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RESTAURAÇÕES INDIRETAS EM RESINA NANOCERÂMICA COM TECNOLOGIA CAD / CAM: RELATO DE CASO

INDIRECT RESTORATIONS IN NANOCERAMIC RESIN WITH CAD/CAM TECHNOLOGY: A CASE REPORT

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Monografia apresentada à Faculdade de Odontologia de Piracicaba da Universidade Estadual de Campinas como parte dos requisitos exigidos para a obtenção do título de Especialista em Dentística.

Orientadora: Prof.ª. Dr.ª Débora Alves Nunes Leite Lima

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RESUMO

A busca por restaurações dentárias funcionais e estéticas tanto em região anterior como posterior aumentou significativamente, como também a procura por melhores técnicas e materiais. Assim, o uso da tecnologia CAD/CAM em fluxo digital total ou parcial traz agilidade ao tratamento, previsibilidade da técnica, melhor adaptação da peça, estética e durabilidade. As cerâmicas ainda são amplamente utilizadas em restaurações onlay, inlay facetas e coroas, porém atualmente temos diversos materiais disponíveis no mercado odontológico para o uso de restaurações indiretas. No entanto, o sucesso clínico da técnica de restaurações indiretas depende do diagnóstico correto do caso, qual o tratamento é o mais indicado e da execução precisa das etapas clínicas envolvidas. Este relato de caso clínico teve como objetivo apresentar a associação do fluxo digital parcial da tecnologia CAD/CAM na confecção duas coroas totais com resina nanocerâmica (Lava Ultimate ™). A justificativa para as escolhas neste protocolo de tratamento é detalhada com referência de literatura pertinente. Dessa maneira, pode-se concluir que a utilização da resina nanocerâmica (Lava™ Ultimate) para confecção de coroas totais associada ao fluxo digital parcial permitiu a obtenção de resultado satisfatório. Uma vez que, a restauração indireta devolveu a forma, a função e a estética dos dentes de maneira previsível, rápida e segura.

Palavras-chave: Desenho Assistido por Computador. Cerâmicas. Coroas. Resinas compostas.

ABSTRACT

The demand for functional and esthetic dental restorations in the anterior and posterior regions has increased significantly, as has the search for better techniques and materials. Thus, CAD/CAM technology in total or partial digital flow brings agility to the treatment, technique predictability, better piece adaptation, aesthetics, and durability. Ceramics are still widely used in onlay, inlay veneer, and crown restorations, but currently, we have several materials available in the dental market for the use of indirect restorations. However, the clinical success of the indirect restoration technique depends on the correct diagnosis of the case, which treatment is the most indicated, and on the precise execution of the clinical steps involved. This clinical case report aimed to present the association of partial digital flow of CAD/CAM technology in making two full crowns with nanoceramic resin (Lava Ultimate ™). The rationale for the choices in this treatment protocol is detailed with pertinent literature references. Thus, it can be concluded that the use of nanoceramic resin (Lava™ Ultimate) for making full crowns associated with partial digital flow allowed obtaining a satisfactory result. Once the indirect restoration restored the teeth's shape, function, and esthetics in a predictable, fast, and safe way.

Keywords: Computer-Aided Design. Ceramics. Crowns. Composite resins.

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1 INTRODUÇÃO

Em meados de 1980 foi introduzida na Odontologia a tecnologia CAD/CAM (Computer Aided Design/Computer Aided Manufacturing) com o objetivo de reproduzir restaurações indiretas com melhor qualidade, tanto no quesito da adaptação marginal, da resistência e da estética (reprodutibilidade da anatomia dental) (Tinschert et al. 2004; Lauvahutanon et al. 2014). Também é objetivo reduzir as etapas laboratoriais e consequentemente reduzir os custos de produção da restauração indireta (Lauvahutanon et al. 2014).

Com a tecnologia CAD/ CAM sendo amplamente utilizada na Odontologia, Werner Mormann, deu origem ao sistema CEREC® (CEramic REConstructions) (Mörmann 2004; Moörmann 2006). Esse sistema permite o planejamento e a confecção de restaurações indiretas com maior previsibilidade do resultado (Moörmann 2006). É importante frisar que a tecnologia do CAD/CAM permite que seu fluxo de trabalho seja totalmente digital, no qual é feito o escaneamento intraoral, planejamento digital da restauração e confecção da mesma em ambiente de consultório (Hilgert et al. 2009). Mas também é possível utilizar a tecnologia CAD/CAM com fluxo digital parcial, nessa modalidade o cirurgião dentista, não possui o equipamento no consultório. Dessa maneira, ele deve realizar uma moldagem convencional e encaminhar o modelo de gesso de trabalho para o laboratório de prótese dentária ou centros de produção que possui a tecnologia disponível (Beuer et al. 2008; Hilgert et al. 2009).

Dentre as muitas vantagens associadas às restaurações dentárias geradas por CAD /CAM pode-se incluir: o acesso a materiais atuais, pré-fabricados industrialmente e controlados; com maior a qualidade, permitindo melhor precisão, planejamento e reprodutibilidade da anatomia dentária perdida (Amesti-Garaizabal et al. 2019; Ruggiero et al. 2021). O software do CAM (Computer Aided Manufacturing) permite a produção da peça a partir dos dados compartilhados pelo CAD (Computer Aided Design) (Hilgert et al. 2009). Dessa maneira, após o planejamento a restauração está pronta para ser fresada. Que pode ser eleito diferentes materiais como as resinas compostas indiretas (MZ100 e Lava Ultimate; 3M – ESPE), as cerâmicas reforçadas por leucita ou por dissilicato de lítio, (Moörmann 2006; Magne et al. 2015; Amesti-Garaizabal et al. 2019). Os blocos cerâmicos possuem composições diferentes e diversas empresas como: a Vita, a Dentsply Sirona, a 3M – ESPE e a Ivoclar Vivadent comercializam esses materiais para uso em CAD / CAM (Hilgert et al. 2009).

