



## CASE REPORT

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# Full digital workflow in fixed adhesive dental prosthesis: Description of a clinical technique

Fluxo de trabalho digital completo em prótese fixa adesiva: descrição de uma técnica clínica

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## ABSTRACT

Digital dentistry has gained space in several dental specialties. It is possible to achieve excellent results with the digital workflow, which combines the efficiency of the restorative material with a greater marginal adaptation. This study aimed to report a clinical case through the digital workflow, with a faster and clinically acceptable prosthetic resolution. In this clinical case report, digital workflow allowed a faster and clinically acceptable prosthetic resolution. A 45-year-old female patient reported cementation failure of the prosthetic crown on tooth 14. As it was a vital tooth, the tooth received a total crown preparation. In the same clinical session, the patient's mouth was scanned then a capture software obtained a virtual model. After, the design software planned a digital "diagnostic wax-up", so a leucitic ceramic was chosen for the rehabilitation. The ceramic block was milled and receive stain and glaze, dispensing the prosthesis laboratory. Then, the adhesive cementation was performed with a dual-polymerized resin cement. The final crown had ideal adaptation, with no need for interproximal and occlusal adjustments, with an excellent marginal fit. Within the limitations of this study, this case report showed that the digital workflow allowed a favorable result in a shorter working time, which brought back function and aesthetics, without the need for interproximal and occlusal adjustments.

## KEYWORDS

Prosthodontics; Cosmetic dentistry; CAD-CAM.

## RESUMO

A odontologia digital vem ganhando espaço em diversas especialidades odontológicas. Com o fluxo de trabalho digital, é possível alcançar excelentes resultados na reabilitação protética, combinando a eficiência do material restaurador com a adaptação marginal proporcionada pela odontologia digital. O objetivo desse estudo foi relatar um caso clínico através do fluxo de trabalho digital, com uma resolução protética mais rápida e clinicamente aceitável. Paciente do sexo feminino, 45 anos, relatou falha de cimentação da coroa protética do dente 26. Por ser um dente vital, o dente recebeu um preparo de coroa total e os dentes foram escaneados e um software de captura obteve um modelo virtual. Posteriormente, o software de projeto planejou um "enceramento diagnóstico" digital, sendo escolhida uma cerâmica leucítica para a reabilitação. O bloco cerâmico foi fresado e recebeu acabamento, maquiagem e glaze pelo próprio dentista, dispensando um técnico laboratorial de prótese dentária. Em seguida, foi realizada cimentação adesiva definitiva. Este relato de caso mostra que, dentro das limitações desse estudo, o fluxo digital permite um resultado favorável em um menor tempo de trabalho, devolvendo a função e estética, sem necessidade de ajustes interproximais e oclusais.

## PALAVRAS-CHAVE

Prótese dentária; Odontologia estética; CAD-CAM.

## INTRODUCTION

Currently, the advent of digital dentistry has revolutionized the way of working with restorative dentistry [1,2]. Its use can provide a mechanized and more standardized workflow, with less chance of technical failures and greater agility during clinical and laboratory procedures [1,3]. Indirect restorative procedures, such as full ceramic crown rehabilitations, are commonly proposed treatments in the routine of dentists and prosthetic technicians. The conventional workflow is a joint work between the dental office and the laboratory, with procedures based on several steps. Thus, it is a great deal to skip laboratory steps and not depending on specific materials and manual techniques, such as the manipulation of impression materials and dental plasters, and also the manual skill of the prosthetic technician. These steps could add errors and distortions in the final result, being one of the main reasons for choosing a full digital workflow [1,4].

This working relationship between the clinic and the prosthesis laboratory also demands a longer time for the completion of the treatment, considering the need to send impressions and plaster casts to the technician, their manual manufacturing process, and the performance of functional and aesthetic tests, creating an extended and costly flow [5]. The advent of digital dentistry brought new possibilities of workflow, based on the use of intraoral scanning processes, digital planning by CAD software, and finally, a mechanized prosthetic milling machine (CAM) to reproduce the planned restoration. In the new scenario, the digital workflow can suppress the dental technician. The advantage of the full digital workflow is less chance of maladjustment and major adjustments [6,7].

