

# Predictable Outcomes with Porcelain Laminate Veneers: A Clinical Report

Welson Pimentel, DDS, MSc,<sup>1</sup> Marcelo Lucchesi Teixeira, DDS, MSc, PhD,<sup>2</sup> Priscila Paganini Costa, DDS, MSc, PhD,<sup>3</sup> Mônica Zacharias Jorge, DDS, MSc, PhD,<sup>4</sup> & Rodrigo Tiossi, DDS, MSc, PhD<sup>5</sup>

<sup>1</sup>Brazilian Dental Association-São Gonçalo Division (ABO-São Gonçalo), São Gonçalo, Rio de Janeiro, Brazil

<sup>2</sup>Department of Prosthodontics, São Leopoldo Mandic School of Dentistry, Campinas, São Paulo, Brazil

<sup>3</sup>Department of Oral Medicine and Pediatric Dentistry, School of Dentistry, State University of Londrina, Londrina, Paraná, Brazil

<sup>4</sup>Department of Prosthodontics, School of Dentistry, Fluminense Federal University, Niterói, Rio de Janeiro, Brazil

<sup>5</sup>Department of Restorative Dentistry, School of Dentistry, State University of Londrina, Londrina, Paraná, Brazil

The article is associated with the American College of Prosthodontists' journal-based continuing education program. It is accompanied by an online continuing education activity worth 1 credit. Please visit www.wileyhealthlearning.com/jopr to complete the activity and earn credit.

#### Keywords

Digital smile design; laminate veneers; dental prosthesis design; ceramics; dental esthetics.

#### Correspondence

Rodrigo Tiossi, Department of Restorative Dentistry, School of Dentistry, State University of Londrina, Rua Pernambuco, 540, Centro, Londrina, Paraná, Brazil. 86020-120. E-mail: rtiossi@uel.br.

Priscila Paganini Costa ORCID http://orcid.org/0000-0002-0250-5905.

Rodrigo Tiossi ORCID http://orcid.org/0000-0001-5781-9760.

The authors deny any conflicts of interest.

Accepted July 24, 2015

doi: 10.1111/jopr.12413

## Abstract

This clinical report describes how to achieve predictable outcomes for anterior teeth esthetic restorations with porcelain laminate veneers by associating the digital planning and design of the restoration with interim restorations. The previous digital smile design of the restoration eliminates the communication barrier with the patient and assists the clinician throughout patient treatment. Interim restorations (diagnostic mock-ups) further enhance communication with the patient and prevent unnecessary tooth reduction for conservative tooth preparation. Adequate communication between patient and clinician contributes to successful definitive restorations and patient satisfaction with the final esthetic outcome.

Patient expectations on the outcomes of esthetic restorations have increased. The early planning and design of dental restorations contribute to successful outcomes. Digital photography has improved the documentation of the intraoral condition and enables a quick demonstration of the diagnosed problems to the patient.<sup>1</sup> Digital dentistry also allows the previous digital design of a restoration, thus improving communication with the patient and treatment predictability.<sup>2</sup> A careful analysis of the patient facial and dental characteristics is possible using simple computer software tools.<sup>2</sup> The selection of the restorative option is also easier to achieve.<sup>2</sup>

Restoration of anterior teeth using a conservative approach allows clinicians to provide porcelain laminate veneers with excellent esthetics without extensive tooth structure removal.<sup>3</sup> Tooth preparation for porcelain veneers requires less tooth reduction compared to other restorative treatment options due to higher fracture strength when resin cement is bonded to enamel.<sup>4-7</sup> High survival rates with low failure rates have been found for porcelain veneers bonded to enamel.<sup>4,8,9</sup> The use of interim prostheses (diagnostic mock-ups) for tooth preparation further prevents unnecessary tooth reduction and potential preparation inaccuracies.<sup>4,10</sup> The interim prosthesis is another tool for objective communication between clinician, patient, and laboratory technician.<sup>10</sup>

This clinical report describes the association of the digital planning and design of restorations with the use of interim prostheses to provide a predictable outcome for anterior teeth esthetic restorations with porcelain laminate veneers.

# **Clinical report**

A healthy 29-year-old woman presented at the clinical practice complaining about the current esthetic appearance of her



Figure 1 Preoperative view.

anterior teeth and smile. Her main complaint was the asymmetry between maxillary incisors (both central and lateral) and presence of large gaps between the central and lateral incisors (Fig 1). Data collection and patient documentation were performed in the first two appointments. The patient was classified as class II according to the American College of Prosthodontists (ACP) classification system for completely dentate patients.<sup>10,11</sup>

The treatment strategy selected was the digital planning and design<sup>1,2</sup> of the anterior esthetic restoration of the four maxillary incisors. Digital planning and esthetic analysis were performed in specialized presentation software (Keynote for Mac; Apple Inc., Cupertino, CA). A photograph of the full face with a wide smile showing teeth was positioned behind horizontal (interpupillary line) and vertical (facial midline) reference lines (Fig 2).<sup>2</sup> Patient photographs were analyzed according to pre-



Figure 2 Digital esthetic design: full-face photograph with horizontal (interpupillary line) and vertical (facial midline) reference lines.