Makhija (2016) observou em seu estudo que 20% dos dentistas que participaram da pesquisa, possuem preferência pelo dissilicato de lítio para confecção de coroas posteriores enquanto que 55% dos dentistas utilizam esse mesmo material para coroas anteriores. Quando utilizados com sistemas CAD/CAM em consultório, os materiais de dissilicato de lítio, como e.max CAD (Ivoclar Vivadent, Schaan, Lichtenstein), são fornecidos ao dentista em um estado amolecido para agilizar o fresamento. Após a moagem, este material é cristalizado em um forno para melhorar suas propriedades mecânicas. Para economizar tempo clínico, novos materiais restauradores CAD / CAM foram introduzidos, os quais não requerem tratamento térmico para atingir resistência adequada (Lawson et al. 2016; Makhija et al. 2016).

A fabricação de restaurações indiretas a partir de novos materiais, como resina nanocerâmica and dual-network ceramic, não requer queima múltiplas (Sen and Us 2018). Os fabricantes desses materiais afirmam combinar as vantagens das cerâmicas e das resinas compostas no mesmo material (Della Bona et al. 2014). Esses materiais possuem indicações que vão desde coroas anteriores, posteriores, onlays, inlays até facetas (Lawson et al. 2016; Sen and Us 2018). Além disso, as resinas nanocerâmicas tem vantagens como: fresamento mais rápido, maior resistência à fratura e também são facilmente polidas e ajustadas em uma única sessão clínica, visto que não necessitam de queimas adicionais (Della Bona et al. 2014; Sen and Us 2018).

A resina nanocerâmica Lava Ultimate™ (3M – ESPE) promove agilidade no tratamento, excelente adaptação e durabilidade (Lauvahutanon et al. 2014; Magne et al. 2015). Uma vez que a mesma possui módulo de elasticidade próximo ao da dentina 12 GPa e uma maior resistência à flexão (~150 MPa) e tenacidade à fratura (~1,2 MPA.m1 / 2) quando comparado às resinas compostas fotopolimerizáveis (~130 MPA e ~0,9 MPA.m1 / 2) (Lawson et al. 2016; Fasbinder et al. 2020; Ruggiero et al. 2021). Diante disso, esse material se mostra promissor quando é indicado corretamente, aliado à tecnologia CAD/CAM e com precisão nas técnicas de cimentação, que diminuem falhas, garantindo restaurações com longevidade e resistência.

Sendo assim, o objetivo desse trabalho foi descrever um caso clínico em que foi utilizado o sistema Lava Ultimate ™ para restaurações indiretas de coroa total em dentes posteriores.

2 ARTIGO

Indirect restorations in nanoceramic resin with CAD/CAM technology: a case report

Introduction

CAD / CAM (Computer-Aided Design/Computer-Aided Manufacturing) technology was introduced in Dentistry in 1980 to reproduce indirect restorations with better quality, both in terms of marginal adaptation, strength, and esthetics (reproducibility of dental anatomy) (1,2). It is also the objective to reduce the laboratory steps and consequently reduce the production costs of the indirect restoration (2).

With CAD / CAM technology is widely used in Dentistry, Werner Mormann gave rise to the CEREC® system (3,4). The CEREC® system (CEramic REConstructions) allows the planning and manufacture of indirect restorations (4). It is important to emphasize that CAD/CAM technology allows your workflow to be fully digital, in which intraoral scanning, digital restoration planning, and preparation in an office environment are done (5). Also, possible to use CAD/CAM technology with the partial digital flow; in this modality, the dental surgeon does not have the equipment in the office. In this way, he must perform a conventional molding and send the working plaster model to the dental laboratory or production centers with the available technology (5,6).

Among the advantages associated with dental restorations generated by CAD / CAM, we can include access to current, industrially prefabricated, and controlled materials; with higher quality, allowing better precision, planning, and reproducibility of lost dental anatomy (7,8). After planning with specific software, the restoration can be milled in polymers such as indirect composite resins (MZ100 and Lava Ultimate; 3M – ESPE) or ceramics reinforced by leucite, lithium disilicate, among others (4,8,9). Different companies offer various compositions of ceramic blocks, such as Vita, Dentsply Sirona, 3M – ESPE, and Ivoclar Vivadent (5).

Makhija et al. (10) observed that lithium disilicate was the material of choice for 20% of dentists surveyed for making posterior crowns and 55% of dentists for anterior crowns. When used with in-office CAD/CAM systems, lithium disilicate materials such as e.max CAD (Ivoclar Vivadent, Schaan, Lichtenstein) are supplied to the dentist in a softened state expedite milling. After milling, this material is crystallized in an oven to improve its mechanical properties. In addition, new CAD/CAM restorative materials have been

introduced to save clinical time and do not require heat treatment to achieve adequate strength (10,11).

The fabrication of indirect restorations from new materials, such as nanoceramic resin and dual-network ceramic, does not require multiple firing (12). Manufacturers of these materials claim to combine the advantages of ceramics and composite resins in the same material (13). These materials include anterior crowns, posterior crowns, onlays, inlays, to veneers (11,12). In addition, nanoceramic resins have advantages such as: faster milling, greater fracture resistance and are also easily polished and adjusted in a single clinical session, as they do not require additional firing (12,13).

The Lava Ultimate™ nanoceramic resin (3M – ESPE) promotes agility in treatment, excellent adaptation, and durability (2,9). Since it has a modulus of elasticity close to that of 12 GPa dentin and greater flexural strength (~150 MPa) and fracture toughness (~1.2 MPA.m1/2) when compared to light-curing composite resins (~130 MPA and ~ 0.9 MPA.m1/2) (7,11,13,14).

Therefore, the objective of this work was to describe a clinical case in which the Lava Ultimate ™ system was used for indirect total crown restorations in posterior teeth.

Case Report

A 50-year-old female patient sought care at the School of Dentistry of Piracicaba (FOP - UNICAMP, Brazil) dissatisfied with elements 25 and 26. After clinical examination, two maladapted provisional crowns were observed (Figure 1A) and after radiographic examination, endodontic treatment and fiberglass posts were identified in teeth 25 and 26 (Figure 1B).