Several studies reported that CAD/CAM technology is a reliable alternative for making fixed partial dentures [1,6]. Full digital

workflow, from scanning to manufacturing the dental prostheses, proved to be safe and reproducible in clinical practice [2]. Restorative treatment is often necessary in one or a few days, depending on the dentist's skill and the patient's requirement. Therefore, the objective of this work was to illustrate a clinical technique in which a fully digital workflow showed how fast and clinically acceptable was the prosthetic resolution of a fixed ceramic prosthesis in restorative dentistry.

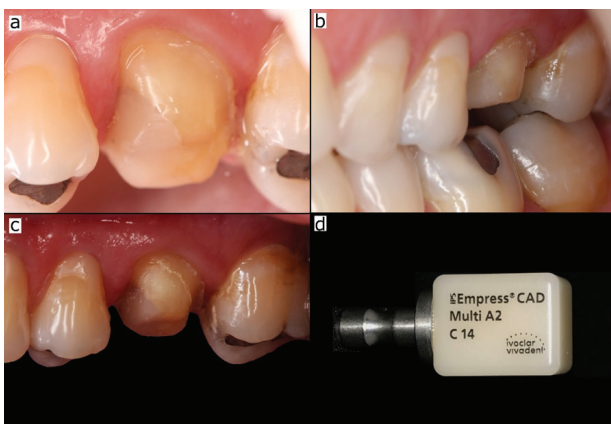
## CASE REPORT

A female patient, leucoderma, 45 years old, went to the dental clinic care of the "CAD/CAM" discipline in the postgraduate program of Restorative Dentistry, at the Institute of Science and Technology (ICT - UNESP), in São José dos Campos campus, complaining of cementation failure of the prosthetic crown previously made on tooth 14, and tooth sensitivity (first left maxillary molar) (figure 1a-b). During the clinical examination, the patient had a provisional crown with premature contact, responsible for the temporary cementation failure and sensitivity ratio, since the dentin was exposed. The tooth was prepared for a new full ceramic crown, using diamond burs #4138 and #4138F (KG Sorensen). The final preparation had a better demarcated and regularized chamfer and received a final polishing with the Dura White FG bur (Shofu Inc.) by a 5:1 high-speed contra-angle (Dentsply Sirona) (figure 1c).

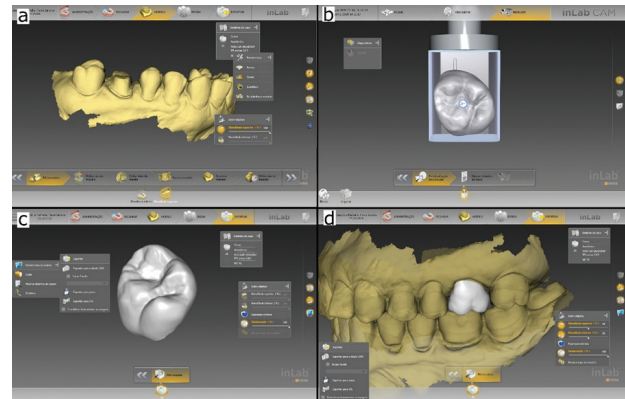
Afterward, the mouth of the patient was scanned by the intraoral scanner CS 3600 Dental (Carestream Dental), both patient's dental arches. Subsequently, the virtual casts were acquired by the CS 3D Imaging Software (Carestream Dental). The gum was retracted using Ultrapak #00 gingival thread retraction (Ultradent Inc.) to properly scan element 14, providing an adequate visualization of the finishing line by the scanner. Then, the scanner

projected a LED light on the dental preparation. The utilized scanner did not require the application of powder on the intraoral surface to capture the image. LED light obtained the image of the area of interest. The scanner was connected directly to a computer with digitization software, where the digital impressions were exported in an open STL format. An open system guaranteed complete freedom for the clinician to manage the subsequent stages of prosthetic rehabilitation [2].

In a second computer, the inLab CAD SW 19 (Dentsply Sirona) software designed, planned, and machining the future crown because of the direct connection to the CEREC mill (Dentsply Sirona) machine. Due to the good occlusal pattern in MIH and an adequate presence of lateral and anterior disocclusion guides in canines and incisors, the milling material was a monolithic leucitic ceramic block, IPS Empress CAD Multi A2 (Ivoclar Vivadent) (figure 1-d). In the inLab software, the digital wax followed basic parameters of dental morphology. The thickness of the restoration, the position in the dental arch, and the dental contacts related to the antagonist teeth were slightly modified (figure 2a-d).

