An esthetic solution for single-implant restorations – type III porcelain veneer bonded to a screw-retained custom abutment: A clinical report

Pascal Magne, DMD, PhD,[a] Michel Magne, CDT, BS,[b] and Sascha A. Jovanovic, DDS, MS[c]
School of Dentistry, University of Southern California, Los Angeles, Calif; University of California Los Angeles, Los Angeles, Calif

A new esthetic solution to restore dental implants in combination with limited interdental, facial or labial, or interocclusal space is presented. This article describes the translational application of novel-design porcelain veneers and adhesive restorative principles in the implant realm. A patient is presented who was treated with a single implant-supported restoration replacing a missing mandibular lateral incisor and partially collapsed interdental space. A screw-retained custom metal ceramic abutment was combined with a bonded porcelain restoration. This unique design was motivated by the limited restorative space and subgingival implant shoulder. It was also developed as a solution to the interference of the screw-access channel with the incisal edge, therefore providing the surgeon with more options during implant axis selection. The porcelain-to-porcelain adhesive approach was used instead of traditional principles of retention and resistance form of the abutment. (J Prosthet Dent 2008;99:2-7)

From a prosthetic perspective, it can be challenging to restore dental implants in combination with limited interdental, facial or labial, or interocclusal space, especially in the anterior segment of the mouth. Traditionally, implant-supported restorations can be attached to implants with screws or can be cemented to abutments which are secured to implants with screws.[1] A solely screw-retained metal ceramic restoration is a typical solution for situations with limited restorative space or a small-diameter implant. Screw-retained restorations, however, present several disadvantages such as an esthetic compromise, if the screw-access opening involves the incisal edge, the potential for leakage of bacterial contaminants around light-polymerized composite resins placed in the screw-access opening, and the increased risk for porcelain fracture and microcracks.[2] In certain situations, axial alignment of the implant for a screw-retained restoration can also generate labial overextension of the restoration (ridge lap design) and other esthetic and surgical problems, which are discussed in this clinical report.

Screw-retained custom abutments covered by a cemented crown can potentially resolve these issues but require retention and resistance form for cementation as well as increased restorative space, especially if a superior esthetic result is expected. Retention and resistance form dilemmas can be encountered when restoring teeth, as is the situation with short clinical crowns, severe loss of dentin/enamel due to wear, erosion, or crown fracture. In response to this problem, minimally invasive approaches using porcelain veneers were developed and applied clinically with success,[3-5] but have not yet been applied to implant-supported restorations.

This clinical report presents a new esthetic solution for single tooth replacement when facing the dilemma of limited restorative space or insufficient retention and resistance form of the abutment. It was also developed as a solution to the interference of the screw-access channel with the incisal edge, therefore providing the surgeon with more options during implant axis selection. A lateral mandibular incisor was replaced using a single implant-supported screw-retained custom metal ceramic abutment combined to a bonded porcelain restoration. The strong and reliable porcelain-to-porcelain adhesive approach[6] was used instead of traditional principles of retention and resistance form of the abutment. This approach corresponds to the translational application of type III porcelain veneers and adhesive restorative principles[7] in implant dentistry. This unique restoration design ultimately allows the generation of a restoration with ad-

[a]Associate Professor, Don and Sybil Harrington Foundation Chair of Esthetic Dentistry, Division of Primary Oral Health Care, School of Dentistry, University of Southern California.
[b]Associate Professor in Clinical Dentistry, Director, Center for Dental Technology, Division of Primary Oral Health Care, School of Dentistry, University of Southern California.
[c]Lecturer, Center for Continuing Education, School of Dentistry, University of California Los Angeles.

