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ALTERNATIVE TECHNIQUE FOR THE RESTORATION OF MULTIPLE NON-CARIOUS CERVICAL LESIONS WITH SELF-CURING DENTAL COMPOSITE

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ABSTRACT

Recently, a self-curing dental composite (Stela, SDI, Australia) was developed with advantages such as low polymerization stress and shrinkage, unlimited depth of activation, homogeneity of polymer conversion, fast curing, good adhesion to dental tissue, fewer clinical steps, and a chameleon effect. Its indications include restoration of Class V cavities. However, this requires additional containment and shape determination maneuvers. Non-carious cervical lesions (NCCLs) involving the posterior teeth are common, and restoring them presents difficulties in isolation, instrumentation, finishing, and polishing. This study presents an alternative technique that uses Stela with a transparent silicone index for direct injection. After making an impression of the region with NCCLs, making models and wax-ups of the restorations, a personalized injection index was constructed. At a subsequent appointment, with the index ready and tested for adaptation and stability, the following restorative steps were performed: prophylaxis, insertion of a non-impregnated retraction cord, adhesive application, index positioning, and resin injection. After 4 minutes, the index was removed, and the restorations were finished and polished. This technique simplified the process with high predictability and efficiency.

Keywords: Glass Ionomer Cements. Tooth Abrasion. Guided Restoration. Non-carious Cervical Lesions.

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TÉCNICA ALTERNATIVA PARA A RESTAURAÇÃO DE MÚLTIPLAS LESÕES CERVICAIS NÃO CARIOSAS COM UM COMPÓSITO DENTÁRIO AUTOPOLIMERIZÁVEL

RESUMO

Recentemente, foi desenvolvido um compósito dentário autopolimerizável (Stela, SDI, Austrália) com vantagens como baixa tensão e contração de polimerização, profundidade de ativação ilimitada, homogeneidade na conversão do polímero, polimerização rápida, boa adesão ao tecido dentário, menor número de etapas clínicas e efeito camaleônico. Suas indicações incluem a restauração de cavidades de Classe V. No entanto, isso requer manobras adicionais de contenção e determinação da forma. Lesões cervicais não cariosas (LCNCs) envolvendo dentes posteriores são comuns, e sua restauração apresenta dificuldades em termos de isolamento, instrumentação, acabamento e polimento. Este estudo apresenta uma técnica alternativa que utiliza o Stela com um guia de silicone transparente para injeção direta. Após moldagem da região com lesões cervicais não cariosas (LCNC), confecção de modelos e enceramento diagnóstico das restaurações, foi confeccionado um guia de injeção personalizado. Em consulta subsequente, com o guia pronto e testado quanto à adaptação e estabilidade, foram realizados os seguintes passos restauradores: profilaxia, inserção de fio de retração não impregnado, aplicação de adesivo, posicionamento do guia e injeção de resina. Após 4 minutos, o guia foi removido e as restaurações foram finalizadas e polidas. Essa técnica simplificou o processo com alta previsibilidade e eficiência.

Palavras-chave: Cimento de Ionômero de Vidro. Abrasão Dental. Restauração Guiada. Lesões Cervicais não Cariosas.

TÉCNICA ALTERNATIVA PARA LA RESTAURACIÓN DE MÚLTIPLES LESIONES CERVICALES NO CARIOSAS CON UN COMPOSITE DENTAL AUTOPOLIMERIZABLE

RESUMEN

Recientemente, se desarrolló un composite dental autopolimerizable (Stela, SDI, Australia) con ventajas como baja tensión y contracción de polimerización, profundidad de activación ilimitada, homogeneidad en la conversión del polímero, polimerización rápida, buena adhesión al tejido dental, menor número de pasos clínicos y efecto camaleónico. Sus indicaciones incluyen la restauración de cavidades de Clase V. Sin embargo, esto requiere maniobras adicionales de contención y determinación de la forma. Las lesiones cervicales no cariosas (LCNC) que afectan a los dientes posteriores son frecuentes, y su restauración presenta dificultades en cuanto a aislamiento, instrumentación, acabado y pulido. Este estudio presenta una técnica alternativa que utiliza Stela con un índice de silicona transparente para inyección directa. Tras tomar una impresión de la zona con NCCL, realizar modelos y encerados de las restauraciones, se confeccionó un índice de inyección personalizado. En una cita posterior, con el índice listo y tras comprobar su adaptación y estabilidad, se llevaron a cabo los siguientes pasos restaurativos: profilaxis, inserción de un hilo de retracción no impregnado, aplicación de adhesivo, posicionamiento del índice e inyección de resina. Tras 4 minutos, se retiró el índice y se terminaron y pulieron las restauraciones. Esta técnica simplificó el proceso con alta predictibilidad y eficiencia.

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Palabras clave: Cemento de Ionómero de Vidrio. Abrasión Dental. Restauración Guiada. Lesiones Cervicales no Cariosas.

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1 INTRODUCTION

The prevalence of non-carious cervical lesions (NCCLs) is increasing in daily clinical practice. Several factors contribute to this occurrence: increased life expectancy, the maintenance of more teeth for longer, diets high in acidic foods such as soft drinks and acidic beverages, and the stress of the modern world (leading to a high frequency of tooth decay and bruxism). Restoring cervical lesions in the posterior teeth is a common challenge. Several factors make the procedure complex: limited visual access; difficulty in insertion and sculpting; limitations imposed on absolute isolation (mainly in gingival retraction in molars); and challenges in finishing and polishing maneuvers (1,2).

