©Operative Dentistry, 2023, 48-6, 618-626

Printed Digital Wax-up Model as a Blueprint for Layered Pressed-ceramic Laminate Veneers: Technique Description and Case Report

CA Jurado • J Villalobos-Tinoco • S Mekled • R Sanchez • KI Afrashtehfar

Clinical Relevance

A printed diagnostic model based on a digital wax-up can serve as the blueprint for fabricating highly esthetic hand-crafted ceramic veneers. Proper guides and techniques based on the digitally designed model can provide the dimensions and contours needed for artistic, conventional, layered, pressed-ceramic veneers.

SUMMARY

This article presents a clinical technique for transferring Digital Smile Design (DSD) information and a digital wax-up to fabricate highly personalized ceramic laminate veneers. The hybrid workflow of digitally designed wax-up and conventional hand-crafted veneers is showcased in a female adult who sought to improve her smile due to maxillary anterior incisal wear. The ceramic veneers, layered by feldspathic porcelain, followed the contours and shade blueprint planned with the digital wax-up. The DSD improved the harmony of the facial-and-smile relationship, and the ceramic restorations fulfilled the patient's esthetic and functional demands. Guides based on the printed model with the digitally designed wax-up can provide a reference for pressed lithium disilicate veneers layered with feldspathic porcelain.

Carlos Alberto Jurado, DDS, MS, associate professor, Department of Prosthodontics, The University of Iowa College of Dentistry and Dental Clinics, Iowa City, Iowa, USA

Jose Villalobos-Tinoco, DDS, MS, visiting faculty, Specialty Program in Periodontics, National University of Rosario School of Dentistry, Rosario, Argentina

Salwa Mekled, DDS, MBA, associate professor, Department of Restorative Dentistry, Temple University Kornberg School of Dentistry, Philadelphia, PA, USA

Ramon Sanchez, MDT, dental technician, private practice, San Felipe, BC, Mexico

*Kelvin I. Afrashtehfar, DDS, MSc, Dr, FDS RCS, FRCDC, assistant professor, Division of Restorative Dental Sciences, Clinical Sciences Department, College of Dentistry, Ajman University, AE, UAE; adjunct research associate professor, Department of Reconstructive Dentistry and Gerodontology, School of Dental Medicine, University of Bern, BE, Switzerland

*Corresponding author: Freiburgstrasse 7, 3010 Berne, BE, Switzerland; e-mail: Kelvin.Afrashtehfar@unibe.ch

http://doi.org/10.2341/22-144-S

INTRODUCTION

More patients are seeking esthetic dental care to improve their smiles, and laminate veneer restorations have become the ideal treatment in many clinical scenarios.[1-4] Previously, full-coverage restorations (ie, single crowns) were the preferred choice for esthetic dental care.[5] However, veneer restorations are a more conservative approach since they remove only between 25% to 50% of the tooth structure compared to traditional single crowns.[6] Conservative laminate veneer preparations are recommended as they can preserve more of the tooth structure, allowing for retreatment if necessary in the future in case of failure or secondary caries.[7] Proper tooth preparation is crucial in providing adequate clearance for the necessary thickness of the final veneer without disrupting periodontal health.[8] Bonding techniques can be maximized on enamel structure; thus, conservative preparations are recommended to be in enamel or with as minimal dentin exposure as possible.[9-12]

In recent years, digital dentistry has been advancing rapidly, with new clinical and laboratory techniques leading the way.[13,14] Novel technologies aim to manufacture restorations more easily, quickly, and accurately to meet patients' demands.[15,16] Additionally, patients have shown preference for digital workflows over conventional techniques.[16,17] Digital workflows can be fully digital or a combination of traditional and novel techniques.[18,19] Diagnostic wax-up is an essential step for fully and partially digital workflows as it minimizes the chance of error and reduces working time.[20] DSD is another novel tool that aids in personalized planning of restorations in the esthetic zone, creating harmony between face and smile. Its information is compatible with the designed intraoral wax-up of all dentition to be treated.[21-24]

Conventional hand-crafted veneer restorations have shown very high esthetic results that meet both patient and clinician demands.[25-27] A wide range of ceramics, including feldspathic porcelain, leucite, lithium disilicate, and a combination of these materials, can be used to fabricate laminate veneers.[28,29] Traditional veneer fabrication techniques allow for the creation of ultrathin restorations with a thickness of 0.1 to 0.3 mm, minimizing or eliminating the need for tooth preparation.[30-33] Lithium disilicate is a glass-ceramic material that has shown a high survival rate in medium-term studies, with up to 98.7% survival rate at a 3-year follow-up.[34] A recent study reported long-term survival of pressable lithium disilicate restorations, with only a 0.2% failure rate after ten years from placement.[35] However, there are no reports describing how to transfer the digital wax-up design to fabricate traditional hand-crafted veneer restorations. Therefore, the present report describes a hybrid technique for transferring the information from DSD and printed diagnostic wax-up models with putty guides for fabricating traditional hand-made pressed lithium disilicate veneers.

CLINICAL CASE REPORT

A 30-year-old female patient presented to the clinic with the chief complaint of "I do not like my smile, and I want porcelain veneers" (Figure 1). The patient reported being unsatisfied with previous resin composite veneers (maxillary right first premolar to the left first premolar) which had been removed. Following the removal of her resin composite veneers, inflamed gingival tissue was observed around her anterior teeth due to overcontouring and plaque accumulation.

