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DENTAL TECHNIQUE

A digital approach to fabricating an abutment replica to control cement volume in a cement-retained implant prosthesis

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ABSTRACT

If a cement-retained implant prosthesis is placed on an abutment, excess cement should be minimized or removed to prevent periimplant inflammation. Various methods for fabricating an abutment replica have been introduced to maintain tissue health and reduce clean-up time. The purpose of this article is to present an alternative technique for fabricating an abutment replica with computer-aided design/computer-aided manufacturing (CAD/CAM) technology. (J Prosthet Dent 2016;116:25-28)

Even though a cement-retained implant prosthesis has advantages,[1-5] residual excess cement has been linked to periimplant disease.[6-13] The removal of excess cement with plastic or metal scalers may be difficult and result in damage to the implant surfaces.[14,15]

Numerous techniques have been described to manage cement volume and minimize excess cement extrusion into the periimplant tissue.[16-21] The computational fluid dynamics approach reveals that a proper margin seal and a smaller cement extrusion occurred when the cement loading site was near the crown margin.[13] Abutment replicas can be categorized into stock replicas[16] and custom replicas with polyvinyl siloxane putty,[17,18] polyvinyl siloxane occlusal registration material,[19] and acrylic resin.[20]

If a stock replica is used, too much cement is extruded because of the built-in die spacer and so it is physically larger in size than the actual abutment used in the patient.[21] Therefore, cement is insufficiently loaded in a crown.[21] If a polyvinyl siloxane material is used,[17-19] polytetrafluoroethylene tape that provides a cement space of approximately 50 μm should be used to line the intaglio surface of a crown, because loading materials into a crown may leave a residue that will interfere with the cementing process.[21] However, replica surfaces may be irregular, because it is difficult to place this tape on the intaglio surface of a crown without folds. To achieve an evenly distributed and thin layer of cement inside a crown, Galván et al[20] introduced a slightly small-scale abutment replica, with a light-body polyvinyl siloxane and autopolymerizing acrylic resin. However, nodules and voids may be present on an acrylic resin replica.

Advances in computer-aided design and computer-aided manufacturing (CAD/CAM) technology have made it possible to design and fabricate abutments with nearly unlimited design options.[22] This article describes an efficient and straightforward technique for fabricating a replica of a stock abutment with CAD/CAM technology.

TECHNIQUE

1. After fabricating a definitive abutment and crown, create an order and click "Abutment wax-up." Secure the definitive abutment to an implant analog and apply a nonreflecting scan spray (Diascan spray; Diaswiss SA).[23] Scan the definitive abutment with a dental scanner (D900L; 3Shape) (Fig. 1). Because the crown is not placed onto the abutment while the

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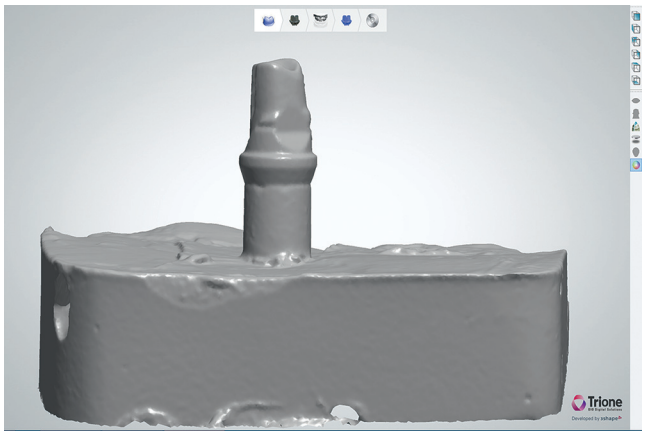

Figure 1. Software view of definitive abutment regarded as crown by scanner system.

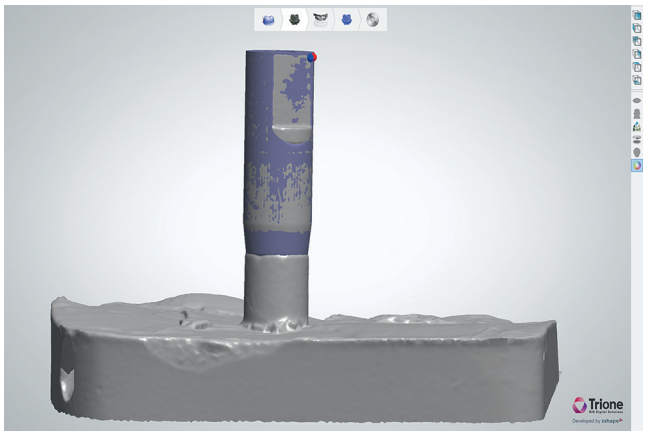

Figure 2. Software view of scannable impression coping.