Figure 1 – A: Intraoral photography; **B:** Periapical radiograph.

This case was performed in two clinical sessions due to partial digital flow with CAD/CAM technology. Initially, the color to be used for making total crowns with nanoceramic was chosen with the visual scale VITAPAN® Classical (VitaZähnfabrik, Bad Säckingen, Alemanha). Then, tooth 24 was used as a reference, and the color chosen was C1 in the mid-incisal third and A2 in the cervical third (Figure 2A and 2B), which was confirmed after intraoral photography and modification to grayscale (Figure 2C and 2D).

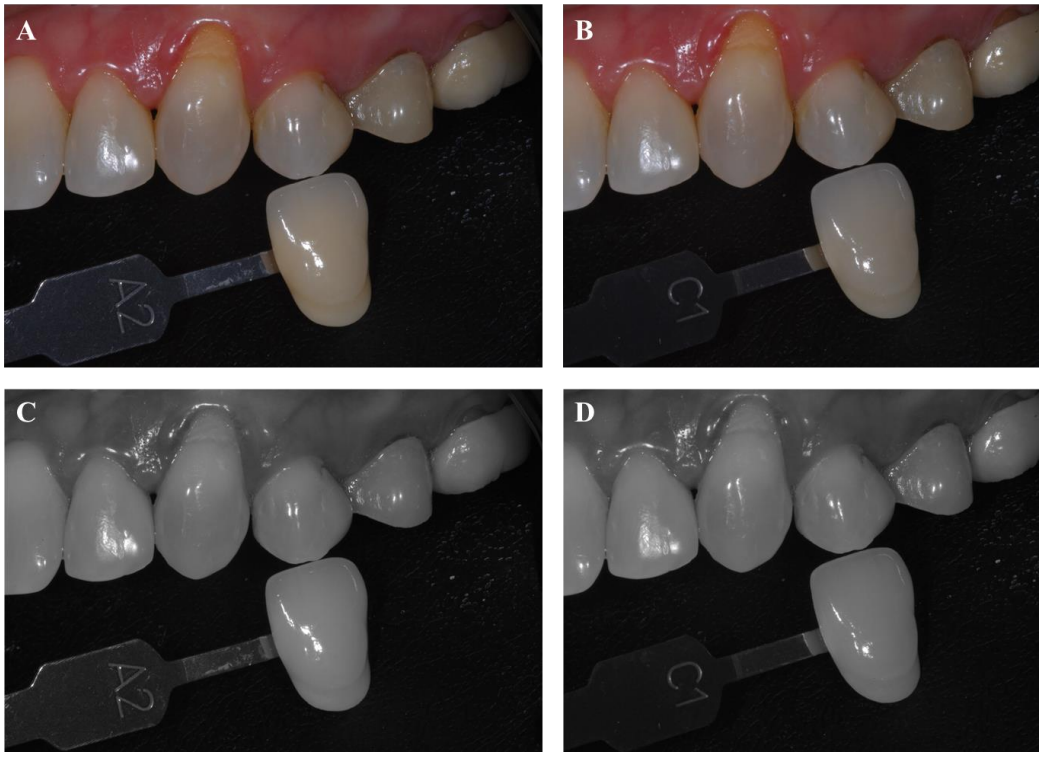

Figure 2 – A and B: Choice of ceramic color with VITA scale; **C and D:** Grayscale photography.

Also, in the first clinical session, the temporary crowns were removed, and the refinement and finishing and preparations with diamond tips (#2135 F and FF; KG Sorensen, São Paulo, Brazil) were carried out (Figure 3 A), followed by polishing with the abrasive rubber system (Composite Polishing Fast Kit, Microdont, São Paulo, Brazil) and finishing with a felt disc (Diamond Flex, FGM, Joinville, Brazil) associated with diamond paste (Diamond Excel, FGM, Joinville, Brazil). These steps are important to ensure the requirements for a full crown preparation. They are sharp edges, rounded bevel, adequate depth and expulsion, polishing, and smoothness.

After refining and polishing the preparation, molding was performed using the double printing technique. For this purpose, a fine retractor cord (#000, UltraPak, Ultradent Products,

Cologne, Germany) was inserted into the gingival sulcus of the teeth to demonstrate the termination and control of the crevicular fluid (Figure 3B). Then, the molding was performed with the dense and light addition silicone (Aquasil Easy Mix Putty, Dentsply Sirona, Bensheim, Germany). After this stage, type IV stone plaster was cast (Durone IV, Dentsply Sirona, Petrópolis, Brazil) to make the working model. With the model cut out, it was taken for scanning. Soon after, the temporary ones were relined with autopolymerized acrylic resin (Jet and Dencôr – Artigos Odontológico Clássicos Ltda,. São Paulo, Brazil), polished, adjusted and cemented with provisional cement (Temp bond – NE, Kerr, Joinville, Brazil) (Figure 3C).