The clinical examination revealed incisal wear from maxillary canine to canine, as well as gingival inflammation from the right first premolar to the left first premolar. The smile evaluation revealed that the patient's wide smile displayed from the right second to the left second premolar. Considering the patient's high esthetic demands, a DSD was proposed, followed by a digital wax-up to provide a diagnostic mock-up for veneers from the right second premolar to the left second premolar. This process aimed to visualize the proposed restorations and evaluate if they could fulfill the patient's desires for her smile, thus ensuring the predictability of the restorative treatment.

The dental team took extra- and intraoral photos to obtain the data required for the DSD (Figures 2 and 3), followed by a digital wax-up to design the proposed shape of the restorations. The team designed the wax-up models digitally using DentalCAD, (Exocad, Darmstadt, Germany), and printed the initial and wax-up models using dental printer resin (Phrozen Aqua Ivory Printer Resin, Phrozen Technology, Hsinchu City, Taiwan) with a Sonic Mini printer (Phrozen Sonic Mini, Phrozen Technology) (Figure 4). Facebow records and printed models were mounted on a semi-

Figure 1. *Frontal initial situation. A) Face smiling. B) Extraoral close-up. C) Intraoral view of maxillary arch.*

Figure 2. *Frontal view of digital smile design evaluation to initial smile. A) Full face view smiling. B) Cheek and lip retraction to obtain intraoral images. C) Tooth lengths and proportions assessment.*

adjustable articulator (Artex CR Amann, Girrbach, Koblach, Austria). The patient approved the proposed restorations, and the dental team initiated the treatment. The patient was informed that the procedure would involve minimally invasive tooth preparation over the diagnostic mock-up followed by the placement of the pressed lithium disilicate veneers.

A transparent polyvinyl siloxane matrix (Exaclear, GC Corporation, Tokyo, Japan) was fabricated based on the printed wax-up model using a pressure pot (Aquapres, Lang Dental Manufacturing Co, Wheeling, IL, USA), under 30 pounds per square inch (psi) for 5 minutes. The clear matrix was removed from the pressure pot and cleaned, and access holes were made on the incisal edge of each tooth to inject flowable composite. The clear matrix fabricated from the mock-up was placed in the mouth and red resin was injected (ID-Pattern LC Implant Resin, ID Dentistry, Gwangju, Korea). This red resin allowed the clinician to differentiate the tooth structure from the red resin material to minimize the amount of tooth structure removal. Conservative veneer preparations were made with horizontal and incisal reduction grooves, and the reduction was measured with periodontal probing (Figure 5). The final tooth preparations were finished with polishing discs (Sof-Lex XT Disc, 3M Oral Care, St Paul, MN, USA). Retraction cords #000 and #1

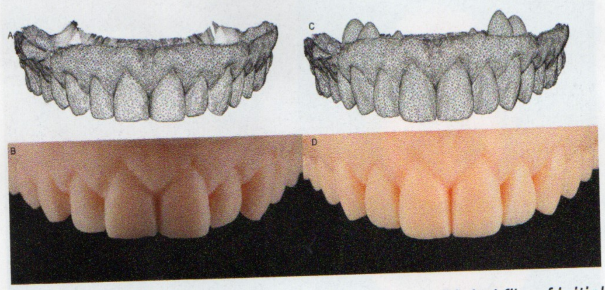

Figure 4. *Digital design and printed models. A) Digital file of initial situation. B) Printed model of initial situation. C) Digital wax-up design. D) Printed digital wax-up.*

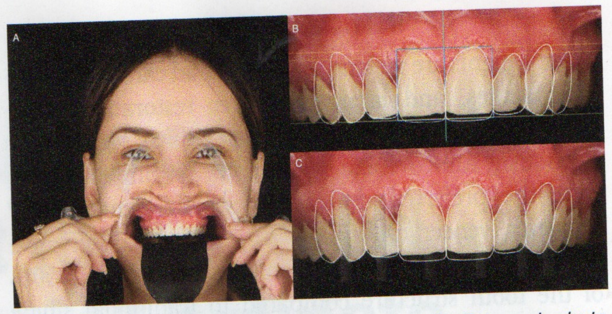

Figure 3. *Digital smile design evaluation. A) Extraoral photo displaying maxillary anterior teeth. B) Teeth contours designed with ideal measurements. C) Use of digital ruler to obtain the desired teeth length.*

(Ultrapak, Ultradent, South Jordan, UT, USA) were placed with 25% aluminum chloride hemostatic agent (ViscoStat Clear, Ultradent). The final impression was made using polyvinyl siloxane impression material in heavy-body and light-body consistency (Elite HD+, Zhermack, Badia Polesine, Italy) (Figure 6). Provisional restorations (Structur Premium, VOCO GmbH, Cuxhaven, Germany) were fabricated directly in the mouth with the same guide as the approved diagnostic mock-up. Then, phonetics, esthetics, lip support, and static and dynamic occlusion were evaluated. The patient was satisfied with these restorations (Figure 7).