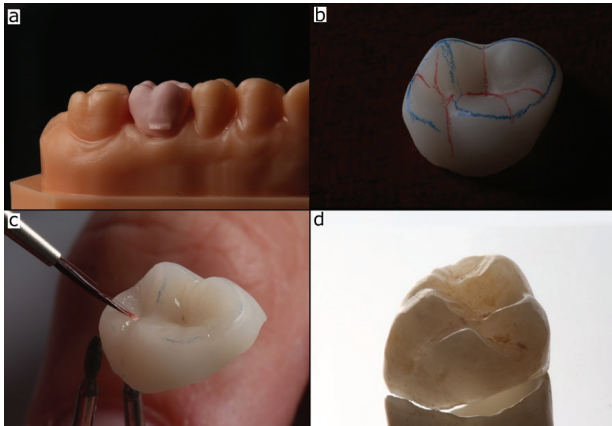


**Figure 1** - a-b) Initial aspects of the preparation for full crown on tooth 26. c) Final feature after reparation, adjustment of the margins, and polishing. d) IPS Empress CAD Multi A2 monolithic ceramic block.



**Figure 2** - a) Digital model after intraoral scanning. b-c) Full crown planning in a ceramic block and finalizing the digital planning of the prosthetic crown. d) Interocclusal relationship planning with scanned antagonist arch.

The ceramic restoration received finishing, stain, and glaze application at the university, dispensing its send to the prosthesis laboratory (figure 3a-d). A trained dentist applied the stain and glaze, using the IPS Ivocolor kit (Ivoclar Vivadent), with the application of stain and glaze by the Kolinsky brush number 4 (Renfert). The firing cycle followed the manufacturer's recommendation, with a waiting temperature of 403 °C and a closing time of 6 minutes. The heating rate was 60 °C/min. The firing temperature was 710 °C with a waiting time of 1 minute. After the firing cycle, the restoration cooled at room temperature. Diamond discs, polishers, and rubbers suitable for ceramics made the finishing of the prosthetic piece received. In the end, the prosthetic crown received a final layer of glaze.



**Figure 3** - a) Crown milled and adapted in a digitally printed model before the sintering process. b) Colored visual planning for manual finishing after sintering. c) Crown staining process. d) Final aspect of the crown after stain and glaze application.

Clinically, it was performed the functional proof (dry) and wet proof. The settlement of the prosthetic restoration was given by the dry proof, the marginal fit at the preparation finish line, the contact points with the adjacent teeth, the occlusal points with the antagonist, and the contacts in lateral and protrusive movements. The prepared tooth had a supra-gingival finishing line allowing a visualization of the correct prosthetic fit, but also, an exploratory probe number 5 proven the fit. There was no overlap or lack of material after the inspection, so the fit was ideal. The contacts on the prosthetic piece were smooth allowing the touching of the adjacent teeth, with no excessive contact on the prosthetic restoration. For lateral and protrusive movements, the patient had an ideal occlusal pattern, with posterior teeth disocclusion when performing mandibular excursion movements, the same happened for the prosthetic restoration. In consequence, the prosthetic tooth did not need any adjustments, so the restorative procedure became faster.

For the cementation, the 10% hydrofluoric acid (Condac Porcelain, FGM Produtos Odontológicos) etched the internal area of the crown per 60 seconds, then after, an air-water spray washed and dried the crown

per 60 seconds. Then, Monobond N (Ivoclar Vivadent) silanized the crown by a disposable applicator (Brush, KG Sorensen). The thin layer of silane dried on the natural environment. Subsequently, the internal prosthetic piece received the application of ExciTE F DSC dual adhesive by a customized applicator with a regular format (Ivoclar Vivadent), according to the manufacturer's guidelines with nonlight curing.

Afterward, the phosphoric acid N-Etch 37% (Ivoclar Vivadent) etched the surface tooth, using the total conditioning technique, applying the acid for 30 seconds on the enamel and 15 seconds over the dentin. Then, an air-water spray washed the surface for 30 seconds. Later, the tooth received the same adhesive system of the prosthetic piece, finalizing the hybridization process in the entire dental preparation, which created a thin and homogeneous layer of adhesive. Then the air spray quickly dried the adhesive layer, according to the manufacturer's guidelines, with no photopolymerization of the adhesive.