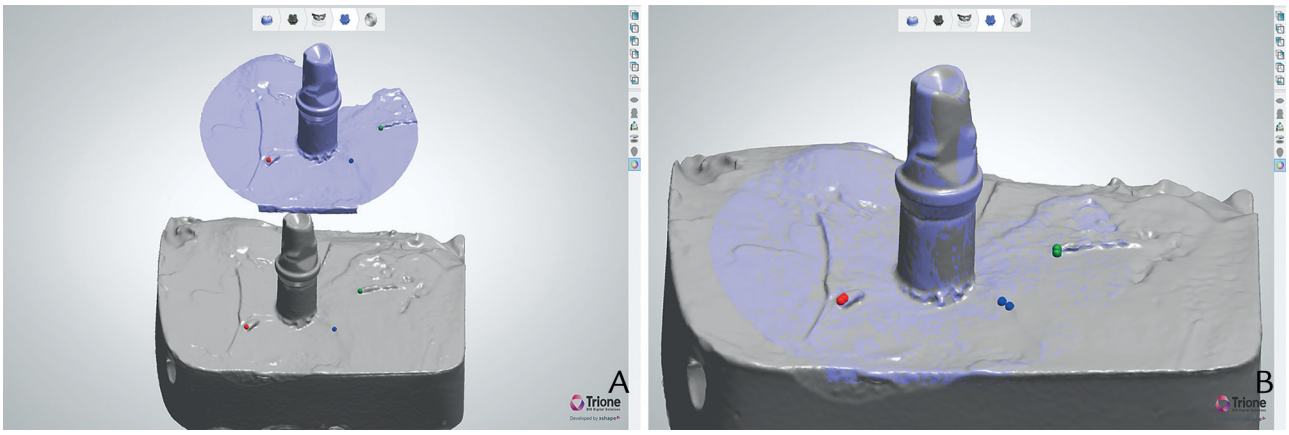

Figure 3. A, Software view of definitive abutment (blue). B, Software view of superimposed image with 3-point matching technique.

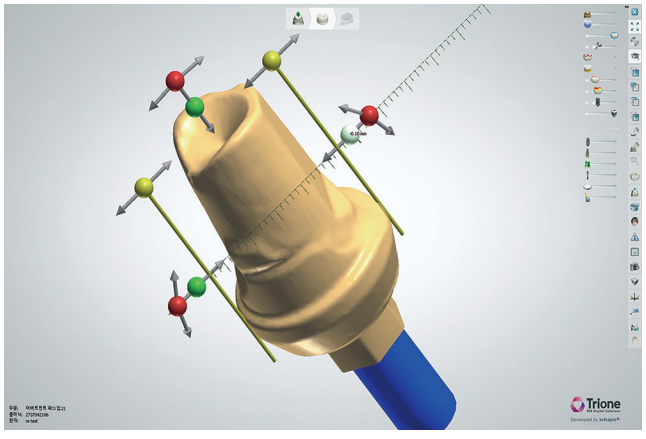

Figure 4. Software view of abutment replica.

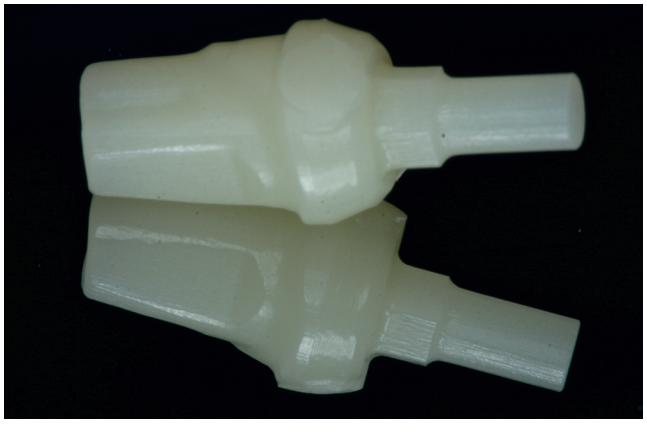

Figure 5. Milled abutment replica.

crown is being scanned, the scanner system regards this abutment image as a kind of crown image. Remove the abutment and tighten a scannable impression coping to the implant analog. Scan the scannable impression coping with the dental scanner (Fig. 2). Unscrew the impression coping and secure the abutment to the implant analog. Rescan the abutment and superimpose this abutment image

Figure 6. Crown placed onto abutment replica, allowing extrusion of excess cement.

