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CASE REPORT

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Is scanning under rubber dam isolation a feasible approach for the execution of indirect restorations?

O escaneamento sob isolamento absoluto é uma técnica viável para execução de restaurações indiretas?

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ABSTRACT

Objective: The aim of the study was to report the aplicability of intraoral scanning while rubber dam isolation is in place. **Material and Methods:** Female patient, 50 years old, required restorative procedures on teeth 35 and 37. An intraoral scan was initially performed on both arches. Isolation was carried out from 33 to 37, tooth preparation and immediate dentin sealing were carried out. A new scan with the rubber dam in place was performed and a CAD/CAM lithium disilicate hybrid block was digitally designed, milled, crystallized and cemented under the tooth surface with the rubber dam still in position. After completing this stage, the rubber dam was removed, the occlusion was verified, presenting excellent aesthetic and functional results. **Results:** The absolute isolation process used in the present study works as an excellent device for gingival retraction. **Conclusion:** The absolute isolation can be recommended in clinical activities of intraoral scanning favoring the quality of the final result of treatments.

KEYWORDS

CAD/CAM; Denture precision attachment; Digital technology; Mouth rehabilitation; Rubber dams.

RESUMO

Objetivo: O objetivo do estudo foi relatar a aplicabilidade do escaneamento intraoral sob isolamento absoluto. **Material e Métodos:** Paciente do sexo feminino, 50 anos, necessitou de procedimentos restauradores nos dentes 35 e 37. Uma varredura intraoral foi inicialmente realizada em ambos os arcos. O isolamento absoluto foi feito de 33 a 37, permitindo a realização do preparo dentário e selamento imediato da dentina. Um novo escaneamento com o dique de borracha colocado foi realizado e um bloco híbrido de dissilicato de lítio CAD/CAM foi projetado digitalmente, fresado, cristalizado e cimentado sob a superfície dentária ainda com o dique de borracha em posição. Após a finalização dessa etapa, o dique de borracha foi removido, a oclusão foi verificada apresentando ótimos resultados estéticos e funcionais. **Resultados:** O isolamento absoluto utilizado no presente estudo funciona como um excelente dispositivo para retração gengival. **Conclusão:** O isolamento absoluto pode ser recomendado em atividades clínicas de escaneamento intraoral favorecendo a qualidade do resultado final dos tratamentos.

PALAVRAS-CHAVES

CAD-CAM; Encaixe de precisão intracoronário; Tecnologia digital; Reabilitação bucal; Diques de borracha.

INTRODUCTION

The Cad-Cam (Computer Aided Design/Computer Aided Manufacturing) technology has enabled the scanning and generation of a three-dimensional digital representation of a tooth's preparation. This digital image can be utilized for the purpose of designing and producing a dental restoration. Within prosthodontics, intra-oral scanning has streamlined the impression process by reducing the number of steps involved. This advancement enhances precision, shortens treatment duration, and ultimately results in a superior fit of the restoration when compared to traditional impressions [1-4]. In addition, the scanning procedure still demands the hability of the operator, but it requests less than the conventional impression. Consequently, it has been reported that patients prefer digital scans because they are more comfortable and less time-consuming [5-9].

It is crucial, during scanning, that the operative field remains as dry as possible. This is because the camera captures images where light interacts with the surface, potentially capturing the same image that is visible to the naked eye. Therefore, the preparation margins must be visible, requiring the application of techniques to displace gingival tissues and keep them free from saliva, gingival fluid, and blood. The presence of these fluids leads to errors due to the difference in refractive index of light in a liquid medium [10,11].

Rubber dam isolation offers several benefits for both the patient and the clinician [12,13]. The rubber dam can enhance the visual field for the clinician as it eliminates the necessity to constantly reposition the cheek, lips, and tongue, thus facilitating work in the targeted area. Additionally, it effectively manages moisture and blood [13,14].

Due to its benefits, the integration of a chairside CAD/CAM system for creating restorations along with the use of a rubber dam has evolved into a standard procedure [15,16]. The most significant benefit of this suggested approach lies in its ability to conduct scanning within a clean and dry setting. Additionally, this method can save time as it enables the clinician to promptly conduct a precise digital scan of the prepared area right after tooth preparation, without requiring additional materials like displacement cord or hemostatic agents [13].

Furthermore, creating an impression after the removal of the rubber dam can be time-consuming and complex, as there is a chance that the prepared finish line, even if it is located above the gingival margin, might become obscured by blood or saliva. This can disrupt or prolong the procedure [13]. Thus, the aim of the study was to report the aplicability of intraoral scanning while rubber dam isolation is in place.

