the esthetic zone.

## TECHNIQUE

### First clinical appointment

1. Complete an intraoral examination of the existing implant-supported interim restorations and the periimplant soft tissue to confirm the desired functional and esthetic outcome (Fig. 1).

2. Remove the implant-supported interim restorations and make a definitive implant-level impression; use customized impression copings to capture the emergence profile of the interim restorations (RC impression post for closed tray; Straumann USA, LLC).<sup>8</sup> Make the definitive impression with a custom tray and polyvinyl siloxane impression material (Aquasil Ultra Light and Heavy Body; Dentsply Caulk).

3. Pour the impression with polyvinyl siloxane material (Softtissue Moulage;

<sup>a</sup>Assistant Professor, Department of Oral Health and Rehabilitation.

<sup>b</sup>Assistant Professor, Department of Oral Health and Rehabilitation.

<sup>c</sup>Assistant Professor, Department of Oral Health and Rehabilitation.

<sup>d</sup>Associate Professor, Department of Oral and Maxillofacial Surgery, Center for Implant Dentistry.

<sup>e</sup>Director, Advanced Education in Prosthodontics; and Professor and Chair, Department of Oral Health and Rehabilitation.

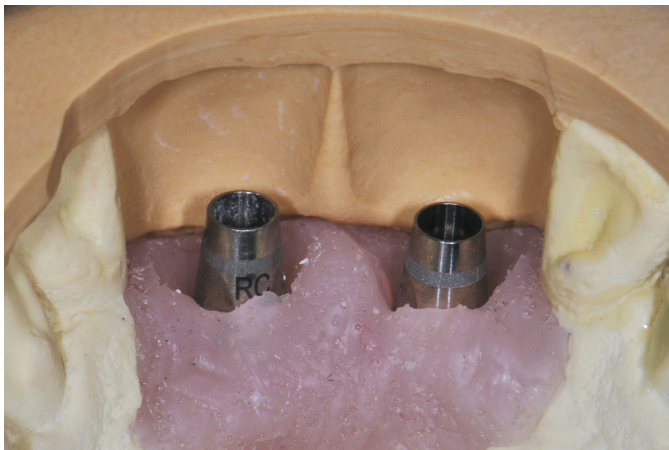




**1** Existing implant-supported interim restorations (maxillary central incisors).



**2** Facial matrix fabricated around interim restorations on definitive cast.



**3** Two-piece prefabricated titanium abutments with minimal gingival height are selected and connected to definitive cast.

Kerr Dental Laboratory Products) and Type IV dental stone (Silky-Rock; Whip Mix Corp) to obtain a definitive cast with a removable resilient gingival replica.

4. Reposition the implant-supported interim restorations onto the definitive cast, and fabricate a facial matrix with polyvinyl siloxane putty (Sil-Tech; Ivoclar

Vivadent), capturing the form of both the interim restoration and the definitive cast (Fig. 2).<sup>12</sup>

### Laboratory procedure

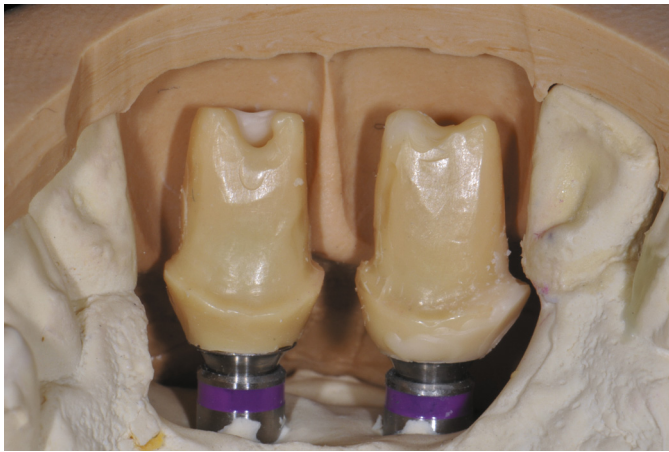
1. Select the corresponding prefabricated titanium abutments with minimal gingival height and abutment diameter (RC 2-piece abutment with diameter of 5.0 mm, gingival height of 1.0 mm, and abutment height of 5.5 mm; Straumann USA, LLC) and connect them to the definitive cast (Fig. 3). Adjust the height of the titanium abutment by using the facial matrix as a reference. Ensure adequate clearance in each dimension for fabrication of optimized definitive crowns.