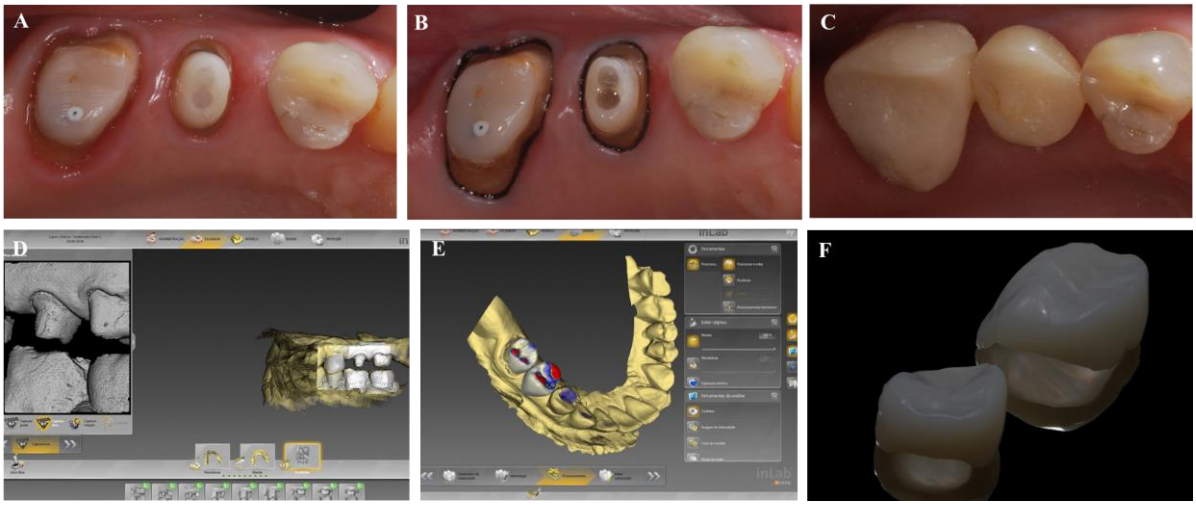

Figure 3 – A: Final appearance of the preparation; **B:** Insertion of retracting cords; **C:** Temporary restoration in acrylic resin; **C and D:** Crown planning in CAD/CAM software; **E:** Milled crowns.

A laboratory stage was carried out between the two clinical sessions to manufacture full crowns with CAD-CAM technology (InLab MC XL, Sirona Dental Systems GmbH, Bensheim, Germany). Therefore, the technician scanned the plaster model with InLab15.0 software (Sirona Dental Systems GmbH, Bensheim, Germany), drawing the full crown's contours and the occlusal relationships virtually (Figures 3D and 3E). Then, full crowns were milled from a monolithic block of nanoceramic resin for CAD-CAM (Lava™ Ultimate, 3M, Sumaré, São Paulo, Brazil) in a standard wet milling process and set speed (Figure 3F).

The provisional restoration was removed in the second and last clinical session, and the preparation was cleaned with a pumice stone. Finally, the test of the full crowns was performed to check the adaptation of the preparation and the occlusal contacts (Figures 4A and 4C). Next, the occlusal adjustment of the crowns was performed with a fine-grained

diamond tip (# 3168 F, Fava, Brazil) (Figure 4B). Then, the final test and analysis of all marginal adaptation of the crowns were carried out. The external surface was polished with abrasive rubbers (KG Sorensen, São Paulo, Brazil) (Figures 5A and 5B) and finished with a felt disc (Diamond Flex, FGM, Joinville, Brazil) associated with a diamond paste (Diamond Excel, FGM, Joinville, Brazil) to obtain a smooth and polished surface (Figure 5C).

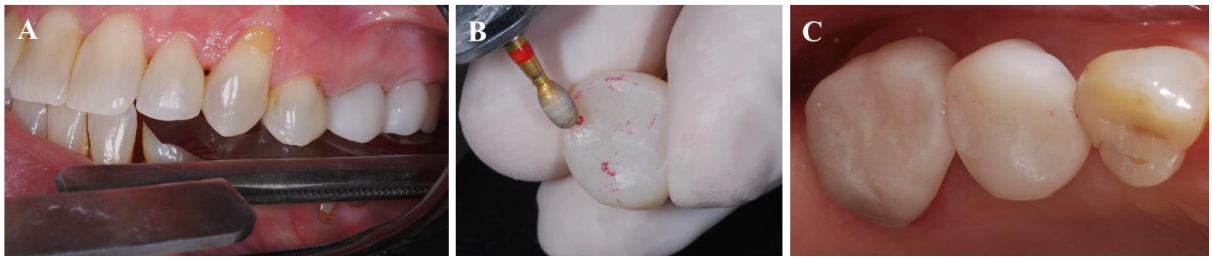

Figure 4 – A: Checking the occlusal contacts; **B:** Crown adjustment; **C:** Checking the adaptation.

The nanoceramic resin used (Lava™ Ultimate, 3M, Sumaré, São Paulo, Brazil) corresponded to a monolithic block with a lighter color than the patient's natural teeth it was necessary to carry out a characterization of the crowns. For this, surface preparation of the pieces was performed, which consisted of applying 37% phosphoric acid (Dentsply Sirona, Petrópolis, RJ, Brazil) for 20 seconds, followed by abundant washing with water 60 seconds and drying with an air jet (Figures 5D and 5E). Then, two thin layers of primer/silane activator mixture (Silano Mais, Dentsply Sirona, Petrópolis, RJ, Brazil) were applied at a ratio of 1:1 and left to rest for at least 60 seconds (Figure 5F). Finally, an adhesive layer was applied (Prime & Bond Universal, Dentsply Sirona, Petrópolis, RJ, Brazil) as recommended by the manufacturer (Figure 5G), followed by light-curing for 10 seconds (Figure 5H). With the pieces ready, the characterization was then carried out with the Yellow and Gray pigments of the Optiglaze Color system (GC, Tokyo, Japan) followed by light curing for 40 seconds on each face, and the pigments were applied.