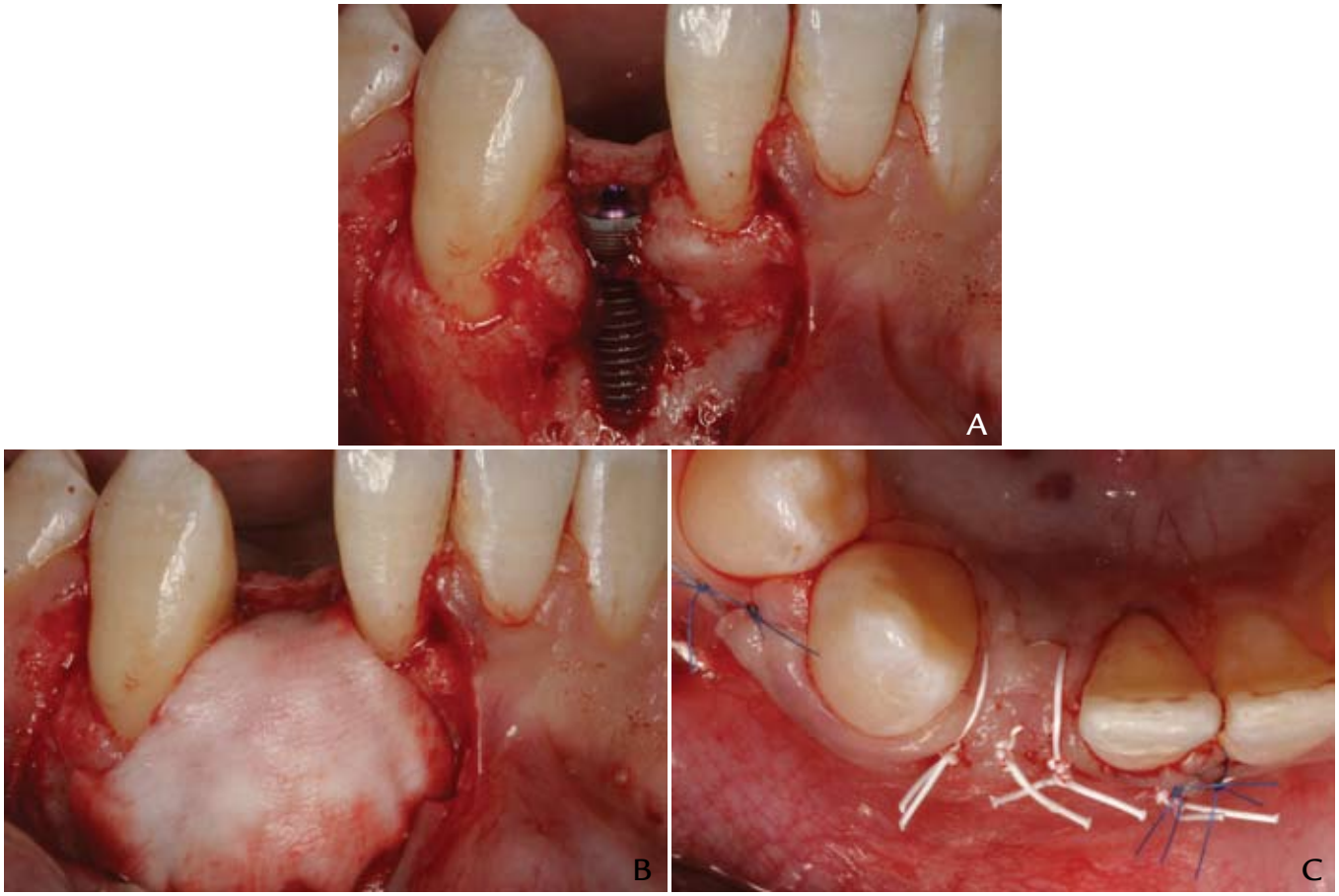
vantages similar to those of a cemented restoration, with the absence of a screw-access opening, yet providing optimal esthetics despite a limited restorative space. The technique is not only suitable in the anterior dentition but also for posterior teeth with limited interocclusal space.