Putty guides were fabricated using condensation silicone (Zetalabor, Zhermack) based on the digital wax-up and were used to create hand-made veneer restorations. The facial and lingual putty guides were evaluated in the master cast. The printed wax-up model and wax-up (Blue Consequent Universal Wax, Yeti Dental GmbH, Engen, Germany) were first placed through the lingual aspect at high temperature. Then

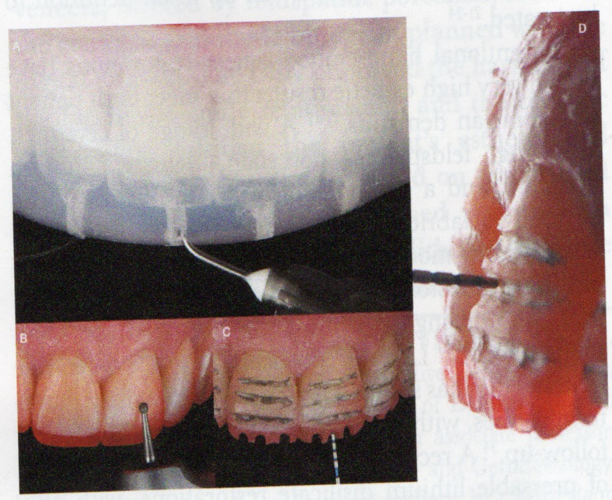

Figure 5. *Conservative tooth preparations aided by injected composite mock-up. A) Injected flowable composite for mock-up. B) Intraoral mock-up. C) Frontal view horizontal and incisal reduction grooves. D) Lateral view of horizontal and incisal reduction grooves.*

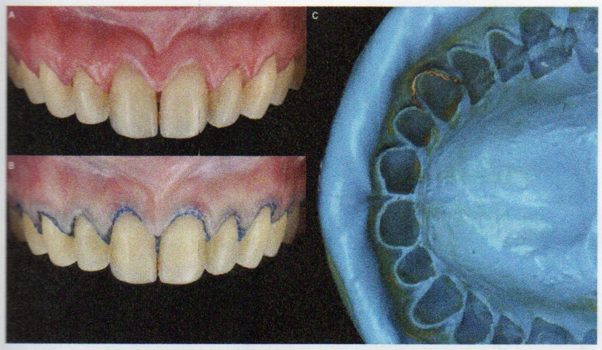

Figure 6. *Teeth preparation phase. A) Final conservative tooth preparations. B) Cord packing for gingival retraction. C) Final polyvinyl siloxane impression.*

Figure 7. *Frontal view of provisional restorations. A) Face smiling. B) Extraoral close-up. C) Intraoral view of maxillary arch.*

the wax was sculpted at regular temperature until the anatomy followed the putty guides (Figures 8 and 9). The final wax-up was pressed to create lithium disilicate (IPS e.max Press, Ivoclar Vivadent, Schaan, Liechtenstein) ceramic laminate veneers (Figure 10). The pressed veneers were placed on a master cast, and the incisal edge was removed to allow for the placement of layered feldspathic ceramics to improve opalescence (Opal Effect 1 and Opal Effect 2, IPS e.max Ceram, Ivoclar Vivadent) following the shape of the putty guide made on the digital wax-up (Figure 11). The final pressed lithium disilicate veneers were tried in the master cast to inspect their shape, contours, and translucency with white and dark backgrounds (Figure 12). The result satisfied both the technician and clinician.

A dry try-in of the restoration was performed to evaluate the veneer margins adaptation, and the patient and clinician approved. Subsequently, a try-in with paste was conducted to evaluate the final shade. The intaglio surface of the veneers was treated first with 5% hydrofluoric acid (IPS Ceramic Etching Gel, Ivoclar Vivadent) for 20 seconds, rinsed, and air-dried. Then, 37% phosphoric acid (Total Etch, Ivoclar Vivadent) was applied for 60 seconds, rinsed, and air-dried. Silane (Monobond Plus, Ivoclar Vivadent) was applied for 60 seconds and then air-dried. Adhesive (Adhesive Optibond FL, Kerr, Orange, CA, USA) was applied, and excess was removed with light air-spraying. Total isolation was achieved by placing a rubber dam (Flexi Dam, Coltene, Altstatten, Switzerland) from the right first molar to the left first molar and retained with plastic clamps (Soft Clamp, Kerr). The tooth surfaces were air-abraded with 29-micron aluminum oxide particles at 2 bar/100 psi pressure (AquaCare Aluminum Oxide Air Abrasion Powder, Velopex, London, UK). Phosphoric acid application as a post-etching cleaning method eliminates surface corrosion induced by residual subproducts of hydrofluoric acid. This crucial step prevents the development of an opaque appearance on ceramic surfaces, preserving optimal bonding to the cement during the bonding

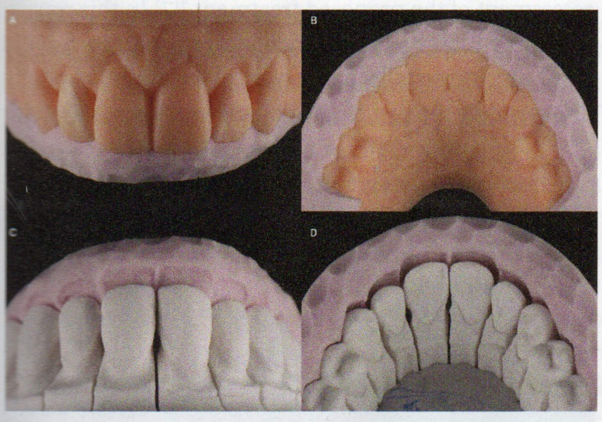

Figure 8. *Putty guides fabrication and master cast relation. A) Facial view of putty guide on printed digital wax-up model. B) Lingual view of putty guide on printed digital wax-up model. C) Facial view of putty guide on master cast. D) Lingual view of putty guide on master cast.*