2. Develop wax patterns for the structures on the prefabricated titanium abutments by using the facial matrix and removable resilient gingival replica as references to achieve the desired abutment shape, emergence profile, and finish line level (Fig. 4). Ensure a minimum thickness of 0.5 mm of the wax to follow the manufacturer's recommendations for the lithium disilicate pressable ceramic (HO ingot, IPS e.max Press; Ivoclar Vivadent).

3. Remove the wax patterns from the prefabricated titanium abutments and invest with phosphate-bonded investment material (IPS PressVEST Speed; Ivoclar Vivadent). Heat-press and deinvest the structures according to the manufacturer's recommendations for lithium disilicate pressable ceramics (HO ingot, IPS e.max Press; Ivoclar Vivadent) (Fig. 5).

4. Verify the fit of the individual structures on the prefabricated titanium abutments with polyvinyl siloxane material (Fit Checker Black; GC America) and adjust with a low-speed dental handpiece and rotary instruments (LD13M LD grinder pink medium; Brasseler USA).

5. Develop the wax patterns of the definitive crowns to fit on the assembly of customized anatomic lithium disilicate structures and prefabricated 2-piece titanium abutments. Invest the wax patterns and heat-press the



**4** Customized wax patterns on 2-piece titanium abutments, illustrating desired morphology, emergence profile, and finish line position for structures.



**5** Devested lithium disilicate pressable ceramic structures.



**6** Completed customized anatomic titanium/lithium disilicate abutments and definitive lithium disilicate crowns.

definitive crowns with lithium disilicate pressable ceramics (LT ingot, IPS e.max Press; Ivoclar Vivadent).

6. Complete the characterization and glazing process for both the

lithium disilicate structures and the definitive crowns with low-fusing nanofluorapatite glass ceramic (IPS e.max Ceram Shades and Essences; Ivoclar Vivadent) (Fig. 6), and ensure

glaze material is absent from the interface between the lithium disilicate structures and the definitive crowns.

7. Abrade the surface of the titanium abutments above the finish line with aluminum oxide (Aluminum Oxide Blasting Media, 50 Micron; Buffalo Dental) under 0.1 MPa pressure to achieve a matte surface. Apply primer (Monobond Plus; Ivoclar Vivadent) onto the abraded surface for 60 seconds and air dry the surface (Fig. 7A).

8. Etch the intaglio surface of the lithium disilicate structures with 5% hydrofluoric acid gel (IPS Ceramic Etching Gel; Ivoclar Vivadent) for 20 seconds (see Fig. 7B). Rinse, air dry the surface, and apply the primer (Monobond Plus; Ivoclar Vivadent) to the treated surface for 60 seconds and air dry.