CLINICAL REPORT

A 24-year-old white man presented with a missing mandibular lateral incisor. The patient history revealed no medical problems. The patient reported that his right mandibular lateral incisor was extruded 2 years earlier subsequent to a car accident. The tooth was extracted following unsuccessful repositioning and the adjacent incisor was endodontically treated because of pulp necrosis. Clinical examination revealed a labial bone concavity and a partially collapsed restorative space (Fig. 1). Tooth replacement with a single implant-supported restoration was selected because the patient rejected any type of fixed partial denture. A conventional crestal incision with 2 remote vertical incisions was used. A tapered implant (Nobel-Replace Tapered Groovy, 3.5 mm x 13 mm; Nobel Biocare AB, Goteborg, Sweden) was placed. The implant presented with a labial dehiscence of 10 mm and was treated after bone perforations with a simultaneous guided bone regeneration procedure using a 2-layer graft technique of autogenous particulate bone and xenograft (Bio-Oss, cancellous 0.25-1 mm; Geistlich Pharma AG, Wolhusen, Switzerland) and a trimmed collagen membrane (Bio-Gide, 25 x 25 mm; Geistlich Pharma AG) (Fig. 2, A and B). The flap was released by a periosteal dissection and closed in a tension-free fashion with an everted crestal flap using monofilament sutures (CV-5 Gore-Tex Suture; W.L. Gore & Associates, Flagstaff, Ariz) (Fig. 2, C). After 6 months of uneventful healing, the implant was uncovered using a mucogingival thickening procedure and a transfer impression (Extrude; Kerr Corp, Orange, Calif) was made (Fig. 3).

1 Preoperative clinical view; A, facial; B, lingual. Note missing right lateral incisor and partially collapsed interdental space and edentulous ridge.

A screw-retained provisional restoration (New Outline; MICROSTAR Dental, Lawrenceville, Ga) was first inserted to condition the soft tissues. Once appropriate soft tissue contours were obtained, the definitive restorative phase began, including the fabrication of a screw-retained custom metal ceramic abutment (GoldAdapt Engaging; Nobel Biocare AB) layered with feldspathic porcelain (Creation; Jensen Industries, North Haven, Conn) and a separate type III porcelain veneer, also fabricated with Creation porcelain, using the refractory die technique (Fig. 4).[7] This design was motivated by the limited restorative space, subgingival implant shoulder, and interference of the screw-access channel with the incisal edge. Axial alignment of the implant for a screw-retained restoration was not possible in this situation because the implant body would not have allowed a good labial emergence profile for the restoration. Implant alignment for a screw-retained restoration would have resulted in labial overextension and darker supporting tissue due to the concave labial architecture. It would also have generated more apical dehiscence of the bone during implant placement, requiring in turn a larger bone graft. The restorative technique presented in this article, including the specific axial implant placement and related bone augmentation procedure (Fig. 2), allowed for optimal esthetics of the supporting tissues (Fig. 3) and proper emergence profile of the restoration (Fig. 4). The metal ceramic abutment was customized with Creation porcelain (Jensen Industries) to generate equi- and supragingival margins for the bonded porcelain suprastructure. Following careful intraoral evaluation and control of interproximal contacts, the fitting surfaces of the porcelain were prepared for adhesive