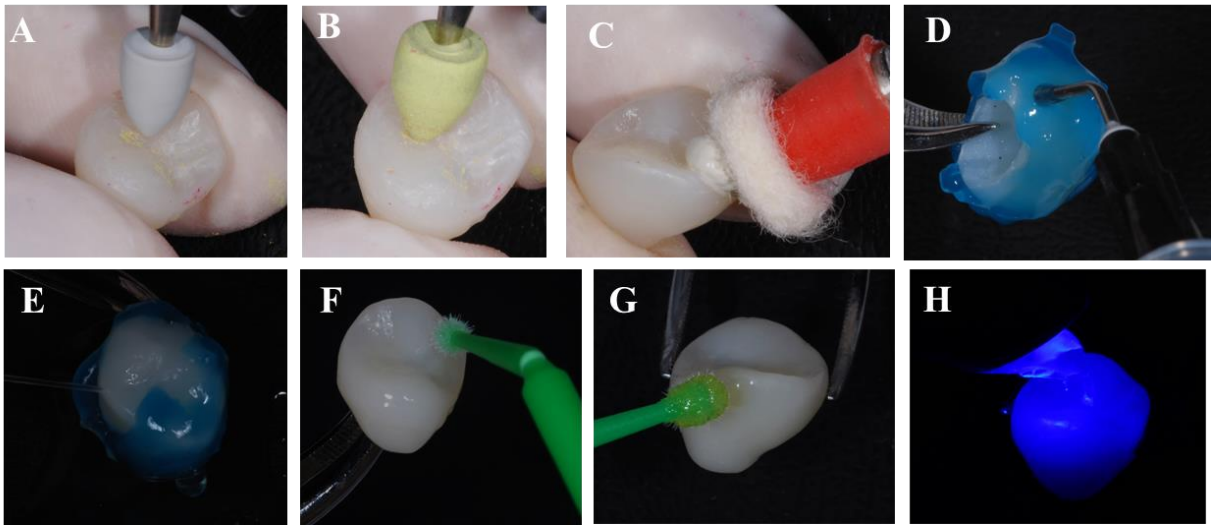

Figure 5 – A and B: Polishing with abrasive rubbers; **C:** Polishing with felt disc association a diamond paste **D:** Phosphoric acid pplication (20 s); **E:** Acid wash; **F:** Silane application; **G:** Universal adhesive application; **H:** Light-curing of adhesive.

Before the cementation process, sandblasting with aluminum oxide (50 µm) was performed for 15 seconds (Figure 6A) on the inner surface of the crowns. After that, to appropriate cementation, surfaces of the nanoceramic crowns and the teeth were treated 37% phosphoric acid (Dentsply Sirona, Petrópolis, RJ, Brazil) was applied on the internal surface of the full crowns for 20 seconds (Figures 6B and 6C), and the surfaces teeth was applied for 30 seconds, followed by rinsing with water and air-drying with oil-free air. Then, two thin layers of the primer/activator silane mixture (Silano Mais, Dentsply Sirona, Petrópolis, RJ, Brazil) was applied and left for rest for at least 60 seconds to ensure evaporation of the solvent before adhesive cementation (Figure 6D).

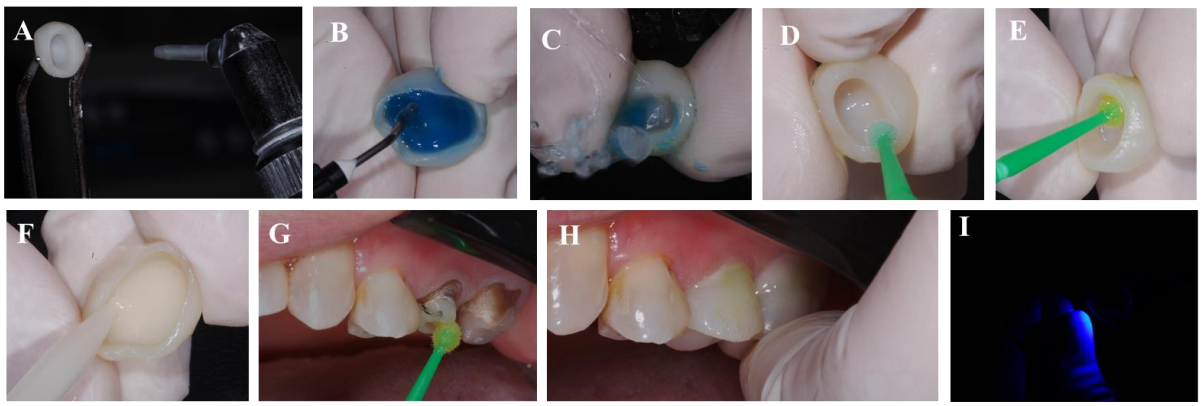

Figure 6 – A: Aluminum oxide application; **B and C:** Application of phosphoric acid and washing; **D:** Silane application; **E:** Adhesive application; **F:** Cement application **G: H:** Crown cementation; **I:** Cement light-activation.

To treat the tooth surface, 37% phosphoric acid (Dentsply Sirona, Petrópolis, RJ, Brazil) was applied on enamel for 30 seconds, rinsed with water, and air-dried. Followed of universal adhesive application (Prime & Bond Universal, Dentsply Sirona, Petrópolis, RJ, Brazil), which was applied onto the crown and teeth surfaces, vigorously, as recommended by the manufacturer, without precuring (Figures 6D and 6G). Soon after, the dual-cure resin cement (Calibra Ceram, Dentsply Sirona) was applied to the internal surface of the nanoceramic full crowns, which was then positioned over the preparations (Figure 6H). Next, an initial light-curing was made using a LED curing unit (Radii-Cal, SDI, Basywater, Victoria, Australia) set to an irradiance of 1200mW/cm2 for 5 seconds (Figure 6I). This light-curing allows the removal of excess cement with ease without losing the stability of the pieces in position. After removing the excesses, a final light-curing was carried out for another 40 seconds on each face of the full crowns.

In intraoral photography (Figure 7A), it is possible to observe the excellent adaptation of the full crowns after cementation, returning form and function. Furthermore, in the extraoral photograph, we observed an aesthetic harmony regarding the color of the crowns in the patient's smile (Figure 7B).