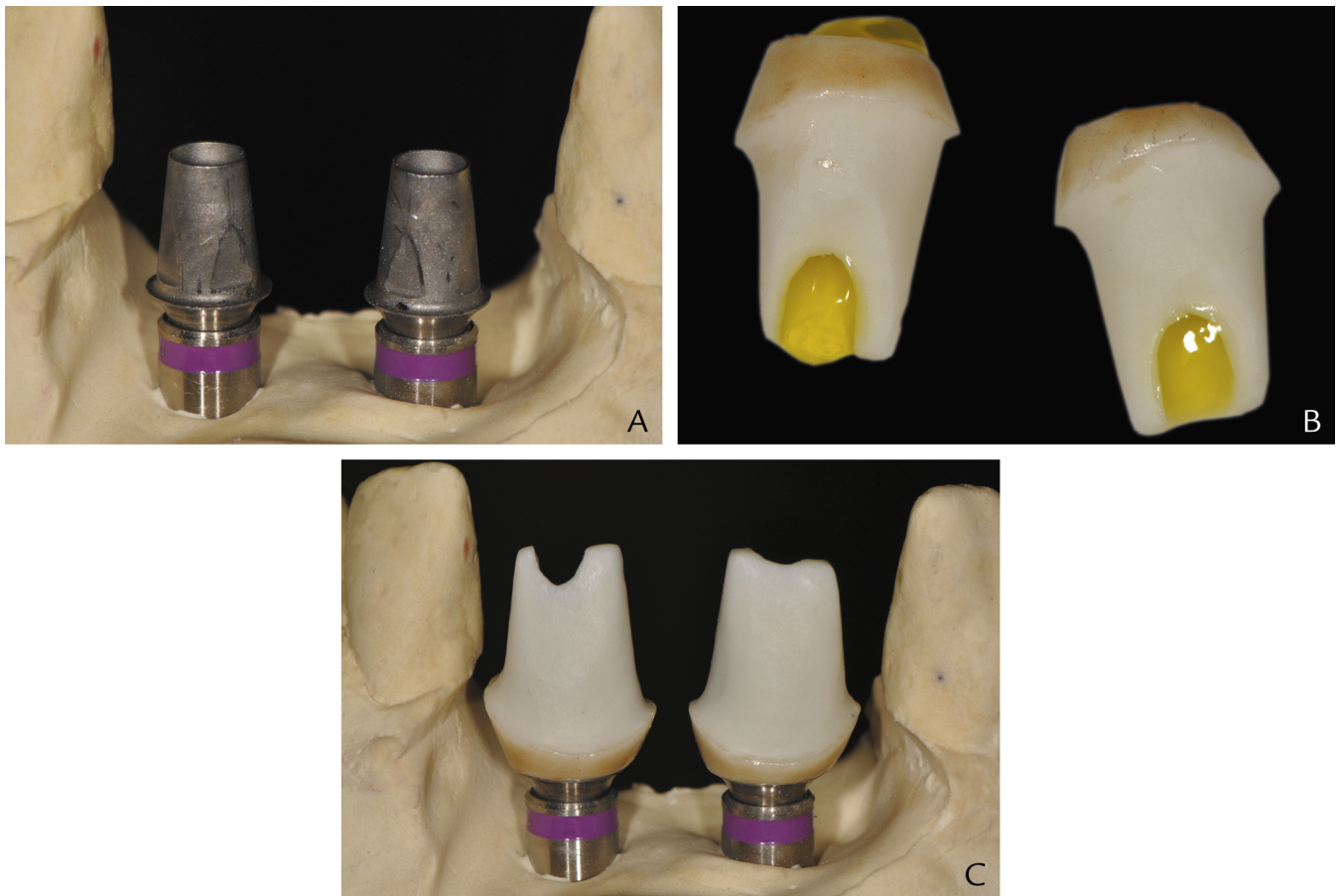
9. Seal the access openings of the titanium abutments with cotton pellets. Lute the lithium disilicate structures to the prefabricated titanium abutments with dual-polymerizing resin cement (Multilink Implant; Ivoclar Vivadent). Remove the excess cement from the completed customized titanium/lithium disilicate abutments (see Fig. 7C).

### Second clinical appointment

1. Remove the interim implant-supported restorations and secure the titanium/lithium disilicate abutments to the implants. Adjust the definitive crowns to achieve satisfactory contacts (occlusal and interproximal) and esthetic and functional outcomes.

2. Etch, rinse, and dry the intaglio surface of the lithium disilicate crowns and the ceramic surface of the titanium/lithium disilicate abutments according to manufacturers' instructions. Apply the primer to all treated lithium disilicate surfaces for 60 seconds and air dry.

3. Seal the access openings of the titanium/lithium disilicate abutments with cotton pellets. Lute the definitive crowns to the titanium/lithium disilicate abutments with dual-polymerizing resin cement (Multilink Implant; Ivoclar



**7** Luting procedures for titanium/lithium disilicate abutments. A, Matte titanium surface achieved with aluminum oxide abrading. B, Intaglio surfaces of lithium disilicate structures treated with 5% hydrofluoric acid gel. C, Luted titanium/lithium disilicate abutments.



