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Clinical Research

Clinical Evaluation of Lithium Disilicate Veneers Manufactured by CAD/CAM Compared with Heat-pressed Methods: Randomized Controlled Clinical Trial

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Clinical Relevance

Lithium disilicate veneers for esthetic restorations show great accuracy and similarity, regardless of the type of fabrication technique.

SUMMARY

Objectives: This study aimed to evaluate and compare the clinical performance of two different ceramic veneer methods: CAD/CAM (IPS e.max CAD) and heat-press (IPS e.max Press) at 6 and 12 months of follow-up, and the level of patient satisfaction after treatment.

Methods and Materials: Patients were selected according to eligibility criteria, with a minimum of two and a maximum of six veneers per patient, for

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a total of 178 veneers randomized in two groups. A split-mouth, longitudinal, interventional, double-blind and single-center study was carried out according to the fabrication technique. Scores were attributed to the veneers according to the criteria of the United States Public Health Service (USPHS) regarding marginal adaptation, color change, marginal discoloration, restoration fracture, tooth fracture, restoration wear, antagonist tooth wear, presence of caries, and postoperative sensitivity. All patients answered a satisfaction questionnaire using the Visual Analogue Scale (VAS). Statistical significance was determined using two-way ANOVA and Tukey test, with a significance level of 5%.

Results: The marginal adaptation criterion showed statistical difference between periods (p=0.017), regardless of the processing method (baseline means: CAD=1.056, PRESS=1.067, 6- to 12-month follow-up: CAD=1.089, PRESS=1.078). The other evaluated criteria showed no statistical differences between baseline and after 6 to 12 months. The level of satisfaction assessed by the VAS before and after treatment was 7.06 and 9.5, respectively.

Conclusions: The two methods presented similar clinical performance after 12 months, and the patient's level of satisfaction was considered high.

INTRODUCTION

Lithium disilicate ceramics have two different initial presentations: ingots for heated-pressed fabrication and blocks for milling using CAD/CAM technology. Ingots (IPS e.max Press; Ivoclar Vivadent, Shaan, Liechtenstein) and blocks (IPS e.max CAD; Ivoclar) largely replace the IPS Empress 2 system. Ingots of leucite-reinforced ceramics for pressing present flexural strength between 120 and 180 MPa and fracture toughness between 1.03 and 1.3 MPa $m^{1/2}$. The lithium disilicate ceramics have shown flexural strength (IPS e.max Press 400 MPa and IPS e.max CAD 360 MPa) and fracture toughness (between 2.8 and 3.5 MPa $m^{1/2}$), and their optical properties contribute to esthetic balance.[1, 2, 3, 4]

Lithium disilicate ceramics provide monolithic restorations.[5] However, the two fabrication methods are different. The milling process prevents inaccuracies resulting from waxing, investment, and improper manipulation during injection, pickling, finishing, and polishing. This technique requires fewer finishing procedures and only surface polishing.[6] The injection of the liquid material in the pressing technique may assure greater marginal flow, resulting in better adaptation of the veneers on preparations with a smaller width in the marginal area.

According to Guess and others,[6] and Willard and others,[7] the milling technique results in a material with fewer defects and more uniform distribution of the crystals. The milled ceramics' disadvantages are inferior marginal adaptation because the parameters of preparation marginal finishing, cement space, and marginal adaptation depend on each software and operator. Some studies demonstrated that pressed lithium disilicate veneers showed better marginal adaptation, thinner cement layers, and greater resistance to marginal leakage than those manufactured by a milling process.[8,9] However, finishing in the two methods requires compensation for customized characterizations.[4]

The ceramic veneer blocks available include feldspathic ceramics reinforced by leucite, lithium disilicate–based,[10,3] and, recently, zirconium-reinforced lithium disilicate.[11] Lithium disilicate blocks are manufactured in the metasilicate state, that is, 40% lithium in metasilicate crystals and vitreous matrix.[12,13] In this state, the material has a bluish color and can be easily milled. After the milling process, the veneer undergoes a final thermal treatment to increase the crystalline phase, resulting in lithium disilicate with the maximum optical and mechanical properties.[14] This crystallization process takes about 25 minutes at 830°C, and the dimensional alteration is about 0.2%, which does not affect marginal and proximal adaptation or occlusion. The physical properties of the lithium disilicate ceramics depend on different parameters, including microstructure, which plays an important role in determining the flexural strength, flexural toughness, modulus of elasticity, and optical properties.[4]

The long-term clinical success of feldspathic ceramics[15] is that of a 93.5% survival rate over 10 years.[16] Taking into consideration marginal adaptation and marginal discoloration, a study revealed that after seven years, only 2.5% and 4.2% of the indirect feldspathic restorations, respectively, exhibited poor adaptation and discoloration with a 97.5% rate of success.[17] Studies have reported the clinical success[18] and marginal adaptation of milled lithium disilicate veneers,[19] but little is known about the effect of the restorative material on the clinical behavior of the CAD/CAM system, mainly regarding the marginal adaptation of veneers.[20] Therefore, this study aimed to evaluate and compare the clinical performance of two different ceramic veneer fabrication methods:

CAD/CAM with CEREC inLab (IPS e.max CAD) and heat-pressed (IPS e.max Press) fabrication, at 6 and 12 months of follow-up, and the level of the patient's satisfaction after treatment. The null hypotheses were: (1) the ceramic veneers manufactured by heat-pressed and CAD/CAM methods would not have statistically significant differences in clinical performance, and (2) the two different methods would show a similar level of patient level satisfaction before and after treatment.