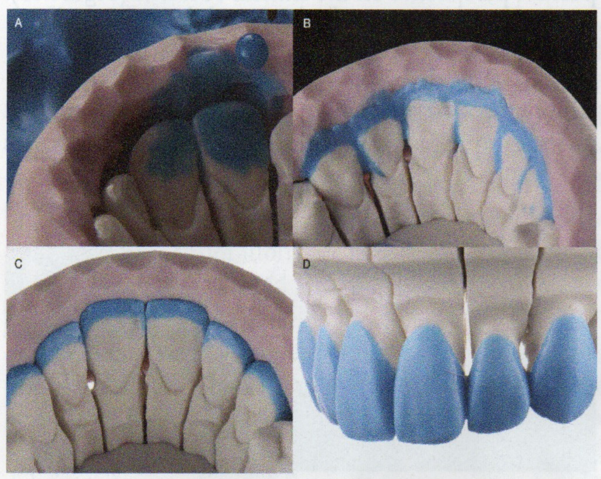

Figure 9. *Waxing up of dies with putty guides. A) Initiating the wax-up with buccal guide. B) Completion of wax-up. C) Individualization of wax-up. D) Frontolateral view of final wax-up for pressable ceramic veneers.*

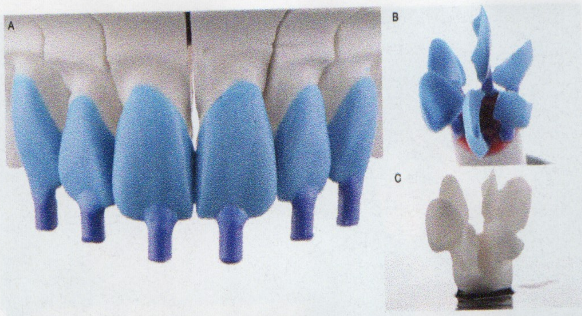

Figure 10. *From wax-up to ceramics. A) Wax-up for pressable veneers. B) Wax ready to be pressed. C) Pressed ceramic veneers.*

process.[36-38] The prepared surfaces of the teeth were then etched with 37.5% phosphoric acid (Gel Etchant, Kerr) for 15 seconds, followed by water rinsing and air-drying. Any excess primer (Primer Optibond FL, Kerr) was gently removed after application, and adhesive (Adhesive Optibond FL, Kerr) was applied according to the manufacturer's recommendations.

Restorations were bonded with a light shade of resin cement (Variolink Esthetic LC, Ivoclar Vivadent). Excess was removed, and each of the bonded restorations was light cured on the facial surface for 20 seconds and interproximally flossed to remove excess cement. The restorations were then cured for another 20 seconds on the palatal, mesial, and distal surfaces. Finally, the oxygen inhibition technique was used by placing glycerin gel (Liquid Strip, Ivoclar Vivadent) to the ceramic surface and light curing it for 20 seconds at the gingival margin area (Figure 13). The patient approved of the final restoration's shape, size, and shade (Figure 14), which fulfilled her esthetic and functional demands. An occlusal night guard was provided to prevent damage to the restorations. At the 5-year follow-up appointment, the patient still had a positive perspective on the clinical outcome (Figure 15).

DISCUSSION

This report describes a hybrid technique workflow used to improve a patient's smile. The technique involves

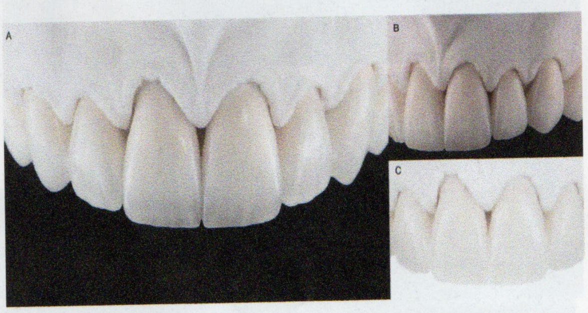

Figure 12. *Evaluation of layered pressed lithium disilicate on master cast. A) Frontal view with black background. B) Lateral view with black background. C) Frontal view with white background.*