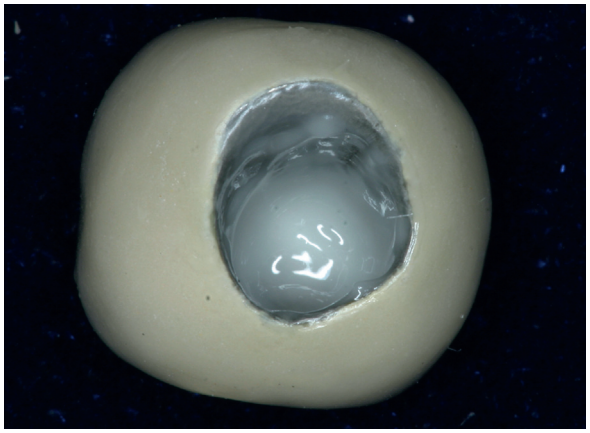

Figure 7. Thin layer of cement inside crown.

over the previously acquired abutment image with a 3-point matching technique (Fig. 3).[24,25]

2. Open the scan data with CAD software (3Shape Dental System; 3Shape). Use the aligned image for an abutment replica design. Attach a handle on the image for a handling aid. Perform 3D cutback of 100 μm with the digital ruler to compensate for the cement space and the thickness of the spray layer on the abutment (Fig. 4).[19,23]
3. Transmit the completed design to a 5-axis milling machine (Zenotec; Wieland Dental). Mill a polymethyl methacrylate block (Vipi Block Monocolor; Vipi) (Fig. 5).
4. Apply the luting agent inside the crown and insert the crown onto the replica, permitting the extrusion of excess cement (Fig. 6).[14] Promptly wipe off the extruded excess cement with an alcohol-soaked cotton ball.[16] Separate the replica from the crown (Fig. 7). Place the crown onto the abutment.

DISCUSSION

With the virtual cutback procedure, the slightly smaller replica of the stock abutment was fabricated to control the cement volume. This technique allowed a more predictable and controllable dimensional change of the replica without the extra chair time required by the clinician. Moreover, this technique can be applied to a CAD/CAM-milled definitive abutment without the superimposition process. In other words, this technique can be used for both stock and custom abutments. However, initial investments for access to CAD/CAM technology are necessary.

REFERENCES

1. Hebel KS, Gajjar RC. Cement-retained versus screw-retained implant restorations: achieving optimal occlusion and esthetics in implant dentistry. J Prosthet Dent 1997;77:28-35.
2. Chee W, Felton DA, Johnson PF, Sullivan DY. Cemented versus screw retained implant prostheses: which is better? Int J Oral Maxillofac implants 1999;14:137-41.
3. Michalakis KX, Hirayama H, Garefis PD. Cement-retained versus screw-retained implant restorations: a critical review. Int J Oral Maxillofac Implants 2003;18:719-28.
4. Karl M, Graef F, Taylor TD, Heckmann SM. In vitro effect of load cycling on metal-ceramic cement-and screw-retained implant restorations. J Prosthet Dent 2007;97:137-40.
5. Lee A, Okayasu K, Wang HL. Screw-versus cement-retained implant restorations: current concepts. Implant Dent 2010;19:8-15.
6. Pauletto N, Lahiffe BJ, Walton JN. Complications associated with REC around crowns on osseointegrated implants: a clinical report. Int J Oral Maxillofac Implants 1999;14:865-8.
7. Quirynen M, De Soete M, Van Steenberghe. Infectious risks for oral implants: a review of the literature. Clin Oral Implants Res 2002;13:1-19.
8. Gapski R, Neugeboren N, Pomeranz AZ, Reissner MW. Endosseous implant failure influenced by crown cementation: a clinical patient report. Int J Oral Maxillofac Implants 2008;23:943-6.
9. Thomas GW, Wilson TG Jr. The positive relationship between excess cement and peri-implant disease: a prospective clinical endoscopic study. J Periodontol 2009;80:1388-92.
10. Wadhwani C, Rapoport D, La Rosa S, Hess T, Kretschmar S. Radiographic detection and characteristic patterns of residual excess cement associated with cement-retained implant restorations: a clinical report. J Prosthet Dent 2012;107:151-7.
11. American Academy of Periodontology. Peri-implant mucositis and peri-implantitis: a current understanding of their diagnoses and clinical implications. J Periodontol 2013;84:436-43.
12. Pesce P, Canullo L, Grusovin MG, de Bruyn H, Cosyn J, Pera P. Systematic review of some prosthetic risk factors for periimplantitis. J Prosthet Dent 2015;114:349-50.
13. Wadhwani C, Goodwin S, Chung KH. Cementing an implant crown: a novel measurement system using computational fluid dynamics approach. Clin Implant Dent Relat Res 2016;18:97-106.
14. Agar JR, Cameron SM, Hughbanks JC, Parker MH. Cement removal from restorations luted to titanium abutments with simulated subgingival margins. J Prosthet Dent 1997;78:43-7.
15. Linkevicius T, Vindasiute E, Puisys A, Linkeviciene L, Maslova N, Puriene A. The influence of the cementation margin position on the amount of undetected cement. A prospective clinical study. Clin Oral Implants Res 2013;24:71-6.
16. Dumbrigue HB, Abanomi AA, Cheng LL. Techniques to minimize excess luting agent in cement-retained implant restorations. J Prosthet Dent 2002;87:112-4.
17. Caudry S, Chvartszaid D, Kemp N. A simple cementation method to prevent material extrusion into the periimplant tissues. J Prosthet Dent 2009;102:130-1.
18. Chee WW, Duncan J, Afshar M, Moshaverinia A. Evaluation of the amount of excess cement around the margins of cement-retained dental implant restorations: the effect of the cement application method. J Prosthet Dent 2013;109:216-21.
19. Wadhwani C, Piñeyro A. Technique for controlling the cement for an implant crown. J Prosthet Dent 2009;102:57-8.
20. Galván G, Kois JC, Chaiyabutr Y, Kois D. Cemented implant restoration: a technique for minimizing adverse biologic consequences. J Prosthet Dent 2015;114:482-5.