METHODS AND MATERIALS

Study Design

This split-mouth, prospective, interventional, double-blinded (patients and examiners), longitudinal, randomized controlled trial compared two factors: fabrication method – (IPS e.max CAD and IPS e.max Press) and time (baseline, 6 months, and 12 months). The veneers were randomized in pairs with the consideration of the manufacturing process. Two examiners evaluated the veneers using the modified United States Public Health Service (USPHS) method.[21] Prior to the study, the examiners were calibrated and Kappa agreement assessed to ensure the standardization and interpretation of the results.[22]

The parameters for the study design followed the Consolidated Standards of Reporting Trials (CONSORT).[23] This study was submitted and approved by the Institutional Review Board. All the participants were instructed about the study and signed an informed consent form.

Selection of the Participants

The inclusion criteria were as follows: individuals of both genders, good general health, aged between 18 and 60 years, referral for veneers on the anterior teeth,[24] requiring at least two and at most six maxillary anterior veneers, willing to undergo radiographic examination, good maxillo-mandibular relation, occlusal stability, and being willing to sign an informed consent. The exclusion criteria was comprised of the following: smokers, individuals with large restorations on anterior teeth, dark colored teeth (shades VITA A3.5 and C4), teeth with fluorosis, teeth with periodontitis, teeth with severe gingival bleeding, poor oral hygiene, high caries rates, history of allergy to any of the materials, pregnancy, use of drugs known to interfere with the oral environment, systemic or malignant diseases, inability to be submitted to any specific techniques of the study, lack of space for the proper installation of the veneers, and presence of parafunctional habits (eg, bruxism). Selection of the participants was done according to the CONSORT 2010 Flow Diagram (Figure 1).

According to the inclusion and exclusion criteria, 33 individuals (27 females and 6 males), aged between 18 and 52 years were selected. Each individual received at least two and at most six veneers on the anterior teeth, manufactured according to the study groups: CAD (experimental) – milling process (CAD/CAM Cerec In Lab, Sirona, Bensheim, Germany); and PRESS (control) – heat pressed process (Table 1). The total number of veneers delivered were 178.

Treatment Planning and Tooth Preparation

Digital smile design was performed using Apple's Keynote Software to obtain veneer proportions, and to enable communication and increase predictability. Standardized extraoral photographs were taken with a Nikon D5300 digital reflex camera using the following parameters: manual mode 1/125, f22, and ISO 125, coupled with Sigma Macro 105mm DX lens; twin manual 1/1 flash (Nikon R1C1 Wireless Close-UP Speedlight System) equipped with four AA Mignon batteries (Energizer Ultimate Lithium, + AA 1,5 V, 3000 mAh); and a flash holder (Agnos, Italy). The analysis of the face thirds was made according to the participant's smile. Initial impressions were taken using a heavy and light condensation silicone (Xantopren/Optosil, Heraeus Kulzer, Germany) one-step technique. The study casts were obtained and the wax-up was performed according to digital planning.

Intraoral photographs were taken prior to tooth preparation to select the color under polarized light, with a gray card and VITA scale. A mock-up with bisacrylic resin (Protemp 4; 3M ESPE, St. Paul, Minnesota, USA) was made to predict the final esthetic outcome (Figure 2A and 2B), checking the tooth shape and size. At the same appointment, after the participant's evaluation and approval, the teeth were prepared through the mock-up in order to guide facial and incisal reduction.

Tooth preparations were standardized, ranging from a 0.5–1.0 mm reduction on the labial surface and a 1.0 mm reduction on the incisal.[25] All preparations were performed by the same practioner (IBLSR). Parallel guide grooves were made on the labial surface with a diamond bur (#4141; KG Sorensen, São Paulo, Brazil) under water irrigation and, from cervical to incisal regions (#2135; KG Sorensen), positioned at two inclinations (Figure 3A and 3B). The incisal reduction was executed following the cervical-incisal guide groove (#3053; KG Sorensen). The preparation of the labial surface was carried out (#2135; KG Sorensen) following the guiding grooves with the aid of a red pencil, the gingival margin was marked, and a retraction cord