Finally, the Variolink N base light-curing paste (Ivoclar Vivadent) cemented the prosthetic piece over the surface tooth (figure 4a-b). The internal surface of the ceramic restoration received a layer of the cement base. Finally, the prosthetic crown was inserted over the preparation until its proper settlement. A brush and an exploratory probe removed the excesses of cement. Bluephase (Ivoclar Vivadent) light-curing photoactivated the cement. Each surface (vestibular, palatal, occlusal, and proximal) received a photoactivation per 20 seconds. After cementation, the dental floss removed any excess cement in the proximal areas, and the occlusal contacts were evaluated by an occlusal marking film, with no need for any adjustments. The patient received follow-ups of seven days, thirty days, six months, and one year (figure 4c-d).



**Figure 4** - a) Final aspect immediately after cementation in occlusal view. b) Anterior intraoral view showing appropriate appearance of the rehabilitated element. c) Vestibular view of the dental prosthesis in maximum usual intercuspation after a 30-day control. d) Final appearance after cementation in vestibular view after six months of prospect.

## DISCUSSION

The purpose of this article was to illustrate a clinical technique in oral rehabilitation by the use of CAD/CAM tool. The technology makes the rehabilitation process faster, reduces costs with the prosthesis laboratory, and develops high-quality rehabilitation work. It is known that all-ceramic rehabilitation has a high cost and, the use of technology at the university expands the population's access to this type of rehabilitation. It is also known that the long-term restoration success depends on many factors, including the excellent marginal fit of prosthetic restoration to the tooth structure. Secondary caries can arise in restorations that failed in adaptation because of bacterial penetration in the mismatch region. Thus, it is mandatory to obtain an adequate impression and a plaster cast to favor the longevity of prosthetic restorations [8-13]

Several studies analyzed the level of precision achieved by intraoral scanning processes and by CAD/CAM systems [7,14-16]. It was found in the studies that the scanning impression obtained adequate virtual casts in which restorations had an efficient marginal precision when compared to the conventional impression. The impression materials used

for oral rehabilitation are usually elastomeric, which have adequate dimensional stability for performing the prosthetic work, as long as they are well indicated and manipulated when compared to hydrocolloid impression materials [17]. Although the elastomeric materials have great stability properties, when performed in studies and clinical practice, several flaws and errors can occur in the prostheses confection by the analog workflow. Such errors can be associated with the clinical phase, such as inadequate preparations impressions; and also with the laboratory phase, as in the impression disinfection, pouring the plaster cast, and the transportation of the work between the dental office and the dental laboratory, which can generate inaccuracies [18-20].

According to McLean and von Fraunhofer [21], the minimum values of marginal adaptation between the restoration and tooth should be up to 120 micrometers ( $\mu\text{m}$ ). Although some studies have shown that the analog method can achieve more accurate adaptation values when compared to the values obtained by the digital method, still, the digital method achieves acceptable and well-consolidated values in the literature. Minimum adaptation values ( $120 \mu\text{m}$ ) were obtained for both intraoral and laboratory scanning [22,23]. When evaluating the marginal fit of crowns, it could be observed in a study that there were no significant differences between crowns processed by the conventional and the digital method. However, for the occlusal regions, crowns processed by conventional methods obtained a lower rate of occlusal adjustment when compared to digital crowns [6]. In the present clinical case, there was no need for proximal and occlusal adjustments.

The digital workflow minimizes the possibility of errors compared to the analogical workflow because excludes the use of materials that can distort and eliminates the stage of the prosthetic laboratory. The prosthesis can be milled and finished by the dentist himself. When

the CAD/CAM technology is combined with the chairside workflow, the prosthetic restoration is obtained as soon as the digital wax-up is finished, as illustrated in the clinical technique. The applicability of CAD/CAM technology in the manufacture of fixed prostheses brought to restorative dentistry a new phase. This phase is based on faster oral rehabilitation maintaining promissory and distinguish results. Despite the high cost of intraoral scanners and the equipment necessary to perform the milling and printing of the restorations and casts, digital dentistry is already a reality, and its use is likely to rise in the coming years since it achieves excellent results.

## CONCLUSION

It was possible to conclude that the rehabilitation treatment option based on the CAD/CAM technology was efficacious in the evaluated time and can be a viable option for such clinical situations, and also was able to minimize the chance of errors and to reduce the number of steps required in the traditional oral rehabilitation.

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