Figure 4 Calibrated virtual ruler to measure virtually drawn teeth.



Figure 5 Digital caliper to aid diagnostic cast wax-up.



Figure 6 Waxed diagnostic cast.

viously determined facial references. Size and proportions of the patient's maxillary incisors were then compared to ideal tooth dimensions described in the literature,<sup>2,12</sup> and the desired definitive tooth shapes were digitally drawn on an intraoral photograph of the patient (Fig 3).

A calibrated virtual ruler<sup>2</sup> measured the virtually drawn teeth (Fig 4), and a digital caliper aided waxing the diagnostic cast with similar dimensions (Figs 5, 6). It was detected that a conservative restoration would satisfy the esthetic needs of the patient, and thin porcelain laminate veneers were therefore suggested. Despite showing the virtual planning to the patient, interim prostheses (mock-up) were fabricated to provide better communication and visualization of the definitive restoration.

A silicone (Zetalabor; Zhermack SpA, Badia Polesine, Italy) impression of the diagnostic wax-up was made to fabricate a

Journal of Prosthodontics 25 (2016) 335–340 © 2015 by the American College of Prosthodontists



Figure 7 Silicone impression of diagnostic cast.



Figure 8 Silicone index for interim restorations (mock-ups).



Figure 9 Bis-acrylic resin insertion into silicone index.

silicone index (Figs 7, 8). Bis-acrylic resin (Luxatemp Automix Plus, DMG America, Englewood, NJ) was then inserted into the silicone index to transfer the diagnostic wax-up to interim prostheses in the patient (Figs 9–11). The interim prostheses allowed clinicians and patient to fully evaluate the suggested anatomy and esthetics for the definitive restorations (Fig 11) and were adjusted for optimized occlusion, phonetics, and esthetics. All needed modifications were performed at this time. After patient approval, all modifications were transferred to



Figure 10 Placement of silicone index with bis-acrylic resin.

the wax-up to assist the fabrication of the porcelain laminate veneers.

Analysis of the interim prostheses detected that little tooth preparation was needed for each laminate veneer, and a minimally invasive approach was performed for tooth preparation.<sup>13</sup> Predetermined depths were prepared with diamond rotary instruments (FG 3053 and FG 2134; KG Sorensen, Cotia, Brazil) according to the thickness required for each laminate veneer (Figs 12 and 13). Tooth preparation with the interim prostheses in place allowed a small amount of enamel tissue removal (0.3 to 0.5 mm for each tooth).<sup>13</sup> After complete removal of the interim prostheses, final preparation depth was concluded, and finishing procedures were performed using carbide finishing burs (FG 151Z; KG Sorensen). A silicone index was sectioned and used to evaluate achieved tooth reduction, throughout and after tooth preparation was finished (Fig 14).<sup>10</sup>

A single retraction cord (Ultrapak Cord #0; Ultradent Products, Inc., South Jordan, UT)<sup>14</sup> (Fig 15) was used for mechanical gingival displacement before impression with vinylpolysiloxane impression material (Express X; 3M Deutschland GmbH, Seefeld, Germany) (Fig 16). Laminates of lithium disilicate (IPS e.max; Ivoclar Vivadent, Schaan, Liechtenstein) were fabricated in the chosen tooth color (A1) (Fig 17). Function, form, and phonetics of the restorations were satisfactory, and the patient was satisfied with the final esthetic outcome (Figs 18–20). Occlusal adjustment was performed to achieve a mutually protected occlusion—vertical and horizontal overlaps were adequate after occlusal adjustment. No postoperative complications were detected after 1 year of the restorations in function. The patient remained satisfied with the 1-year esthetic and functional outcomes.

### Discussion

This clinical report described how to achieve a predictable outcome for anterior teeth esthetic restorations with porcelain laminate veneers. Specialized presentation software (Keynote for Mac) was used for the digital plan and design of esthetic restorations for the four maxillary incisors. The computer presentation used for the digital restoration design allowed objective communication with the patient and assisted the clinician throughout patient treatment. The use of patient photographs for the



Figure 11 Evaluation of suggested anatomy and esthetics for definitive restorations.



Figure 12 Tooth preparation (incisal edge reduction).

virtual esthetic plan allowed direct and effective feedback from the patient to immediately modify the esthetic and prosthetic planning, thus satisfying esthetic expectations of the patient when possible.<sup>15</sup> Reference lines and tooth shapes placed over the patient's photographs—and the association between the two—also improved visualization of possible limitations and risk factors, allowing an esthetic preview of the restorations.<sup>2</sup>

The dental laboratory will later transfer the virtual restoration design and patient preferences and suggestions (if any) to dental casts for the diagnostic wax-up.<sup>15</sup> Interim restorations (diagnostic mock-ups) are fabricated based on the diagnostic wax-up to further improve visualization of the digital restoration design. An experienced dental technician transferred the virtually designed restoration to the dental casts. Despite the dental technician's experience, transfer errors are expected.



Figure 13 Tooth preparation (buccal surface reduction).



Figure 14 Silicone index to evaluate tooth reduction.