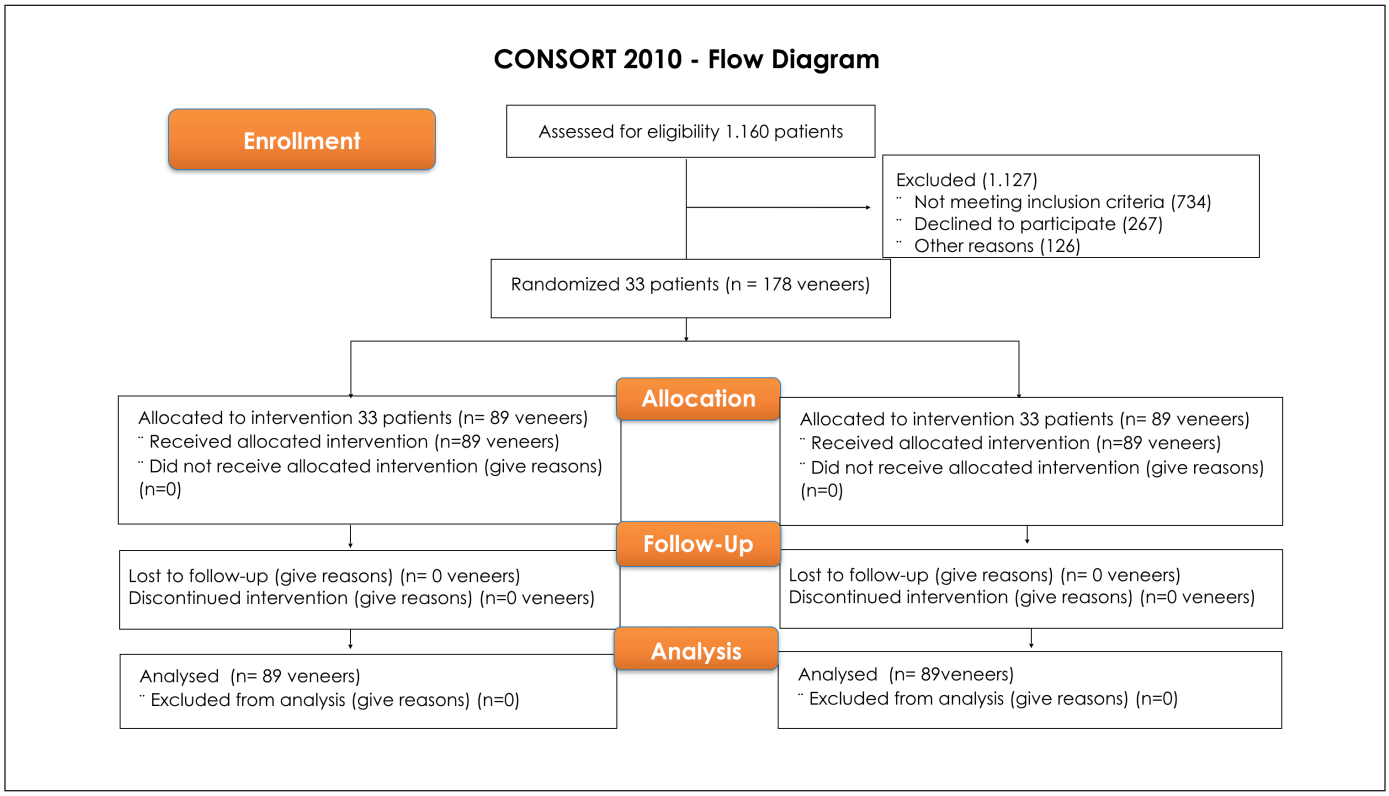

Figure 1. *CONSORT 2010 Flow Diagram.*

was inserted (Ultrapack 000; Ultradent, South Jordon, Utah, USA). The finishing procedure was done with a bur (#2135FF; KG Sorensen). Polishing was accomplished with Soflex discs (3M ESPE) and rubber polishing burs (Astropol, Ivoclar Vivadent) (Figure 4A). Prior to the impression, a retraction cord (Ultrapack 000; Ultradent) was inserted (Figure 4B) and the impression was performed with heavy and light body Polyvinyl siloxane (PVS) (Virtual, Ivoclar Vivadent) to obtain the working casts. The provisional restorations were made with bisacrylic resin (Protemp 4; 3M ESPE).

Preparation of the Veneers

The working casts were sent to the laboratory to obtain veneers made according to the following manufacturing methods:

Table 1: *Study Groups*

Groups	Ceramic	Color	Follow-up	Composition[a]
CAD (n=89)	Lithium disilicate	IPS e. max CAD (HT, LT)	Baseline, 6 and 12 months	Components: SiO_2 Other Components: Li_2O, K_2O, MgO, ZnO, Al_2O_3, P_2O_5, and other oxides.
PRESS (n=89)	Lithium disilicate	IPS e.max Press (HT, LT)	Baseline, 6 and 12 months	Components: SiO2 Other Components: Li2O, K2O, MgO, ZnO, Al2O3, P_2O_5, and other oxides.

Abbreviations: Al_2O_3, aluminum oxide; Li_2O, lithium oxide; K_2O, potassium oxide; MgO, magnesium oxide; P_2O_5, phosphorus pentoxide; ZnO, zinc oxide.
[a]Manufacturers' information.