21. Wadhwani C. Cementation in dental implantology. New York: Springer; 2015. p. 139-50.
22. Rosenstiel SF, Land MF, Fujimoto J. Contemporary fixed prosthodontics. 5th ed. St. Louis: Elsevier; 2016. p. 361-6.
23. Dehurtevent M, Robberecht L, Béhin P. Influence of dentist experience with scan spray systems used in direct CAD/CAM impressions. J Prosthet Dent 2015;113:17-21.
24. Biethman R, Land MF, Hruskocy H, Colgin B. Retrofitting a crown to a sleep apnea device by using computer-aided design and computer-aided milling technology. J Prosthet Dent 2014;112:79-82.
25. Kim C, Kim JY, Lim YJ. Use of CAD/CAM to fabricate duplicate abutments for retrofitting an existing implant prosthesis: a clinical report. J Prosthet Dent 2014;112:429-33.

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Noteworthy Abstracts of the Current Literature

Survival of dental implants placed in grafted and nongrafted bone: A retrospective study in a university setting

Tran DT, Gay IC, Diaz-Rodriguez J, Parthasarathy K, Weltman R, Friedman L
Int J Oral Maxillofac Implants. 2016;31:310-7.

Purpose. To compare dental implant survival rates when placed in native bone and grafted sites. Additionally, risk factors associated with dentalimplant loss were identified. This study was based on the hypothesis that bone grafting has no effect on implant survival rates.

Materials And Methods. A retrospective chart review was conducted for patients receiving dental implants at the University of Texas, School of Dentistry from 1985 to 2012. Exclusion criteria included patients with genetic diseases, radiation and chemotherapy, or an age less than 18 years. To avoid misclassification bias, implants were excluded if bone grafts were only done at the same time of placement. Data on age, sex, tobacco use, diabetes, osteoporosis, anatomical location of the implant, implant length and width, bone graft, and professional maintenance were collected for analysis.

Results. A total of 1,222 patients with 2,729 implants were included. The cumulative survival rates at 5 and 10 years were 92% and 87% for implants placed in native bone and 90% and 79% for implants placed in grafted bone, respectively. The results from multivariate analysis (Cox regression) indicated no significant difference in survival between the two groups; having maintenance therapy after implant placement reduced the failure rate by 80% ($P < .001$), and using tobacco increased the failure rate by 2.6-fold ($P = .001$).

Conclusion. There was no difference in the dental implant survival rate when implants were placed in native bone or bone-grafted sites. Smoking and lack of professional maintenance were significantly related to increased implant loss.