CLINICAL REPORT

A 50-year-old female patient visited the Institute of Science and Technology of São Jose dos Campos, from São Paulo State University necessitating restorative procedures for teeth 35 and 37 (Figure 1). The tooth 35 had a history of previously performed endodontic treatment, with a direct composite resin restoration which developed secondary caries and margin maladaptation. The tooth presented buccal, mesial and palatal remaining faces. The patient reported food accumulation in the interproximal region and tearing of dental floss during its use. Tooth 37 had a history of restorative treatment with a silver amalgam alloy, presenting clinical signs of enamel cracks and misfitting edges of the restoration in relation to the tooth substrate. Remaining faces presented was buccal, distal, and palatal. The antagonist had sound teeth 24, 25, and 27, with tooth 26 as a ceramic crown.

The patient's occlusion and esthetic demands were evaluated, and the Shofu Block HC Hard - ceramic based restorative block for milling (Shofu, Japan) was selected as the restorative material (Figure 2). It is composed by Zirconium silicate, UDMA, Urethane diacrylate, micro fumed silica and pigments. An A3 – HT block was selected.

Figure 1 - Preoperative condition, labial view.

This material was chosen due to the excellent mechanical and optical properties provided by the material, interesting for partial restorations of posterior teeth. The HT block was chosen considering the thickness of the onlay and the possibility of staining the restorations.

An intraoral scan (CS 3600, Carestream) was initially conducted on both arches and a buccal bite registration was completed without a rubber dam (Figures 3, 4). Rubber dam isolation was provided from 33 to 37 with a Nictone latex rubberdam - medium thickness and 6x6 inches for proper sealing, extended isolation in the hemi-arch, color contrast and brightness for scanning and visualization of the area to be worked on, tissue retraction, patient comfort, and maintenance of operative times. A Hu Friedy W3 clamp (Wingless master clamp for molars) was utilized.

Both dental preparations were performed for adhesive indirect onlay restorations, preserving most of the initial geometry of the preparations after the removal of the old restorations (Figure 5). Spherical burs 1012 and 1014 were used for removal of the old restorations. Conical burs 2135 and 2135F performed the preparation and refinement of the remaining structure. Prophylaxis was made with Robinson brush and pumice stone solution with distilled water followed by sandblasting with aluminum oxide (Al2O3) for 10s on each wall.

Acid etching (37%, Condac 37 FGM) for 30s on enamel. Primer was vigorous applicated on all dentin walls with FL Bond II - Shofu - a two-bottle self-etch adhesive, air spray for volatilization and application of adhesive on dentin and enamel was conducted. The removal of its excess was made with an endodontic suction, subsequently light-cured for 20 seconds on each wall. A thin layer of Beautifil Flow Plus F00 - Shofu resin was applied in dentin areas, and light-cured for 40 seconds on each wall. An application of Beautifil II LS resin mass - color A3 for partial cavity reconstruction was performed and finally finishing, and resin polishing procedures were undertaken (Figure 6).

A new intraoral scan with the rubber dam in place was made (Figures 7, 8) and the image was automatically interposed in the previous image of the teeth without the rubber dam. A CAD/CAM hybrid lithium disilicate block was digitally designed (DentalPlan, Exocad) and milled (CEREC MC XL, Dentsply Sirona). The restoration was sintered (Programat CS2, Ivoclar Vivadent) following the manufacturer's recommendation.

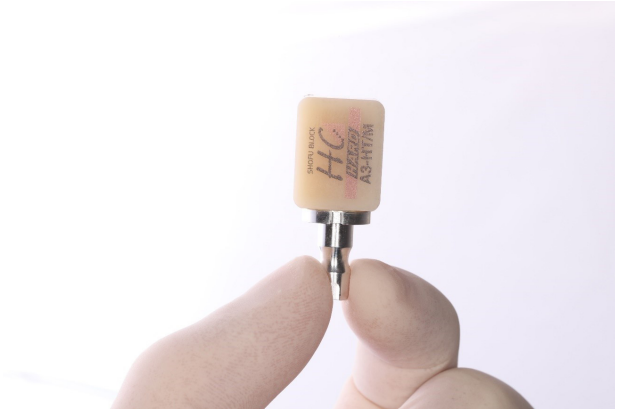

Figure 2 - Shofu Block HC Hard - ceramic based restorative block for milling (Shofu, Japan) selected as the restorative material.

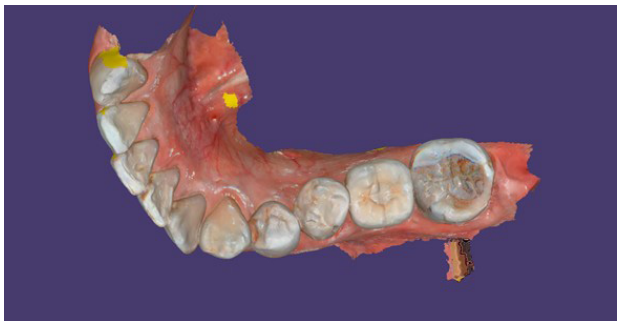

Figure 3 - Preoperative intraoral scans with no dental dam, occlusal view.