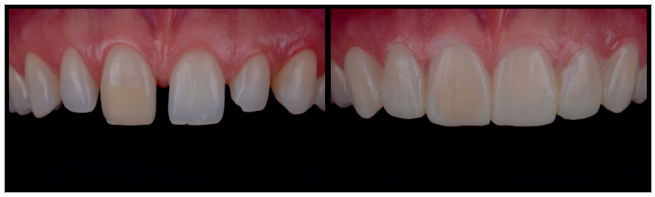

Figure 2. *(A): Intraoral initial photograph. (B): Mock-up with bisacrylic resin.*

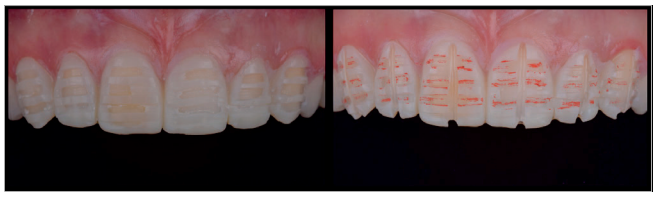

Figure 3. *Tooth preparation. (A): Mesial-distal guide grooves on labial surface. (B): Cervical-incisal guide grooves.*

CAD/CAM: Titanium oxide powder was applied, and the working casts were digitally scanned (inEos Blue scanner; CEREC 3D, Sirona). The images were processed by the CEREC InLab (SW15.0) software to enable preparation analysis and veneer design. All veneers were designed with the aid of the Biocopy tool, which uses the initial wax planning as a guide (Figure 6A). Other software tools were also used to adjust tooth morphology, marginal adaptation, texture, incisal edge, and the cast position to obtain the insertion axis. The adjustments were performed on both labial and palatal surfaces (Figure 5A and 5B). After that, the ceramic block (IPS e.max CAD; Ivoclar Vivadent) information was introduced in the software to initiate milling (MXCL; Sirona). After milling, each veneer was tested on the model to check adaptation (Figure 6B) and submitted to the specific crystallization cycle in a Programat oven (Ivoclar Vivadent), following the manufacturer's instructions.

PRESS: The veneers were made using injectable ingots (IPS e.max Press) following the manufacturer's instructions. The press technique is based on the lost wax technique, followed by

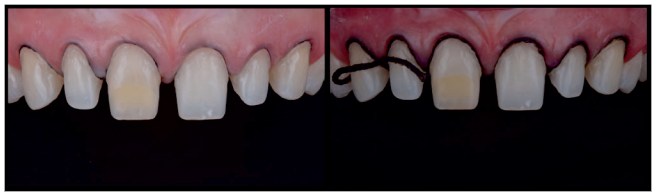

Figure 4. *(A): Tooth preparation after polishing procedure. (B): Insertion of the retraction cord for impression.*

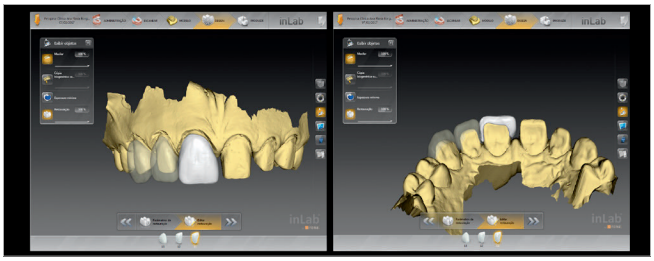

Figure 5. *Software tools for marginal adjustment. (A): labial surface. (B): Palatal surface.*

investing, wax elimination in an oven, press injection of the ceramic ingot in an appropriate oven, and a pickling and finishing procedure. Regardless of the manufacturing process, the veneers were tested on the working cast (Figure 7) and on the prepared tooth to verify the adaptation. The veneers were then finished with pigments and glazed.

Cementation of the Veneers

First, the cement color was selected with the respective Variolink N Try-in resin cement (Ivoclar Vivadent). Next, the teeth were submitted to prophylaxis with pumice (Maquira; Maringá, PR, Brazil) and Robinson brush (Injecta, São Paulo, SP, Brazil), followed by absolute isolation. All teeth were acid etched with 37% phosphoric acid (Dentsply), for 30 seconds, followed by rinsing and air drying. On the etched tooth surface, a layer of the adhesive of Adper Scotchbond Multi-Purpose (3M ESPE) was applied without light-curing. In areas of exposed dentin, the Adper Scotchbond Multi-Purpose primer (3M ESPE) was applied for 15 seconds, followed by the adhesive agent application, and was air dried for 5 seconds.