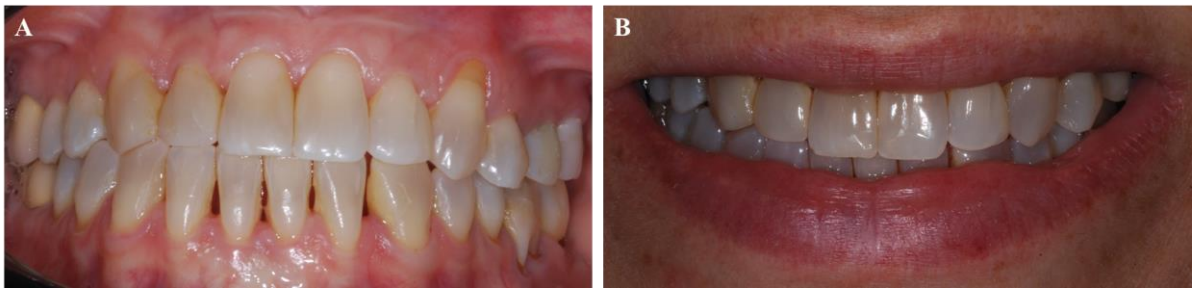

Figure 7 – A: Intraoral photograph after immediate completion of treatment **B:** Extraoral.

Discussion

CAD/CAM technology can be used through two workflows, fully digital or partial. The difference between them is that all steps are performed in a single session in the fully digital flow since the dentist has the CAD/CAM system (4,5). Thus, the same consultation is carried out the preparation, intraoral scanning, restoration planning, and part milling. However, a disadvantage of the technique is the high cost of equipment and training when there is not a high flow of patients (15).

An alternative for these situations is the use of partial workflow, as described in this clinical report. In which working plaster models were made from conventional molding and then taken to the laboratory and scanned with the CAD/CAM software. This information is

then transmitted to the machine that will mill the nanoceramic crowns. Therefore, it is a way to take advantage of CAD/CAM technology and obtain quality indirect restorations with the most diverse materials, reducing costs and offering the patient a quick treatment (16) of only two clinical sessions, as seen in this clinical case.

According to the manufacturer, the prefabricated Lava Ultimate nanoceramic resin blocks can be found in various colors, the color available for milling the full crowns was A1-HT. As it is a white block, it was necessary to perform the extrinsic characterization of the restoration to mimic the color of the patient's adjacent teeth. However, there are no studies in the literature that prove the longevity of maintaining the extrinsic characterization with these light-curing pigments. It should also be noted that extrinsic characterization is a process that requires manual dexterity to obtain ideal esthetics and, as it is a step that involves laboratory care, it can prolong the total time of the restorative treatment (5).

The nanoceramic manufacturers also inform that LavaTM Ultimate can be indicated for different indirect restorations such as inlay, onlay, veneers, and full crowns. This restorative material combines the characteristics of polymers, which have an elastic modulus similar to dentin, with the reinforcement mechanism of ceramics (7). Furthermore, the nanoceramic is composed of zirconia nanoparticles and zirconia-silica nanoclusters linked by a highly cured resin matrix (Bis-GMA, UDMA, Bis-EMA, TEGDMA) (2) Thus, the use of this restorative material for CAD/CAM in the fabrication of full crowns as described in the case report section is well indicated.

In the study by Sen and Us (12), the biaxial flexural strength of nanoceramic resin (Lava™ Ultimate; 3M – ESPE), feldspathic ceramic (VITAblocks Mark II; VITA Zahnfabrik), lithium disilicate reinforced ceramic (IPS e.max CAD; Ivoclar Vivadent), and hybrid ceramic (VITA Enamic; VITA Zahnfabrik) was compared. And it was observed that the group restored with IPS e.max CAD achieved superior flexural strength, followed by the group restored with Lava™ Ultimate, VITA Enamic, and VITAblocks Mark II, all with statistical differences between them.

Studies evaluating crowns with different thicknesses, such as that by Chen et al. (17), observed that the fatigue strength of IPS e.max ceramic was superior to the resin at thicknesses of 3.0 mm. However, there were no differences in average thicknesses of 1.0 mm, 1.5 mm, and 2.0 mm, and in crowns with ultra-thin thicknesses of 0.5 mm, LavaTM Ultimate presented superior performance. Furthermore, Carvalho et al. (18) and Magne et al. (9) found

no significant difference between the two materials for 1.5 mm and 0.7 mm thick crowns, respectively, after performing the fatigue test, although the 41 crowns reinforced with lithium disilicate had greater survival. These findings demonstrate that although ceramics are considered the material of the first choice for indirect restorations due to their mechanical and aesthetic properties, nanoceramic resins such as the one used in this case report can also be an excellent choice for making a total crown. Since they indicate that the fatigue strength of crowns made of nanoceramic resin (Lava™ Ultimate), lithium disilicate ceramic, or feldspathic may be influenced by the thickness of these materials (9).

Regarding cementation, it is essential to choose a system compatible with the restorative materials used and the clinical dental substrate so that the longevity of the treatment can be successful (19). Thus, the choice of cement should be based on adhesive strength, resistance to compression and flexion, adequate marginal sealing, aesthetics, and ease of handling (20). Since the leading causes of adhesive failure refer to the loss of retention of the piece with the dental substrate and marginal adhesive degradation (21). In the described clinical case, full crowns made of nanoceramic resin and milled in a CAD/CAM system showed excellent marginal adaptation. A dual resin cement was used for the cementation, which involves chemical and physical activation (22). Dual resin cements are indicated in most clinical situations, as the action of the two activation systems improves the physical properties of the cement, increasing the degree of conversion of monomers into polymers. In addition, they are particularly indicated in situations where access to light for photoactivation is difficult (18,23).

Given the above, it can be concluded that there is still no indirect restorative material produced by the CAD/CAM system with total superiority for making restorations (18). Both ceramics and resins have advantages and disadvantages when subjected to load tests (7,13,17,18). However, the CAD/CAM technology in the totally digital or partial flow provides quality in manufacturing pieces from nanoceramic resin blocks, with a fast investment and low cost.

Conclusion

The use of nanoceramic resin (Lava™ Ultimate) for confection full crowns associated with partial digital flow allowed effective results, restoring the shape, esthetic, and function of the tooth in a predictable, fast, and safe.

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Conflict of Interest

The authors declare that they have no conflict of interest.

References

1. Tinschert J, Natt G, Hassenpflug S, Spiekermann H. Status of current CAD/CAM technology in dental medicine. Int J Comput Dent. 2004;7(1):25–45.