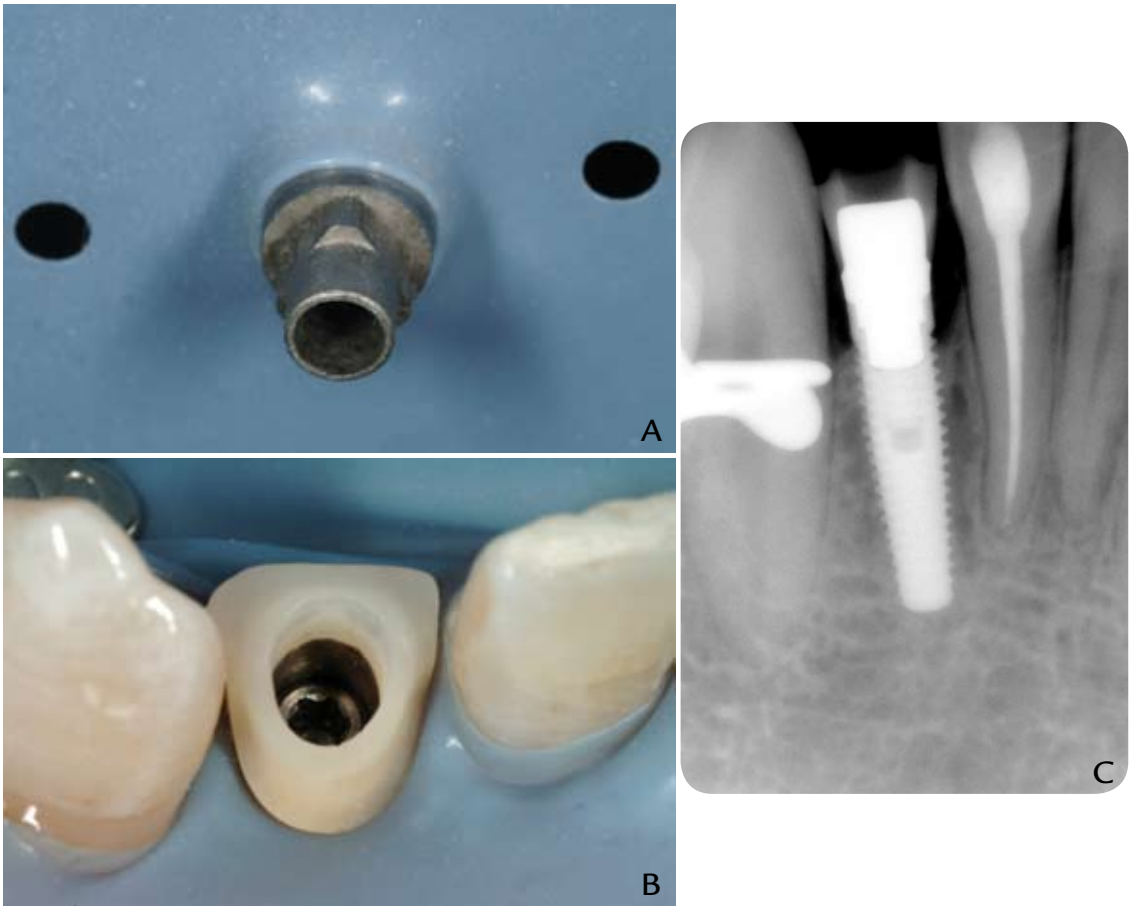


2 A, Optimal implant placement resulted in labial bone dehiscence. B, Simultaneous resorbable guided bone regeneration (GBR) procedure with 2-layer bone graft. C, Occlusal view demonstrates augmented edentulous space after GBR procedure.

3 Clinical intraoral situation just before transfer impression.

placement by etching with 9% hydrofluoric acid (Porcelain Etch; Ultradent Products Inc, South Jordan, Utah) for 90 seconds, and rinsing with water for 20 seconds. The etched surfaces were then subjected to postetching cleaning using a microbrush and 37.5% phosphoric acid (Ultra-Etch; Ultradent Products Inc) with a gentle brushing motion for 30 seconds, followed by rinsing with water for 20 seconds. Cleaning was completed by immersion in distilled water in an ultrasonic bath for 5 minutes. Following thorough oil-free air drying, the intaglio surfaces were then silanated (Silane; Ultradent Products Inc) and dried at 100°C for 5 minutes in an oven (DI-500; Coltene/Whaledent Inc, Cuyahoga Falls, Ohio). When bonding porcelain veneers, inlays, or onlays, the postetching cleaning[6,8-10] and heat drying of the silane[11-13] are essential to the porcelain resin bond strength. The previously described surface conditioning was applied to both the porcelain of the abutment and the veneer. Intraoral placement of the abutment and the corresponding veneer was achieved with the use of a

4 A, Restoration combining screw-retained gold abutment customized with feldspathic porcelain and feldspathic porcelain veneer; note optimal emergence profile of abutment due to proper implant alignment (sagittal view). B, Lingual view.



5 A, Following surface conditioning, apical portion of abutment was inserted through small hole into rubber dam and carefully placed into implant. B, Adjacent teeth were also engaged through rubber dam to provide optimal access for adhesive placement of veneer, and 35 Ncm torque was applied to abutment screw. C, Radiograph of abutment and implant.