Figure 4 - Preoperative intraoral scans with no dental dam, labial view.

Figure 5 - Dental preparation under rubber dam isolation, labial view.

Figure 6 - Dentin sealing under rubber dam isolation, Occlusal view.

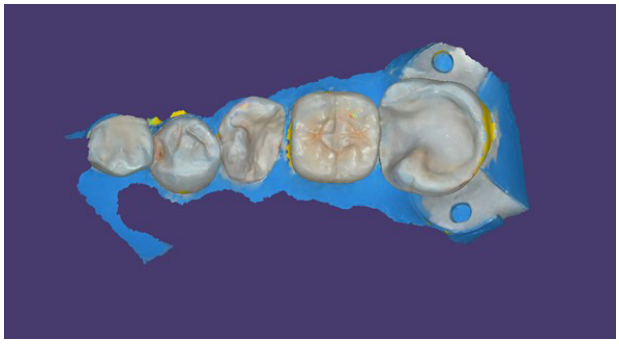

Figure 7 - Dentin sealing scan under rubber dam isolation, Occlusal view.

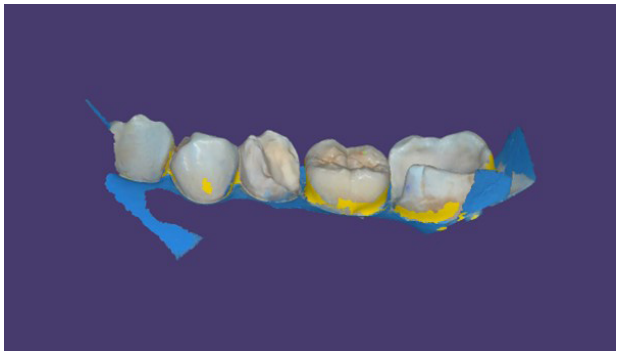

Figure 8 - Dentin sealing scan under rubber dam isolation, labial view.

Figure 9 - Occlusal view of cementation process under rubber dam isolation.

For cementation the restorations were sandblasted in their adhesive surface with Al2O3 50 μm for about 10 sec, the sandblasted surfaces were cleaned with alcohol and dry with air, followed by the application of primer with HC Primer silane, as instructed by the manufactures, where a layer of silane was applied using a microbrush inside the onlay and 5 minutes was waited to proceed. The Beautifil Flow Plus F03 A3 color flowable resin was the cementation material selected for this case due to its high-filled, bioactivity, and excellent flowability, with the potential for adequate polymerization considering the thickness of the cemented restorations. The flowable resin was applied inside the restoration, and the onlay piece was installed in position. Removal of excess material with a fine spatula and brush was made and initial light-curing was executed to maintain the resin in a gel state. The final removal with a fine spatula and the final light-curing, finishing with excess removal spatula and finishing discs was done.

Table I - Materials and products utilized for the bonding and cementation protocol

Material	Product
Phosphoric acid 37%	Condac 37 - FGM
Self-etch Bond	FL Bond II - Shofu
Cement	Beautifil Flow Plus F03 A3 - Shofu
Rubber dam	Nictone latex rubberdam - medium thickness and 6x6 inches
Clamp	Hu Friedy W3 clamp (Wingless master clamp for molars)

The polishing procedures were performed with abrasive rubbers (OptraGloss - Ivoclar) and natural hairbrushes (Figure 9). The materials and products utilized for the bonding and cementation protocol were described in Table I. The restorations were photoactivated with Elipar Deep Cure (3M Oralhealth) all along the procedures. Restorations were polished with OptraGloss (Ivoclar Vivadent). The rubber dam was removed, occlusion was checked. No adjustments previously or after bonding was required. Patient expressed satisfaction with the treatment's esthetic and functional outcomes. The case was conducted by the chaird-side workflow, where the case was solved in one appointment.

DISCUSSION

The combination of rubber dam isolation of the operating field and digital impressions make procedures in adhesive restorative dentistry easier and more effective [14]. In the reported

case, a digital workflow was detailed with the purpose of evaluating the efficiency of tissue retraction using a rubber dam and obtaining final impressions using an intraoral scanner. Furthermore, the described technique provides necessary information for reducing errors during the scanning process.