2. Lauvahutanon S, Takahashi H, Shiozawa M, Iwasaki N, Asakawa Y, Oki M, et al. Mechanical properties of composite resin blocks for CAD/CAM. Dent Mater J. 2014;33(5):705–10.

3. Mörmann WH. The origin of the Cerec method: a personal review of the first 5 years. Int J Comput Dent. 2004 Jan;7(1):11–24.

4. Moörmann WH. The evolution of the CEREC system. J Am Dent Assoc. 2006 Sep;137:7S-13S.

5. Hilgert L, Schweiger J, Beuer F, Andrada M, Araújo E, Edelfoff D. CAD/CAM restorative dentistry: the present state-of-the-art. Part 2 – Restorative Possibilities and CAD/CAM Systems. Clín Int J Braz Dent. 2009;5(4):424:435.

6. Beuer F, Schweiger J, Edelhoff D. Digital dentistry: An overview of recent developments for CAD/CAM generated restorations. Br Dent J. 2008;204(9):505–11.

7. Ruggiero MM, Soares Gomes R, Pedroso Bergamo ET, Freitas MIM, Bonfante EA, Del Bel Cury AA. Resin-matrix ceramics for occlusal veneers: Effect of thickness on reliability and stress distribution. Dent Mater. 2021 Mar;37(3):e131–9.

8. Amesti-Garaizabal, Agustín-Panadero, Verdejo-Solá, Fons-Font, Fernández-Estevan, Montiel-Company, et al. Fracture Resistance of Partial Indirect Restorations Made With CAD/CAM Technology. A Systematic Review and Meta-analysis. J Clin Med. 2019 Nov 9;8(11):1932.

9. Magne P, Carvalho AO, Bruzi G, Giannini M. Fatigue resistance of ultrathin CAD/CAM complete crowns with a simplified cementation process. J Prosthet Dent. 2015 Oct;114(4):574–9.

10. Makhija SK, Lawson NC, Gilbert GH, Litaker MS, McClelland JA, Louis DR, et al. Dentist material selection for single-unit crowns: Findings from the National Dental Practice-Based Research Network. J Dent. 2016 Dec;55:40–7.

11. Lawson NC, Bansal R, Burgess JO. Wear, strength, modulus and hardness of CAD/CAM restorative materials. Dent Mater. 2016;32(11):e275–83.

12. Sen N, Us YO. Mechanical and optical properties of monolithic CAD-CAM restorative materials. J Prosthet Dent. 2018;119(4):593–9.

13. Della Bona A, Corazza PH, Zhang Y. Characterization of a polymer-infiltrated ceramic-network material. Dent Mater. 2014 May;30(5):564–9.

14. Fasbinder DJ, Neiva GF, Heys D, Heys R. Clinical evaluation of chairside Computer Assisted Design / Computer Assisted Machining nanoceramic restorations : Five-year status. J Esthet Restor Dent. 2020;32(2):193–203.

15. Davidowitz G, Kotick PG. The Use of CAD/CAM in Dentistry. Dent Clin North Am. 2011 Jul;55(3):559–70.

16. Montenegro G, Tine J, Silva W, Pinto T. Aesthetic Rehabilitation with Ceramic Laminates By the System CAD/CAM- A Case Report. Adv Dent Oral Heal. 2018 Aug 29;9(4):555769.

17. Chen C, Trindade FZ, de Jager N, Kleverlaan CJ, Feilzer AJ. The fracture resistance of a CAD/CAM Resin Nano Ceramic (RNC) and a CAD ceramic at different thicknesses. Dent Mater. 2014 Sep;30(9):954–62.

18. Carvalho AO, Bruzi G, Giannini M, Magne P. Fatigue resistance of CAD/CAM complete crowns with a simplified cementation process. J Prosthet Dent. 2014 Apr;111(4):310–7.

19. Flor-Ribeiro MD, Pierote JJA, Marchi GM, Paulillo LAMS. Conservative Substitution of Fractured Ceramic Onlays Using Self-Adhesive Cement: Case Report. J Heal Sci. 2019;21(5):464–9.

20. Soares CJ, Faria-E-Silva AL, Rodrigues M de P, Vilela ABF, Pfeifer CS, Tantbirojn D, et al. Polymerization shrinkage stress of composite resins and resin cements - What do we need to know? Braz Oral Res. 2017 Aug 28;31(suppl 1):e62.

21. Manuja N, Nagpal R, Pandit IK. Dental adhesion: mechanism, techniques and durability. J Clin Pediatr Dent. 2012;36(3):223–34.

22. Caughman WF, Chan DC, Rueggeberg FA. Curing potential of dual-polymerizable resin cements in simulated clinical situations. J Prosthet Dent. 2001 May;85(5):479–84.

23. Braga RR, Cesar PF, Gonzaga CC. Mechanical properties of resin cements with different activation modes. J Oral Rehabil. 2002 Mar;29(3):257–62.

3 CONCLUSÃO

A utilização da resina nanocerâmica (Lava™ Ultimate) para confecção de coroas totais associada ao fluxo digital parcial permitiu a obtenção de resultado satisfatório. As coroas totais devolveram forma, função e estética ao dente de maneira previsível, rápida e segura.

REFERÊNCIAS*

Amesti-Garaizabal, Agustín-Panadero, Verdejo-Solá, Fons-Font, Fernández-Estevan, Montiel-Company, et al. Fracture Resistance of Partial Indirect Restorations Made With CAD/CAM Technology. A Systematic Review and Meta-analysis. J Clin Med. 2019 Nov 9;8(11):1932.

Beuer F, Schweiger J, Edelhoff D. Digital dentistry: An overview of recent developments for CAD/CAM generated restorations. Br Dent J. 2008;204(9):505–11.

Della Bona A, Corazza PH, Zhang Y. Characterization of a polymer-infiltrated ceramic-network material. Dent Mater. 2014 May;30(5):564–9.