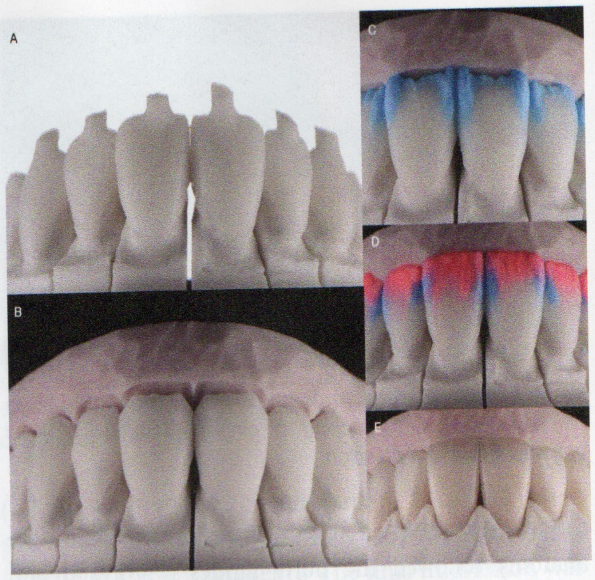

Figure 11. *Layered feldspathic porcelain on pressed lithium disilicate cut-back assisted by lingual putty guide. A) Pressed ceramic on master cast. B) Incisal edge cutback. C) Blue opalescent effect layer. D) Pink opalescent effect layer. D) Final glazed restorations.*

transferring information obtained from the DSD and digital wax-up to manufacture highly esthetic ceramic veneers using traditional hand-crafting methods. DSD is a digital model that helps the clinician and patient create a new proposed smile with simulation and pre-visualization before any invasive treatment.[39] DSD improves communication between patient and technician, supports diagnostic evaluation, and enhances treatment predictability by analyzing the characteristics of the smile and face with a clinical photographic protocol.[40]

The literature contains an extensive number of publications using the DSD for simple and complex full-mouth reconstruction because it provides a visual assessment of the proposed treatment.[41-43] In this report, clinicians took extraoral and intraoral photos for the DSD, and the smile frame was altered after digitally drawing over the pictures to enhance each tooth's length

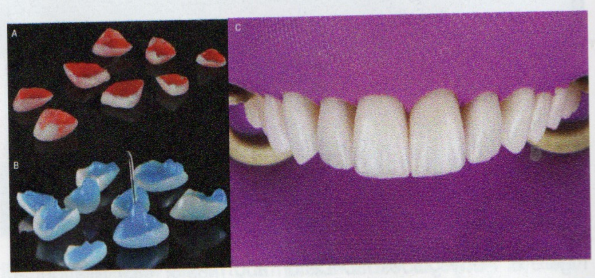

Figure 13. *Treatment and bonding of the laminate veneers. A) Hydrofluoric acid treatment to intaglio surface. B) Phosphoric acid treatment to intaglio surface. C) Veneers bonded under complete isolation with rubber dam.*

Figure 14. *Frontal view of delivered final restorations. A) Intraoral view of maxillary arch. B) Extraoral close-up. C) Face smiling.*

and shape. The patient presented stable occlusion with no interferences during lateral and protrusive movement, so no treatment in the posterior dentition was required. The patient approved the proposed shape of the new restorations after being shown the DSD. The DSD has also been shown to be essential to increase patient acceptance of dental care.[41] However, this novel tool is not mandatory; traditional techniques such as physical waxing and mock-ups can also help with patient acceptance, and the authors also recommend the use of DSD as an auxiliary tool for dental care.

Digital wax-up is a procedure in which the proposed restorations' new shape is provided. The proposed restorations are based on the patient's smile line and occlusion to fulfill the patient's esthetic and functional demands.[42] This step allows the operator to modify the restoration's shape, outline, and color before irreversibly altering the tooth structure.[43] A recent study compared the accuracy of three-dimensional (3D) printed casts, digital, and conventional casts, and found that 3D-printed casts showed clinically acceptable accuracy.[44] Therefore, they may be considered a substitute for stone casts for diagnosis, treatment planning, and fabrication of prosthetic restorations.[44] In the present report, the digital wax-up provided the new dimensions of the proposed restorations based on the DSD and the digital evaluation of occlusion. Initially, the length of the teeth was measured in the diagnostic model, and those measurements were incremented to obtain a width to length ratio of 85% for central incisors, 79% for lateral incisors, and 83% for canines, as recommended by Duarte Jr and others.[45] The incremented length was introduced in the DSD, and the diagnostic model was printed out. The authors acknowledged the dynamic guidelines for determining the length of incisors based on the correlation between the patient's protrusive record and speech position (eg, /s/ sound, average closest speaking space values) with adequate vertical and horizontal overlap.[46-48] Additionally, during the phonetic evaluation, the patient was asked to make

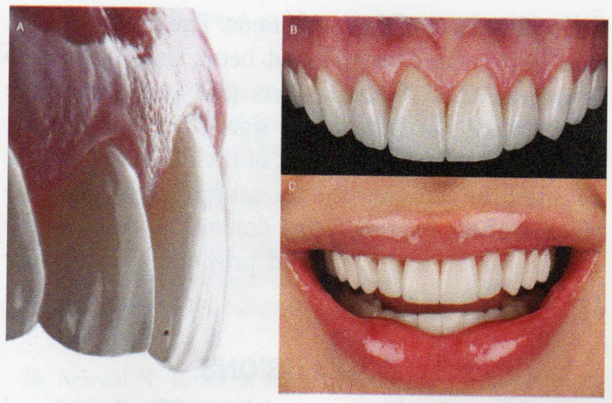

Figure 15. *Five-year follow-up images. A) Lateral view of maxillary anterior close-up. B) Intraoral view of maxillary arch. C) Extraoral smile close-up.*

labiodental sounds (ie, "f," "v" and "ph"), which assisted in determining the anteroposterior position of the maxillary anterior incisal edge. Hence, the incisal edge position was determined by occlusion, phonetics, and esthetics, which help in placing anterior teeth for more enduring success.[22,26,45,47,48]