The veneers' internal surfaces were prepared by conditioning with 10% hydrofluoric acid (Condac Porcelana; FGM, Joinville, SC, Brazil) for 20 seconds, followed by rinsing and air drying. On the conditioned ceramic surface, a layer of silane (Monobond Plus; Ivoclar Vivadent) was applied for 60 seconds, followed by a layer of adhesive system Adper Scotchbond

Figure 6. *(A): Initial waxed working cast. (B): Checking the veneers' adaptation on the working cast.*

Figure 7. *Test of the veneers on the working cast before and after crystallization.*

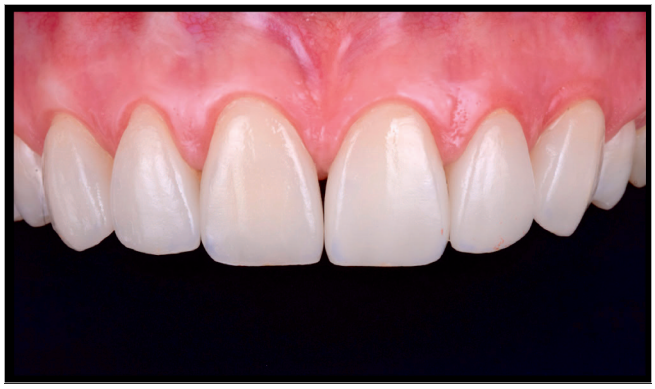

Figure 9. *Final photograph after cementation.*

Multi-Purpose (3M ESPE). Then, the selected light-cured resin cement Variolink N (Ivoclar Vivadent) (Figure 8A) was applied on the internal surface of the veneer, and the veneer was seated with mild digital pressure on the tooth, starting with the central incisors, followed by the lateral incisors, and then the canine teeth. The cement was light-cured with a mulitple-peak LED light-curing device (VALO Cordless, Ultradent) with a PointCure lens (Ø 2.5 mm, VALO Cordless; Ultradent), to provide a localized beam on a reduced area, for 3 seconds (Figure 8B). This is the time period for the initial light-curing of the cement in the middle third. The excess resin cement was removed with a thin brush on all the veneer margins. The final light-curing (maximum power of 1400 mW/cm^2) was performed in the labial and incisal surfaces for 60 seconds each (VALO Cordless; Ultradent). The polishing procedure was carried out 24 hours after final light-curing, with the aid of abrasive rubber polishing points (Astropol; Ivoclar Vivadent) (Figure 9).

Clinical Assessment

The veneers were scored according to the modified USPHS method[21] for: marginal adaptation, color alteration, marginal discoloration, restoration fracture, tooth fracture, restoration wear, antagonist tooth wear, presence of caries, and postoperative sensitivity (Table 2).[26] For the analysis of the evaluation criteria, the clinical examination performed was tactile and visual. During the examination, a clinical mirror and an exploratory probe were used to check marginal integrity, adaptation, discrepancies, stains, and surface texture of the veneers. The clinical assessments were performed by two calibrated and blinded examiners at the study periods: baseline, 6 months, and 12 months of follow-up.

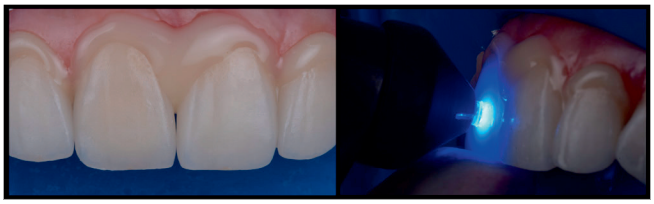

Figure 8. ***A:*** *Application of the resin cement and placement of the veneer.* ***B:*** *Initial light-curing (3 seconds) with the point cure method.*

Assessment of the Patient's Level of Satisfaction – To record the level of esthetic satisfaction, all patients were asked to answer a questionnaire with a VAS before and after treatment. This questionnaire comprised 10 questions, in which the answers were registered by a horizontal line scored from 0 (very unsatisfied) to 10 (very satisfied). The questions were:

Are you satisfied with the aesthetics of your smile?
Are you satisfied with the color of your teeth?
Are you satisfied with the shape of your teeth?
Are you satisfied with the size of your teeth?
Regarding chewing, how do you feel?
Regarding comfort, how do you feel?
Regarding phonetics, how do you feel?
Are you satisfied with the appearance of your gums?
Are you satisfied with the shape of your lips?
Are you satisfied with the alignment of your teeth?

Statistical Analysis – Values were assigned to each score as follows: Alpha=1, Bravo=2, Charlie =3. Repeated measures two-way ANOVA and Tukey test were used to compare the modified USPHS method values (α=0.05). All statistical analyses were performed with STATISTICA 10.0 software and SIGMAPLOT 12.0 software.

Table 2. *Criteria of the Modified United States Public Health Service Method*

Topics (acronym)	Score	Criteria
Marginal adaptation (MARA)	Alpha	Margin continuity (without prominence or crack)
	Bravo	Little discontinuity detectable by explorer, but it does not require replacement
	Charlie	Prominence or crack; require replacement
Color alteration (COA)	Alpha	No color alteration close to the tooth structure
	Bravo	Little color alteration, clinically acceptable
	Charlie	Esthetically unacceptable
Marginal discoloration (MARD)	Alpha	No marginal discoloration
	Bravo	Marginal discoloration
	Charlie	Deep discoloration
Restoration fracture (RESF)	Alpha	No fracture
	Bravo	Small fracture fragments (1/4 of the restoration)
	Charlie	Severe fracture (3/4 of the restoration)
Tooth fracture (TFRA)	Alpha	No tooth fracture
	Bravo	Small fracture fragments of tooth fracture (1/4)
	Charlie	Severe tooth fracture (1/2)
Restoration wear (RESW)	Alpha	No wear
	Bravo	Wear
Antagonist tooth wear (ANTW)	Alpha	No wear
	Bravo	Wear
Caries presence (CARP)	Alfa	Absent
	Charlie	Present
Postoperative sensitivity (POSTS)	Alpha	Absent
	Charlie	Present

RESULTS

Clinical Assessment

At the follow-up visits, a 100% response rate was achieved; therefore, the 178 veneers placed were accounted for.