Despite all the technological advancements in intraoral scanners, challenges still exist in obtaining accurate copies and images of preparation margins. Studies indicate that deep margins, the presence of saliva, or bleeding can compromise the accuracy of images during the scanning process [17]. Therefore, in the quest to improve the efficiency of digital scanning [18,19], it is reported that the use of a rubber dam during the procedure provides a clean and dry environment and also promotes tissue retraction for better image capture. Supporting these approaches, in the described protocol, it was possible to observe the advantages of using isolation, and furthermore, it demonstrated how the performed technique can allow the clinician to quickly and definitively scan during the various stages of the procedure.

The advantages of intraoral scanning are well established, such as patient satisfaction and comfort, which promote greater acceptance of this method [19,20], primarily due to its potential to enhance communication between dentist and patient regarding the clinical case [21]. However, another factor that must be strongly considered is the accuracy that the system can provide for achieving passive fit of the planned prosthesis [22,23] once, state-of-the-art scanners offer accuracy similar to that obtained through conventional impressions for individual restorations or even up to 4 dental elements or implants, which is a great advantage associated with patient comfort and acceptability discussed previously [24].

In other hand, the difficulty in detecting subgingival or gingival-level finish lines in the distal region of prepared teeth is still a challenge. In such cases image acquisition can become more complex when bleeding is involved, which may require a steeper learning curve to achieve satisfactory results [22,24]. In front of this, to attain adequate precision during intraoral scanning, it is necessary to balance factors such as scanning conditions: saliva, as well as blood, gums, tongue, and ambient lighting [21].

The approach used to address this issue in the current study was rubber dam isolation, which provides better operative field visualization, allowing for subsequent inspection of the preparation performed and adjustments without interference from other anatomical structures. Another significant point closely related to the quality of image acquisition during scanning is moisture reduction, as the presence of moisture leads to light reflection during data acquisition, resulting in distorted impressions and the need for rescanning and successive mesh overlays under the same prior working conditions [25]. The possibility of gingival retraction, saliva isolation, blood control, and tongue positioning create ideal scenarios for satisfactory intraoral digitization [26].

During the procedure described in this case report, the image acquisition process demonstrated a higher fidelity than could be achieved without the use of rubber dam isolation associated to gingival retraction cords and hemostatic agents. This was especially noteworthy because the clinical case involved the lower posterior teeth (35 and 37). Of particular emphasis is the tooth 37, which had a finish line in the mesial aspect that was challenging to access. This was due to its proximity to the distal contact of tooth 36 and the fact that its finish line was located intra sulcularly. These factors would have interfered with gingival retraction, bleeding control in the operative field, as well as saliva and tongue interference.

In this case, only the hemi-arch was scanned as there was no necessity to scan the complete arches. Using software, the hemi-arches can be articulated without requiring the entire arch. Hemi-arch scans are more accurate compared to complete arch scans due to their simplified procedures, which minimize potential errors and the superimposition of scanned images. The procedure can achieve better fidelity in copying the preparation finish line and efficiency through the protocol of prior scanning of the upper and lower dental arches combined with bite registration before dental preparation (Figures 7 and 8).

This allows for subsequent image acquisition of only the hemi-arch of the isolated prepared teeth, as the scanner software is capable of matching the pre- and post-scanning and replacing images with those of the teeth with clearly defined finish lines

achieved through gingival isolation with a rubber dam, while retaining the previous data from other regions, as well as the interocclusal record. This interocclusal record is of utmost importance for the subsequent planning of the fabricated indirect restoration [18].

Although the technique yields satisfactory results, it is important to highlight the difficulties that may be encountered during the execution of this process. These challenges include the needs of rubber dam isolation, as well as the use of an appropriate technique to isolate the last tooth in the arch with intra sulcular preparation, ensuring proper hemostasis. It should be done in a way that allows for accessibility and scanning. In posterior regions, without correct isolation, obtaining adequate scanning can be considered challenging and requires more operator training [21,22].

In light of the various points discussed, performing intraoral scans on teeth with preparations below the gingival margin offers significant advantages to the clinician seeking to achieve excellent results for proper adaptation of indirect restorations.

CONCLUSION

The isolation process with a rubber dam used in the present study works as a device for gingival retraction and can offer several associated advantages, such as humidity control, better visualization and removal of anatomical structures, and can be recommended in clinical intraoral scanning activities, favoring the quality of the final result. However, operator training must be necessary, as the presence of the rubber dam can make access difficult.

Author's Contributions

TCP, CM: Conceptualization, Methodology. TCP: Investigation, Software. TCP, APAG, TSQ: Writing – Original Draft Preparation. APAG: Formal Analysis. APAG, TSQ: Data Curation. RMMM, MAB, GSFAS: Visualization, Supervision. ALSB: Supervision. ALSB, GSFAS: Writing – Review & Editing.

Conflict of Interest

No conflicts of interest declared concerning the publication of this article.

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Regulatory Statement

For the development of this study, the patient signed the free and informed consent form.

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