Ceramic laminate veneers have shown excellent esthetic results that satisfy patient demands. Clinicians can fabricate them with CAD/CAM technology or traditional techniques, and both are clinically acceptable.[45,49,50] However, some studies show preference for traditional hand-crafted veneer restorations. A recent retrospective study evaluating the color match, marginal discoloration, marginal adaptation roughness, and wear of 358 lithium disilicate veneers placed in patients with fluorosis have shown a 99.7% survival rate at ten years' follow-up.[51] This may encourage us to consider traditional pressable lithium disilicate in patients with high esthetic demands such as advanced fluorosis. Recent studies evaluated the marginal accuracy, microleakage, and internal adaptation of ceramic restorations and concluded that pressable veneers produced superior marginal adaptation compared to machinable/milled veneers.[52,53] Moreover, some studies evaluated the marginal adaptation of traditional press and novel techniques, and the results favored the traditionally manufactured restorations. A recent study evaluated the fit accuracy of pressed and milled inlay restorations based on conventional or digital CAD/CAM impressions. The study evaluated molar mesio-occlusal restorations and found significant differences between groups, with the pressed ceramic restoration having a smaller marginal gap (37.4 μm) than the CAD/CAM fabricated restoration (69.2 μm).[54] Another recent study evaluated the marginal adaptation of heat-pressed and CAD/CAM veneers using a 40× microscope at three different locations in the margin and nine for the internal surfaces of the restorations. The results showed that heat-pressed veneers had better adaptation (295 μm) than CAD/CAM veneers (314 μm), but those values were not statistically significant.[55] Therefore, the evidence-based treatment of the described patient consisted of conventional pressable lithium disilicate veneers where the restoration dimensions followed the digital wax-up and DSD and provided a satisfactory result for the patient.

CONCLUSIONS

Hybrid workflows that combine smile design and digitally designed wax-up with conventional pressable veneers provide the best of both worlds: high digital accuracy and hand-made esthetic results. Guides based on the printed diagnostic wax-up can aid the technician in waxing the pressed ceramic veneers following the desired digitally designed contours.

Regulatory Statement

This study was conducted in accordance with all the provisions of the local human subjects oversight committee guidelines and policies of the University of Iowa and Ajman University.

Conflict of Interest

The authors of this article certify that they have no proprietary, financial, or other personal interest of any nature or kind in any product, service, and/or company that is presented in this article.

(*Accepted 17 June 2023*)

REFERENCES

1. Jurado C, Watanabe H, Tinoco JV, Valenzuela HU, Perez GG, & Tsujimoto A (2020) A conservative approach to ceramic veneers: A case report *Operative Dentistry* **45**(3) 229-234.

2. Calamia JR & Calamia CS. (2007) Porcelain laminate veneers: Reasons for 25 years of success *Dental Clinics of North America* **51**(2) 399-417.

3. Touyz LZ, Raviv E, & Harel-Raviv M (1999) Cosmetic or esthetic dentistry? *Quintessence International* **30**(4) 227-233.

4. Afrashtehfar KI & Assery MK (2014) Five considerations in cosmetic and esthetic dentistry *Journal of the New Jersey Dental Association* **85**(4) 14-15.

5. Meyenberg KH (1995) Modified porcelain-fused-to-metal restorations and porcelain laminates for anterior aesthetics *Practical Periodontics and Aesthetic Dentistry* **7**(7) 33-44.

6. Edelhoff D & Sorensen JA (2002) Tooth structure removal associated with various preparation designs for anterior teeth *Journal of Prosthetic Dentistry* **87**(5) 503-509.

7. Holm C, Tidehag P, Tillberg A, & Molin M (2003) Longevity and quality of FDPs: A retrospective study of restoration, 30, 20 and 10 years after insertion *International Journal of Prosthodontics* **16**(3) 283-289.

8. Yuodelis R & Faucher R (1980) Provisional restorations: An integrated approach to periodontics and restorative dentistry *Dental Clinics of North America* **24**(2) 285-303.

9. Horn HR (1983) Porcelain laminate veneers bonded to etched enamel *Dental Clinics of North America* **27**(4) 671-684.

10. Jurado CA, Fischer NG, Mourad F, Villalobos-Tinoco J, & Tsujimoto A (2020) Conservative ultrathin veneer restorations with minimal reduction: A 5-year follow-up report *Journal of Contemporary Dental Practice* **21**(11) 1293-1297.

11. Van Meerbeek B, Vanherle G, Lambrechts P, & Braem M (1992) Dentin- and enamel-bonding agents *Current Opinion in Dentistry* **2** 117-127.

12. Dumfahrt H & Schaffer H (2000) Porcelain laminate veneers. A retrospective evaluation after 1 to 10 years of service: Part II – Clinical results *International Journal of Prosthodontics* **13**(1) 9-18.

13. Li RW, Chow TW, & Matinlinna JP (2014) Ceramic dental biomaterials and CAD/CAM technology: State of the art *Journal of Prosthodontic Research* **58**(4) 208-216.