Regardless of the manufacturing process, the marginal adaptation (MARA) exhibited statistically significant greater means at the following-up periods of 6 and 12 months (CAD = 1.089; PRESS = 1.078) than at baseline (CAD = 1.056; PRESS = 1.067) (p=0.017), without statistical difference between the groups (p=0.923) and with interaction of group vs time periods (p=0.362) (Figure 10).

The assessment of the restoration fracture (RESF) showed no statistically significant differences between periods (p=0.097), groups (p=0.343), and without the interaction of group versus time periods (p=0.715) (Figure 10). No statistically significant differences occurred for the postoperative sensitivity (POSTS) between periods (p=0.081), groups (p=0.556), and without interaction of group vs time periods (p=0.081) (Figure 10).

Regardless of the manufacturing process and the study period, the following topics were scored as Alpha at all assessments, and no statistically analysis was possible: color alteration, marginal discoloration, tooth fracture, restoration wear, tooth antagonist wear, and caries presence.

Assessment of the Patient's Level of Satisfaction – All participants (n=33) returned for the assessment and answered the questionnaire before and after treatment. The level of satisfaction before treatment was 7.06 ± 1.5 and 9.5 ± 0.49 after treatment (Figure 11).

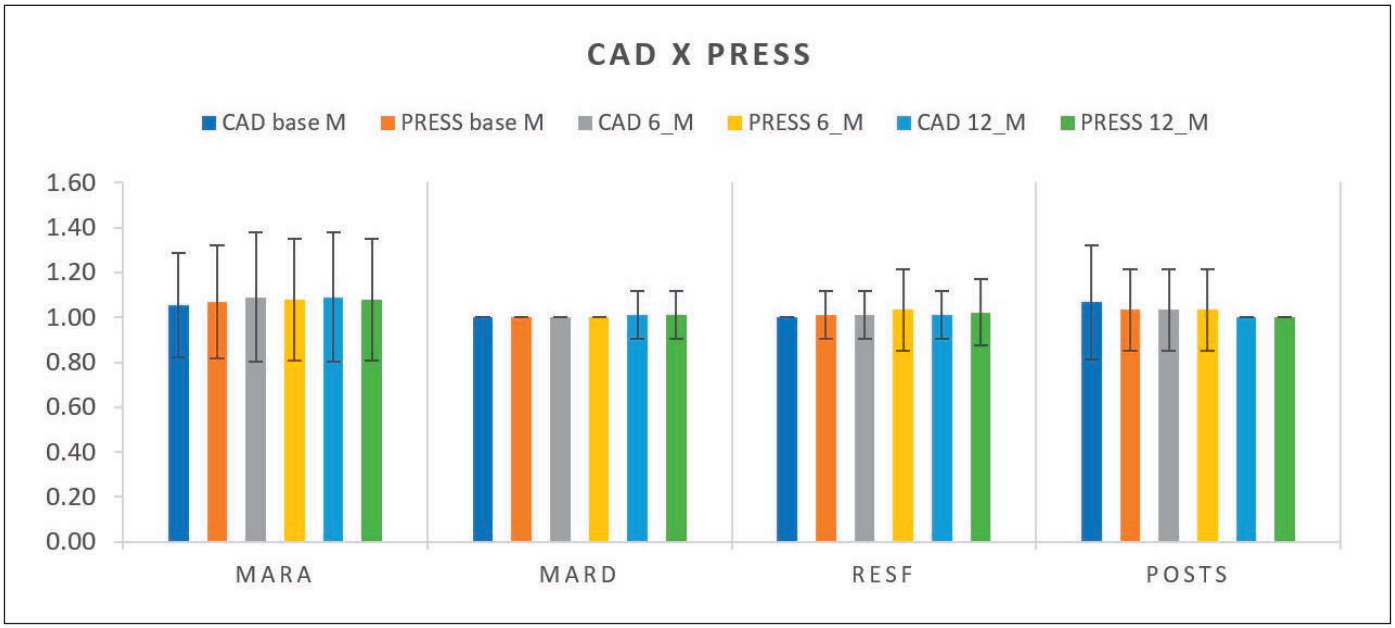

Figure 10. *Means and standard deviation of the manufacturing process at the study periods (baseline, 6 months, and 12 months of follow-up) for the topics marginal adaptation (MARA), restoration fracture (RESF), and postoperative sensitivity (POSTS).*