6 Placement of porcelain veneer with preheated light-polymerizing restorative composite.

7 A, Facial view of restoration on mandibular right lateral incisor following rehydration. B, Detailed view showing optical characteristics and surface texture.

rubber dam to avoid any contamination of the fitting surfaces. The abutment was first inserted through a small hole into the rubber dam (Fig. 5, A), then placed intraorally and engaged into the implant for final insertion with 35 Ncm torque applied to the abutment screw (Fig. 5, B). The exact positioning of the abutment was controlled with a radiograph (Fig. 5, C). As is the case with crowns cemented to screw-retained abutments, a soft material (gutta-percha) was used to cover the abutment screw and fill part of the access opening. The previously etched and silanated porcelain surfaces were then coated with adhesive resin, and the veneer was finally inserted with a preheated, light-polymerizing restorative composite resin (Fig. 6). The definitive restoration displays optimal function and esthetics despite the limited interdental space (Fig. 7). The restoration has been in place for 5 months without complications.

SUMMARY

A new solution is described in which a clinical situation presenting limited restorative space, a subgingival implant shoulder, and interference of the screw-access channel with the incisal edge was approached using a screw-retained custom metal ceramic abutment combined with a bonded porcelain restoration.

REFERENCES

1. Chee W, Jivraj S. Screw versus cemented implant supported restorations. Br Dent J 2006;201:501-7.
2. Zarone F, Sorrentino R, Traini T, Di Iorio D, Caputi S. Fracture resistance of implant-supported screw- versus cement-retained porcelain fused to metal single crowns: SEM fractographic analysis. Dent Mater 2007;23:296-301.
3. Andreasen FM, Flugge E, Daugaard-Jensen J, Munksgaard EC. Treatment of crown fractured incisors with laminate veneer restorations. An experimental study. Endod Dent Traumatol 1992;8:30-5.
4. Walls AW. The use of adhesively retained all-porcelain veneers during the management of fractured and worn anterior teeth: Part 1. Clinical technique. Br Dent J. 1995;178:333-6.
5. Walls AW. The use of adhesively retained all-porcelain veneers during the management of fractured and worn anterior teeth: Part 2. Clinical results after 5 years of follow-up. Br Dent J 1995;178:337-40.
6. Magne P, Cascione D. Influence of post-etching cleaning and connecting porcelain on the microtensile bond strength of composite resin to feldspathic porcelain. J Prosthet Dent 2006;96:354-61.
7. Magne P, Perroud R, Hodges JS, Belser UC. Clinical performance of novel-design porcelain veneers for the recovery of coronal volume and length. Int J Periodontics Restorative Dent 2000;20:440-57.
8. Jones GE, Boksman L, McConnell RL. Effect of etching technique on the clinical performance of porcelain veneers. Quintessence Dent Technol 1986;10:635-7.
9. Peumans M, Van Meerbeek B, Yoshida

Y, Lambrechts P, Vanherle G. Porcelain veneers bonded to tooth structure: an ultra-morphological FE-SEM examination of the adhesive interface. Dent Mater 1999;15:105-19.
10. Canay S, Hersek N, Ertan A. Effect of different acid treatments on a porcelain surface. J Oral Rehabil 2001;28:95-101.
11. Roulet JF, Soderholm KJ, Longmate J. Effects of treatment and storage conditions on ceramic/composite bond strength. J Dent Res 1995;74:381-7.
12. Barghi N, Berry T, Chung K. Effects of timing and heat treatment of silanated porcelain on the bond strength. J Oral Rehabil 2000;27:407-12.
13. Shen C, Oh WS, Williams JR. Effect of post-silanization drying on the bond strength of composite to ceramic. J Prosthet Dent 2004;91:453-8.

Corresponding author:
Dr Pascal Magne
School of Dentistry, University of Southern California
3151 S. Hoover St, Suite E201
Los Angeles, CA 90089-7792
Fax: 213-821-5324
E-mail: magne@usc.edu