14. Jurado CA, Tsujimoto A, Tanaka K, Watanabe H, Fischer NG, Barkmeier WW, Takamizawa T, Latta MA, & Miyazaki M (2019) 3D printed coping for intraoral evaluation: A clinical report *Quintessence International* **50**(7) 534-538.

15. Afrashtehfar KI (2021) Conventional free-hand, dynamic navigation and static guided implant surgery produce similar short-term patient-reported outcome measures and experiences *Evidence Based Dentistry* **22**(4) 143-145.

16. Jurado CA, Lederman R, Cohen J, & Tsujimoto A (2021) Intraoral scanning with rubber dam isolation in place for fabrication of a chairside computer-assisted design and computer-assisted manufacture ceramic restoration *Journal of Contemporary Dental Practice* **22**(8) 943-946.

17. Sivaramakrishnan G, Alsobaiei M, & Sridharan K (2020) Patient preference and operating time for digital versus conventional impressions: A network meta-analysis *Australian Dental Journal* **65**(1) 58-69.

18. Hasanzade M, Aminikhah M, Afrashtehfar KI, & Alikhasi (2021) Marginal and internal adaptation of single crowns and fixed dental prostheses by using digital and conventional workflows: A systematic review and meta-analysis *Journal of Prosthetic Dentistry* **126**(3) 360-368.

19. Afrashtehfar KI, Jurado CA, & Moshaverinia A (2022) Dynamic navigation may be used for most implant surgery scenarios due to its satisfactory accuracy *Journal of Evidence-Based Dental Practice* **22**(4) 101797.

20. Cattoni F, Teté G, Calloni AM, Manazza F, Gastaldi G, & Capparè P (2019) Milled versus moulded mock-ups based on the superimposition of 3D meshes from digital oral impressions: A comparative *in vitro* study in the aesthetic area *BMC Oral Health* **19**(1) 230.

21. Coachman C, Calamita MA, & Sesma N (2017) Dynamic documentation of the smile and the 2D/3D digital smile design

process *International Journal of Periodontics and Restorative Dentistry* **37(2)** 183-193.

22. Alikhasi M, Yousefi P, & Afrashtehfar KI (2022) Smile design: Mechanical considerations *Dental Clinics of North America* **66(3)** 477-487.

23. Parize H, Coachman C, Salama M, Sesma N, & Bohner L (2022) Three-dimensional (3D) facially driven workflow for anterior ridge defect evaluation: A treatment concept *Journal of Oral Implantology* 2022 **48(4)** 332-338.

24. Yang JW, Liu Q, Yue ZG, Hou JX, & Afrashtehfar KI (2021) Placement using a stackable surgical guide fabricated using SLM technology *Journal of Prosthodontics* **30(8)** 645-650.

25. Jurado CA, Parachuru V, Villalobos Tinoco J, Guzman-Perez G, Tsujimoto A, Javvadi R, & Afrashtehfar KI (2022) Diagnostic mock-up as a surgical reduction guide for crown lengthening: Technique description and case report *Medicina* (Kaunas) **58(10)** 1360.

26. Del Monte S, Afrashtehfar KI, Emami E, Abi Nader S, & Tamimi F (2017) Lay preferences for dentogingival esthetic parameters: A systematic review *Journal of Prosthetic Dentistry* **118(6)** 717-724.

27. Krump M & Krumpova Z (2022) Esthetic rehabilitation of anterior dentition with different types of ceramic restorations: Two case reports *European Journal of Dentistry* **16(1)** 234-239.

28. Lang SA & Starr CB (1992) Castable ceramics for veneer restorations *Journal of Prosthetic Dentistry* **67(5)**:590-594. doi: 10.1016/0022-3913(92)90152-z. PMID: 1527738

29. Soares PV, Spini PH, Carvalho VF, Souza PG, Gonzaga RC, Tolentino AB, & Machado AC (2014) Esthetic rehabilitation with laminated ceramic veneers reinforced by lithium disilicate *Quintessence International* **45(2)** 129-133.

30. Farias-Neto A, Gomes EM, Sánchez-Ayala A, Sánchez-Ayala A, & Vilanova LS (2015) Esthetic rehabilitation of the smile with no-prep porcelain laminates and partial veneers *Case Reports in Dentistry* **2015** 452765.

31. Villalobos-Tinoco J, Jurado CA, Rojas-Rueda S, & Fischer NG (2022) Additive wax-up and diagnostic mockup as driving tools for minimally invasive veneer preparations *Cureus* **14(7)** e27402.

32. Tsujimoto A, Jurado CA, Villalobos-Tinoco J, Fischer NG, Alresayes S, Sanchez-Hernandez RA, Watanabe H, & Garcia-Godoy F (2021) Minimally invasive multidisciplinary restorative approach to the esthetic zone including a single discolored tooth *Operative Dentistry* **46(5)** 477-483.

33. Gonzalez-Martin O, Avila-Ortiz G, Torres-Muñoz A, Del Solar D, & Veltri M (2021) Ultrathin ceramic veneers in the aesthetic zone: A 36-month retrospective case series *International Journal of Prosthodontics* **34(5)** 567-577.

34. Malchiodi L, Zotti F, Moro T, De Santis D, & Albanese M (2019) Clinical and esthetical evaluation of 79 lithium disilicate multilayered anterior veneers with a medium follow-up of 3 years *European Journal of Dentistry* **13(4)** 581-588.