DISCUSSION

These study results revealed no statistically significant differences in the clinical performance of the two manufacturing processes (CAD/CAM milling or heat-pressed); thus, the first null hypothesis was accepted. Other laboratory studies analyzed possible differences between the manufacturing methods of lithium disilicate veneers, and they did not find statistically significant differences by reporting that both processes had marginal gap values lower than 120 µm, which is within the clinically acceptable rate.[27]

According to the analysis of this study's modified USPHS data, the marginal adaptation exhibited statistically significant differences between study periods, regardless of the manufacturing process. This agrees with a study reporting that the manufacturing process did not affect the marginal adaptation of veneers.[5,6] Nevertheless, recent laboratory studies showed that lithium disilicate veneers manufactured by the heat-pressed method demonstrated marginal spaces that were significantly smaller than those manufactured by a CAD/CAM system, although both results were within the clinically acceptable limits.[28,29,30] Further studies are necessary on marginal adaptation because this is one of the determining factors for long-term success, due to its impact on esthetics, resistance, gingival health, and caries risk.[31,32]

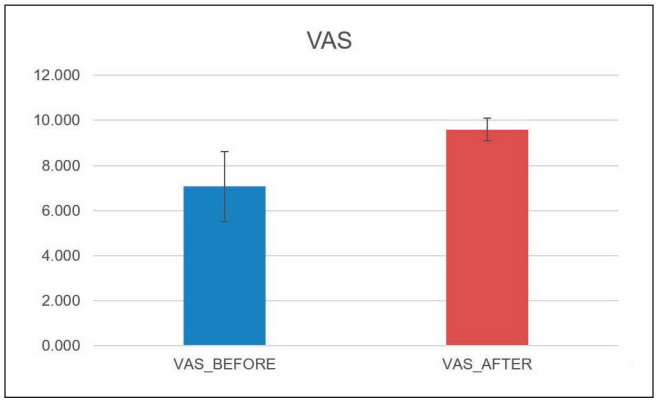

Figure 11. *Mean and standard deviation of the patient's level of satisfaction.*

The tooth preparation type is one of the factors that can influence the marginal adaptation of the veneers. In this study, the preparation width ranged from 0.5–1.0 mm, with a flat incisal edge, and no palatal bevel. The rationale behind this choice was that incisal reductions with a palatal bevel are more prone to ceramic fracture.[25]

The tooth preparations used in this study were minimally invasive and were based on the literature reporting the best results of resistance to fracture of veneers, which contributes to the long-term success of the restorations.[33-37] We performed the tooth preparation on the mock-up because of the advantages of making the diagnosis and communication easier, by providing treatment predictability, aiming at greater control of the preparation, and resulting in enough room for the proper adaptation of the veneers. This technique is based on the final volume of the restoration and enables most of the preparation to stay in the enamel. The study

by Gurel and others[36] demonstrated that this technique increases the number of restorations over enamel (80.5%) and has a high index of marginal adaptation (100%), significantly increasing the performance of the veneers and decreasing postoperative sensitivity. Knowing that the bond strength to enamel is higher than that to dentin,[38] marginal gaps occur due to the wear of the cement, leading to microleakage, staining, and postoperative sensitivity.[15] Interproximal tooth reduction was performed to enable the adjustments required to change the tooth shape and position.[24] This proximal surface preparation had clinical and laboratory advantages that overcome significantly the removal of the tooth structure.[39]

Other topics scored in this study by the modified USPHS method were color alteration, marginal discoloration, restoration fracture, tooth fracture, restoration wear, wear of the antagonist tooth, caries presence, and postoperative sensitivity, with no statistical significance between study periods and groups. Clinical studies on the applicability of lithium disilicate veneers in many clinical situations show success rates ranging from 93.5%–100% for follow-up periods from 1 to 6 years.[40, 41]

Although the 12-month clinical analysis of this study did not reveal any color changes of the restorations, regardless of the material, the examiners scored some marginal discoloration observed as pigmentation points on the cement line, in the cervical area, but without statistical differences between the manufacturing methods. Neither restoration fracture nor fracture of the antagonist tooth was observed. This may be justified because of the high five-year survival rate and clinical success of lithium disilicate veneers of 99.0% and 96. 4%, respectively.[42] In this study, all participants had satisfactory oral hygiene and no caries lesions were detected.

The second null hypothesis was rejected because of the difference between the patient's level of satisfaction before and after treatment. The level of satisfaction is an important topic in clinical trials.[43] The VAS is the most used method for measuring tooth and facial esthetics.[44] All participants returned for the second assessment, and the mean values increased from 7.05 (before) to 9.5 (after treatment). This result agrees with the literature reporting high levels of satisfaction after ceramic laminates.[42] The reason behind the high level of esthetic satisfaction was the treatment planning process, which plays an important role in building rapport between dentists and patients, who may initially disagree about what is important and significant from an esthetic point of view. [45]

Considering a clinically acceptable maladaptation of 120 μm reported in laboratory studies (ISO 6872:2015) and that IPS e.max CAD had higher flexural resistance and better internal adjustment,[46] we consider that it is possible to obtain a satisfactory outcome of the veneers produced by a CAD/CAM system. We emphasize the important role of communication between the dentist and the laboratory technician, and performing the try-in of the veneers on the working cast in clinic prior to cementation. These steps enable the detection of possible failures in marginal adaptation, and improve the understanding about the veneers' characterization. This will consequently improve the esthetic outcome.