Figure 15 Retraction cords in place.

This is a limitation of the described technique. Some minor transfer errors were found in the diagnostic wax-ups and mock-ups in the present clinical report—the four incisors were a little canted toward the patient's right side, which led to a slightly longer left central incisor (Figs 6, 11). As seen in the patient's photographs, minor adjustments were performed, and all in-accuracies were corrected in the definitive restorations (Figs 18–20).

After patient and clinician approval of the digitally designed restoration, a conservative tooth preparation was performed. Enamel preservation and careful treatment planning are considered two of the most important factors to achieve clinical success in laminate veneers.<sup>16</sup> Excessive tooth preparation



Figure 16 Vinylpolysiloxane impression of maxillary arch.



Figure 19 Patient smile with definitive restorations.



Figure 17 Laminates of lithium disilicate.



Figure 18 Intraoral view of definitive restorations.

may lead to dentin exposure and reduce the long-term clinical success of the restoration.<sup>16</sup> This study used the interim prostheses to guide tooth preparation, thus allowing optimized enamel preservation and minimum tooth preparation.

Incorrect treatment planning and microleakage at the tooth/porcelain margin are contributing factors for the early



Figure 20 Full-face photograph showing patient satisfaction.

esthetic failure of porcelain laminate restorations.<sup>4</sup> Fracture and debonding are common failures influenced by occlusal factors and features related to the tooth/cement/ceramic interface.<sup>4</sup> Strength of ceramic laminates directly influences the long-term success of the restoration. Despite having less flexural strength, feldspathic ceramics can be stratified in different layers and thicknesses.<sup>13</sup> Lithium disilicate ceramics have greater flexural strength and can be machined and dry-pressed, and receive stratified ceramic coverings.<sup>13</sup> Both previously described materials can be successfully used for porcelain laminate veneer fabrication<sup>13</sup>—this study selected lithium disilicate ceramics for the restorations.

# Conclusion

Digital restoration design delivers objective communication with the patient and assists the clinician throughout patient treatment. Interim restorations (diagnostic mock-ups) allow the evaluation of the suggested anatomy and esthetics for the definitive restorations and assistance for optimized tooth preparation. Adequate communication between patient and clinician contributes to successful definitive restorations and for patient satisfaction with the final esthetic outcome.

## References

- 1. McLaren EA, Garber DA, Figueira J: The Photoshop Smile Design technique (part 1): digital dental photography. Compend Contin Educ Dent 2013;34:772, 774, 776 passim
- Coachman C, Calamita M: Digital Smile Design: a tool for treatment planning and communication in esthetic dentistry. Quintessence Dent Technol 2012;35:103-111
- Reshad M, Geller W, Cascione D: An ultraconservative approach to porcelain veneers in the 21st century. Quintessence Dent Technol 2011;34:193-199
- Gurel G, Sesma N, Calamita MA, et al: Influence of enamel preservation on failure rates of porcelain laminate veneers. Int J Periodontics Restorative Dent 2013;33:31-39
- Edelhoff D, Sorensen JA: Tooth structure removal associated with various preparation designs for anterior teeth. J Prosthet Dent 2002;87:503-509
- Piemjai M, Arksornnukit M: Compressive fracture resistance of porcelain laminates bonded to enamel or dentin with four adhesive systems. J Prosthodont 2007;16:457-464

- 7. Peumans M, Van Meerbeek B, Lambrechts P, et al: Porcelain veneers: a review of the literature. J Dent 2000;28:163-177
- Cotert HS, Dundar M, Ozturk B: The effect of various preparation designs on the survival of porcelain laminate veneers. J Adhes Dent 2009;11:405-411
- 9. Sadowsky SJ: An overview of treatment considerations for esthetic restorations: a review of the literature. J Prosthet Dent 2006;96:433-442
- Reshad M, Cascione D, Magne P: Diagnostic mock-ups as an objective tool for predictable outcomes with porcelain laminate veneers in esthetically demanding patients: a clinical report. J Prosthet Dent 2008;99:333-339
- McGarry TJ, Nimmo A, Skiba JF, et al: Classification system for the completely dentate patient. J Prosthodont 2004;13:73-82
- Gurel G (ed): The Science and Art of Porcelain Laminate Veneers, Vol 1 (ed 1). Chicago, Quintessence, 2003, p. 528
- Coachman C, Gurel G, Calamita M, et al: The influence of tooth color on preparation design for laminate veneers from a minimally invasive perspective: case report. Int J Periodontics Restorative Dent 2014;34:453-459
- 14. Donovan TE, Chee WW: Current concepts in gingival displacement. Dent Clin North Am 2004;48:433-444
- 15. Lin WS, Zandinejad A, Metz MJ, et al: Predictable restorative work flow for computer-aided design/computer-aided manufacture-fabricated ceramic veneers utilizing a virtual smile design principle. Oper Dent 2015;40:357-363
- De Andrade OS, Hirata R, Celestrino M, et al: Ultimate ceramic veneer: a laboratory-guided preparation technique for minimally invasive laminate veneers. J Calif Dent Assoc 2012;40: 489-494