**8** Definitive customized anatomic titanium/lithium disilicate implant abutments and lithium disilicate crowns at 6-month follow-up appointment.

Vivadent) and remove the excess cement (Fig. 8).

## DISCUSSION

Although CAD/CAM technology is commonly used to fabricate

customized zirconia implant abutments, the limitations of CAD software and the experience of the dental laboratory technician in the field of digital dentistry may prevent ideal digital abutment/restoration design and restrict the esthetics of definitive restorations. In

addition, the compatibility of internal connections between zirconia abutments and the titanium implants may be less than optimal. The described technique can be used to fabricate a customized anatomic abutment independent of CAD/CAM with conventional dental laboratory techniques.

In the current report, both the abutments and definitive crowns were fabricated with heat-pressed lithium disilicate with similar characterization and glazing processes. Therefore, the abutments in the periimplant mucosal region were of a shade closer to the restorations they supported and may provide improved long-term esthetic outcomes in patients with thin tissue biotype. Furthermore, because of improved shade matching between the abutment and the definitive restoration, the restoration finish line design may be optimized at the equigingival or supragingival level, thereby improving

access for the removal of excess luting agent.

Some limitations are associated with this technique. Compared with a CAD/CAM customized zirconia abutment, the titanium/lithium disilicate abutment assembly consumes more restorative space with its multiple layers of materials. Additional laboratory steps and costs are needed for this technique and include individual waxing, heat-pressing, and devesting procedures for both the lithium disilicate structure and the crown.

## REFERENCES

1. Guess PC, Att W, Strub JR. Zirconia in fixed implant prosthodontics. *Clin Implant Dent Relat Res* 2012;14:633-45.
2. Gomes AL, Montero J. Zirconia implant abutments: a review. *Med Oral Patol Oral Cir Bucal* 2011;16:e50-5.
3. Lin WS, Harris BT, Morton D. The use of a scannable impression coping and digital impression technique to fabricate a customized anatomic abutment and zirconia restoration in the esthetic zone. *J Prosthet Dent* 2013;109:187-91.
4. Nakamura K, Kanno T, Milleding P, Ortengren U. Zirconia as a dental implant abutment material: a systematic review. *Int J Prosthodont* 2010;23:299-309.
5. Kim JS, Raigrodski AJ, Flinn BD, Rubenstein JE, Chung KH, Mancl LA. In vitro assessment of three types of zirconia implant abutments under static load. *J Prosthet Dent* 2013;109:255-63.
6. Foong JK, Judge RB, Palamara JE, Swain MV. Fracture resistance of titanium and zirconia abutments: an in vitro study. *J Prosthet Dent* 2013;109:304-12.
7. Kohal RJ, Att W, Bächle M, Butz F. Ceramic abutments and ceramic oral implants: an update. *Periodontol* 2000 2008;47:224-43.
8. Wadhvani CP, Piñeyro A, Akimoto K. An introduction to the implant crown with an esthetic adhesive margin (ICEAM). *J Esthet Restor Dent* 2012;24:246-54.
9. Shah K, Holloway JA, Denny IL. Effect of coloring with various metal oxides on the microstructure, color, and flexural strength of 3YTZP. *J Biomed Mater Res B Appl Biomater* 2008;87:329-37.
10. Oates TW, West J, Jones J, Kaiser D, Cochran DL. Long-term changes in soft tissue height on the facial surface of dental implants. *Implant Dent* 2002;11:272-9.
11. Kim S, Kim HI, Brewer JD, Monaco EA Jr. Comparison of fracture resistance of pressable metal ceramic custom implant abutments with CAD/CAM commercially fabricated zirconia implant abutments. *J Prosthet Dent* 2009;101:226-30.
12. Lin WS, Ercoli C. A technique for indirect fabrication of an implant-supported, screw-retained, fixed provisional restoration in the esthetic zone. *J Prosthet Dent* 2009;102:393-6.

### Corresponding author:

Dr Wei-Shao Lin  
Department of Oral Health and Rehabilitation  
University of Louisville  
501 S. Preston Street  
Louisville, KY 40202  
E-mail: WeiShao.Lin@Louisville.edu

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