Fasbinder DJ, Neiva GF, Heys D, Heys R. Clinical evaluation of chairside Computer Assisted Design / Computer Assisted Machining nano-ceramic restorations : Five-year status. J Esthet Restor Dent. 2020;32(2):193–203.

Hilgert L, Schweiger J, Beuer F, Andrada M, Araújo E, Edelfoff D. CAD/CAM restorative dentistry: the present state-of-the-art. Part 2 – Restorative Possibilities and CAD/CAM Systems. Clín Int J Braz Dent. 2009;5(4):424:435.

Lauvahutanon S, Takahashi H, Shiozawa M, Iwasaki N, Asakawa Y, Oki M, et al. Mechanical properties of composite resin blocks for CAD/CAM. Dent Mater J. 2014;33(5):705–10.

Lawson NC, Bansal R, Burgess JO. Wear, strength, modulus and hardness of CAD/CAM restorative materials. Dent Mater. 2016;32(11):e275–83.

Magne P, Carvalho AO, Bruzi G, Giannini M. Fatigue resistance of ultrathin CAD/CAM complete crowns with a simplified cementation process. J Prosthet Dent. 2015 Oct;114(4):574–9.

Makhija SK, Lawson NC, Gilbert GH, Litaker MS, McClelland JA, Louis DR, et al. Dentist material selection for single-unit crowns: Findings from the National Dental Practice-Based Research Network. J Dent. 2016 Dec;55:40–7.

Moörmann WH. The evolution of the CEREC system. J Am Dent Assoc. 2006 Sep;137:7S-13S.

* De acordo com as normas da UNICAMP/FOP, baseadas na padronização do International Committee of Medical Journal Editors - Vancouver Group. Abreviatura dos periódicos em conformidade com o PubMed.

Mörmann WH. The origin of the Cerec method: a personal review of the first 5 years. Int J Comput Dent. 2004 Jan;7(1):11–24.

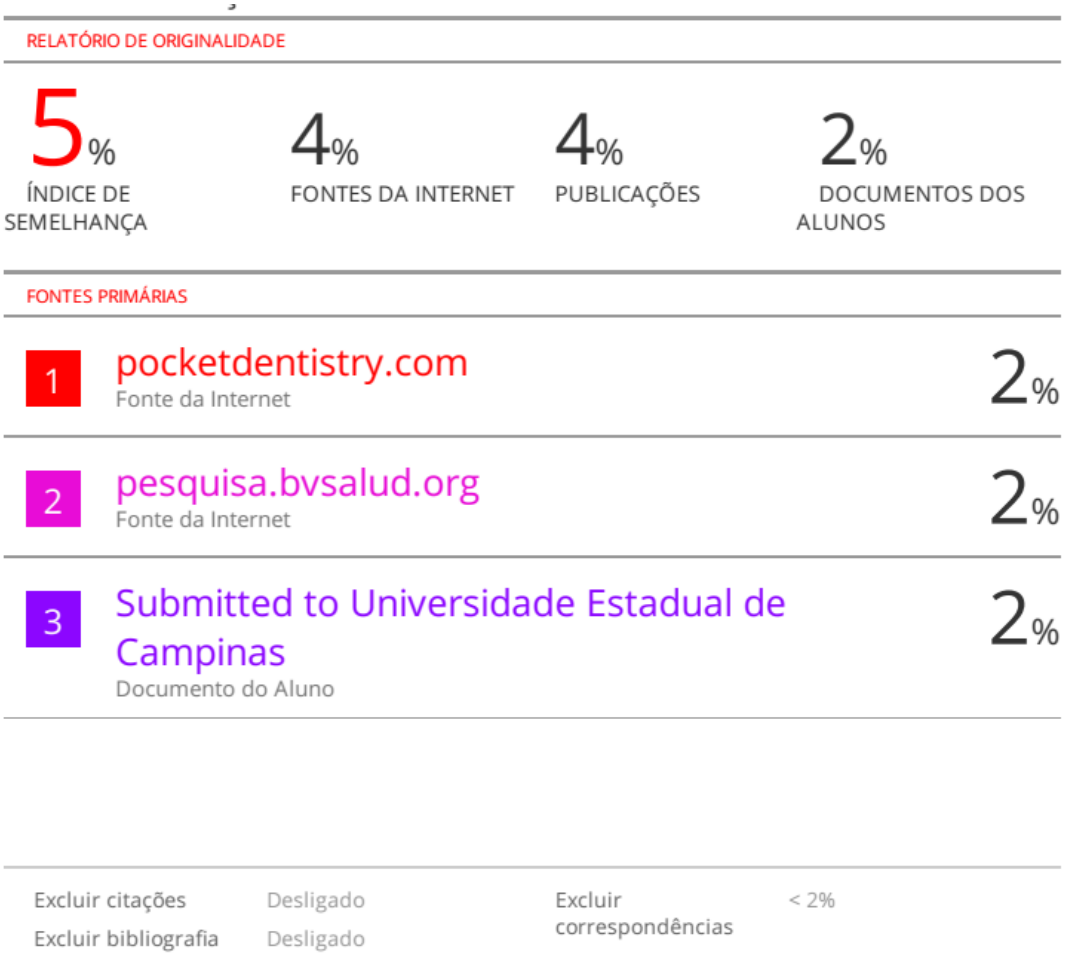
Ruggiero MM, Soares Gomes R, Pedroso Bergamo ET, Freitas MIM, Bonfante EA, Del Bel Cury AA. Resin-matrix ceramics for occlusal veneers: Effect of thickness on reliability and stress distribution. Dent Mater. 2021 Mar;37(3):e131–9.

Sen N, Us YO. Mechanical and optical properties of monolithic CAD-CAM restorative materials. J Prosthet Dent. 2018;119(4):593–9.

Tinschert J, Natt G, Hassenpflug S, Spiekermann H. Status of current CAD/CAM technology in dental medicine. Int J Comput Dent. 2004;7(1):25–45.

ANEXO

Anexo 1 - Verificação de originalidade e prevenção de plágio por meio do software Turnitin



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