35. Malament KA, Natto ZS, Thompson V, Rekow D, Eckert S, & Weber HP (2019) Ten-year survival of pressed, acid-etched e.max lithium disilicate monolithic and bilayered complete-coverage restorations: Performance and outcomes as a function of tooth position and age *Journal of Prosthetic Dentistry* **121(5)** 782-790.

36. Tavangar SM, Tayefeh Davalloo R, Darabi F, & Vaez Ghasemi (2020). Evaluation of the effect of three different post-etching surface treatments of feldspathic ceramic on the shear bond strength to composite resin *Journal of Dentomaxillofacial Radiology Pathology Surgery* **9(4)** 20-26.

37. Bruzi G, Carvalho AO, Giannini M, Maia HP, & Magne P (2017) Post-etching cleaning influences the resin shear bond strength to CAD/CAM lithium-disilicate ceramics *Applied Adhesion Science* **5(17)** 1-9.

38. Agarwal N, Bansal S, Pai UY, Rodrigues SJ, Shetty TB, & Saldanha SJ(2020) Effect of post etching cleansing on surface microstructure, surface topography, and microshear bond strength of lithium disilicate *Journal of Indian Prosthodontic Society* **20(4)** 363-370.

39. Stanley M, Paz AG, Miguel I, & Coachman C (2018) Fully digital workflow, integrating dental scan, smile design and CAD-CAM: Case report *BMC Oral Health* **18(1)** 134.

40. Coachman C & Calamita M (2012) Digital smile design: A tool for treatment planning and communication in aesthetic dentistry *Quintessence Dental Technology* **35** 103-111.

41. Lee JH, Kim SH, Han JS, Yeo IL, & Yoon HI (2019) Contemporary full-mouth rehabilitation using a digital smile design in combination with conventional and computer-aided design/manufacturing restorative materials in a patient with bruxism: A case report *Medicine* (Baltimore) **98(48)** e18164.

42. Jafri Z, Ahmad N, Sawai M, Sultan N, & Bhardwaj A (2020) Digital Smile Design - An innovative tool in aesthetic dentistry *Journal of Oral Biology and Craniofacial Research* **10(2)** 194-198.

43. Zanardi PR, Laia Rocha Zanardi R, Chaib Stegun R, Sesma N, Costa BN, & Cruz Laganá D The use of the Digital Smile Design concept as an auxiliary tool in aesthetic rehabilitation: A case report *Open Dentistry Journal* **10** 28-34.

44. Aly P & Mohsen C (2020) Comparison of the accuracy of three-dimensional printed casts, digital, and conventional casts: An *in vitro* study *European Journal of Dentistry* **14(2)**189-193.

45. Duarte S Jr, Schnider P, & Lorezon AP (2008) The importance of width/length ratios of maxillary anterior permanent teeth in esthetic rehabilitation *European Journal of Esthetic Dentistry* **3(3)** 224-234.

46. Pound E (1977) Let /S/ be your guide *Journal of Prosthetic Dentistry* **38(5)** 482-489.

47. Sakar O, Bural C, Sülün T, Öztaş E, & Marşan G (2013) Evaluation of the closest speaking space in different dental and skeletal occlusions *Journal of Prosthetic Dentistry* **109(4)** 222-226.

48. Small BW (2000) Location of incisal edge position for esthetic restorative dentistry *General Dentistry* **48(4)** 396-397.

49. Jurado CA, Mourad F, Felton D, & Tinoco JV (2020) Clinical workflow of two different CAD/CAM systems for veneers manufacture *European Journal of General Dentistry* **9(3)** 174-180.

50. Aslan YU, Uludamar A, & Özkan Y (2019) Clinical performance of pressable glass-ceramic veneers after 5, 10, 15, and 20 years:

A retrospective case series study *Journal of Esthetic and Restorative Dentistry* **31(5)** 415-422.

51. Demirekin ZB & Turkaslan S (2022) Laminate veneer ceramics in aesthetic rehabilitation of teeth with fluorosis: A 10-year follow-up study *BMC Oral Health* **22(1)** 42.

52. Aboushelib MN, Elmahy WA, & Ghazy MH (2012) Internal adaptation, marginal accuracy and microleakage of a pressable versus a machinable ceramic laminate veneers *Journal of Dentistry* **40(8)** 670-677.

53. Al-Dwairi ZN, Alkhatatbeh RM, Baba NZ, & Goodacre CJ (2019) A comparison of the marginal and internal fit of porcelain laminate veneers fabricated by pressing and CAD-CAM milling and cemented with 2 different resin cements *Journal of Prosthetic Dentistry* **121(3)** 470-476.

54. Homsy F, Bottin M, Özcan M, & Majzoub Z (2019) Fit accuracy of pressed and milled lithium disilicate inlays fabricated from conventional impressions or a laboratory-based digital workflow *European Journal of Prosthodontics and Restorative Dentistry* **27(1)** 18-25.

55. Yuce M, Ulusoy M, & Turk AG (2019) Comparison of marginal and internal adaptation of heat-pressed and CAD/CAM porcelain laminate veneers and a 2-year follow-up *Journal of Prosthodontics* **28(5)** 504-510.