Regardless of the manufacturing process, the clinical success can be achieved by proper treatment planning, knowledge on proper bonding techniques, clinical and laboratory expertise, and clinical optimization and patient satisfaction.[47]

CONCLUSION

The different manufacturing methods of lithium disilicate veneers (milling or pressing) had similar clinical performance after a 12-month follow-up period, with a high level of patient esthetic satisfaction.

Acknowledgement

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Conflict of Interest

The authors have no financial interest in any of the companies or products mentioned in this article.

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Errata

Operative Dentistry apologizes for the errors in the following manuscripts.

IF Leão, N Araújo, CK Scotti, RFL Mondelli, MM de Amoêdo Campos Velo, JFS Bombonatti; The Potential of a Bioactive, Pre-reacted, Glass-Ionomer Filler Resin Composite to Inhibit the Demineralization of Enamel *in Vitro*. *Oper Dent* 1 January 2021 **46 (1)**: E11-E20. doi: https://doi.org/10.2341/19-151-L

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DM De Paula, AD Loguercio, A Reis, S Sauro, AH Alves, PR Picanço, K Yoshihara, VP Feitosa; Lack of Neutralization of 10-MDP Primers by Zirconia May Affect the Degree of Conversion of Dual-cure Resin Cement. *Oper Dent* 1 January 2021 **46 (1)** 107-115. doi: https://doi.org/10.2341/18-189-L

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Flexural Properties and Polished Surface Characteristics of a Structural Colored Resin Composite

K Mizutani • T Takamizawa • R Ishii • S Shibasaki • H Kurokawa • M Suzuki • A Tsujimoto • M Miyazaki

Polishing the structural colored resin composite Omnichroma with an aluminum oxide flexible disk after finishing with a tungsten carbide bur significantly improved its surface properties when compared with the other methods.

http://doi.org/10.2341/20-154-L

Post-Space Treatment Influences the Bond Strength In Endodontically Treated Teeth: A Systematic Review and Meta-Analysis of *In Vitro* Studies

TC Bohrer • PE Fontana • RO Rocha • OB Kaizer

Several factors can influence the retention of posts to root canal dentin. Post-space treatment is one of these factors, which can improve the bond strength of the post to dentin.

http://doi.org/10.2341/19-277-LIT

Intrapulpal Concentration of Hydrogen Peroxide of Teeth Restored With Bulk Fill and Conventional Bioactive Composites

DP Silva • BA Resende • M Kury • CB André • CPM Tabchoury • M Giannini • V Cavalli

Using a 35% hydrogen peroxide bleaching agent in-office increases the concentration and diffusion of hydrogen peroxide into the pulp chamber compared to a low-concentration (9.5%) hydrogen peroxide gel.

http://doi.org/10.2341/20-091-L

F Ozer, O Irmak, O Yakymiv, A Mohammed, R Pande, N Saleh, M Blatz; Three-year Clinical Performance of Two Giomer Restorative Materials in Restorations. *Oper Dent* 1 January 2021 **46 (1)** E60-E67. doi: https://doi.org/10.2341/17-353-C

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IBL Soares-Rusu, CA Villavicencio-Espinoza, NA de Oliveira, L Wang, HM Honório, JH Rubo, PAS Francisconi, AFS Borges; Clinical Evaluation of Lithium Disilicate Veneers Manufactured by CAD/CAM Compared with Heat-pressed Methods: Randomized Controlled Clinical Trial. *Oper Dent* 1 January 2021 **46 (1)** 4-14. doi: https://doi.org/10.2341/19-233-C

There are errors in the corresponding author information and in paragraph 1 under Treatment Planning and Tooth Preparation in the Methods and Materials section (p6), and in the legend for Figure 10 (p11). They should read (corrections are underlined):

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Digital smile design was performed using Apple's Keynote Software to obtain veneer proportions and to enable communication and increase predictability. Standardized extraoral photographs were taken with a Nikon D5300 digital reflex camera using the following parameters: manual mode 1/125, f22, and ISO 125, coupled with Sigma Macro 105mm DX lens; twin manual 1/1 flash (Nikon R1C1 Wireless Close-UP Speedlight System) equipped with Watson CR123A Rechargeable Lithium Battery (3V, 400mAh); and a flash holder (Agnòs, Italy). The analysis of the face thirds was made according to the participant's smile. Initial impressions were taken using a heavy and light condensation silicone (Xantopren/Optosil, Heraeus Kulzer, Germany) onestep technique. The study casts were obtained, and the wax-up was performed according to digital planning.

Figure 10. *Means and standard deviation of the manufacturing process at the study periods (baseline, 6 months, and 12 months of follow-up) for the topics marginal adaptation (MARA), marginal discoloration (MARD), restoration fracture (RESF), and postoperative sensitivity (POSTS).*