Considering these intrinsic problems, alternative restorative techniques have been introduced to improve the clinical performance of these restorations (3-8). Variations in the insertion methods (3,4) and matrix stabilization techniques (5) have been described. Still, they do not solve the problems related to the gingival margins of molars' cavities, which are often positioned sub gingivally and present contours that are difficult to isolate due to the presence of a furcation between the roots. Hence, semi-direct (6) and indirect (7) techniques have been introduced, which, despite their indisputable merits, are more complex and costly and do not provide superior clinical results (8).

Materials with advantageous properties have also been developed. Flowable resins, which have been indicated for some time for the restoration of cervical lesions, offer several advantages for this indication. Their use seems rational, as their modulus of elasticity is substantially lower than that of packable composites, which have been proposed to increase absorption of polymerization shrinkage and flexural stress (9). Flowable resin composites are low-viscosity restorative materials that differ from regular-viscosity resin composites by having lower filler load and less viscous resin. As a result, these materials are less rigid and have an elastic modulus that is 20% to 30% lower than that of regular-viscosity composites. The reduced elastic modulus can absorb the stress generated by polymerization shrinkage and mechanical loading of the composites to which the teeth are subjected during function. This hypothesis has led to the so-called 'elastic bonding concept,' in which materials with low elastic modulus can absorb the compression induced by tooth flexure stress, preventing restoration dislodgment (9-11). Due to the difficulty of sculpting and shaping flowable resins, methods have been proposed, such as using an intermediate layer (11) or a single first layer contained within a stabilized matrix (5). Additionally, the reduced viscosity of flowable composites (achieved by either reduction of filler content or increase of diluent monomers

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like triethylene glycol dimethacrylate – TEGDMA - in the composite matrix) can lead to a higher polymerization shrinkage, which, on the other hand, results in more stress at the adhesive interface and may raise a concern about sufficient marginal sealing, especially in non-retentive cavities like non-carious cervical lesions (NCCLs) and after more extended periods of clinical service (12). To date, no clinical study or systematic review has confirmed that flowable resins perform better than conventional resins (12,13).

Other polymer composites also offer better performance because of their lower degree of contraction and stress during polymerization. Bulk-fill resins, available in both flowable and packable forms, promise better performance in this regard (14-17). Likewise, dual-cure and self-cure composites aim to mitigate the harmful effects of polymerization contraction. Several studies have shown that a slower polymerization rate for self-curing materials can delay the gel point, allowing more resin to flow from the unbonded surface and extend the viscous phase, resulting in lower shrinkage stress values (18,19).

Recently, a self-curing, bulk-fill restorative material has been introduced to the market (Stela AUTOMIX, SDI, Australia), comprising an adhesive system that polymerizes upon contact with the restorative material and requires no light curing. It is indicated for various clinical applications, including the restoration of Class V cavities. It is believed to have a polymerization sequence that mitigates stress. The primer contains a catalyst that initiates curing at the restoration interface, providing a gap-free interface and reducing contraction-related problems. In addition, it presents a chameleon effect that mimics the shade of the surrounding teeth (20,21).

The use of a transparent silicone index obtained from diagnostic wax-ups is a viable option. In addition to providing the correct anatomy, it enables the use of flowable or sticky materials, such as flowable resins, bulk-fill resins, and glass ionomer cement, in their various presentation forms. It represents a quick and straightforward way to restore the contours and shape of cervical lesions with difficult access, isolation, and unfavorable contours, as with molars (22-24).

This study aims to present a technique combining a transparent index and a new self-cured restorative composite to restore cervical cavities in molar and premolar regions concomitantly. This technique is proposed as a viable alternative with high applicability in clinical settings.

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2 TECHNIQUE PRESENTATION

This study was approved by the Ethics Committee for Human Research at the Pedro Ernesto University Hospital (CEP-HUPE - CAAE: 42340820.0.0000.5259).

A 51-year-old female patient presenting bilateral NCCLs in the buccal aspect of the right maxillary first molar, first premolar, and canine underwent the proposed technique (Fig. 1A). After the patient answered health questions and underwent oral examination, it was concluded that the lesions had multiple causes (occlusal factors, abrasion due to incorrect tooth brushing, and bone remodeling caused by second premolar loss). The lesions were not very sensitive, but they prevented good oral hygiene. Some margins of the cavities extended sub gingivally and had irregular contours, making efficient rubber dam isolation impossible.

At the first appointment, gingival retraction was performed using a non-impregnated retraction cord (Ultrapak 00; Ultradent, USA). An accurate impression was obtained with a partial disposable plastic tray using Impregum™ F Polyether medium-bodied (3M Dental Products, USA). The patient was released after the retraction cord removal for the next appointment. After pouring the impression with a stone (Durone, Dentsply Sirona, Brazil) (Fig. 1B), a wax-up replicated the desired outcome. With the plaster cast trimmed, it was possible to access all cavity details, and the wax-up sculpture was performed without restrictions.

A box was then built around the affected area using red wax. This box is crucial in the procedure because it must be sufficiently high to induce an adequate thickness of the silicone index (minimum of 1 mm) concerning the buccal and occlusal contours. The box limits must account for the teeth to be restored (Figs. 1C and 1D). Similarly, the box must extend over the occlusal face of the teeth to provide structural rigidity and exact references for fitting (Figs. 1C and 1D). Another vital procedure must be carried out during the manufacturing of the box: the planned filling of excessively retentive areas by the plaster cast. Eventually, in situations where the interdental space is entirely open owing to gingival retraction and the absence of a gingival papilla, the plaster model must be modified in these locations by filling these negative spaces with wax so that any excessive retention is removed while maintaining sufficient silicone penetration in the region, ensuring the fitness and stabilization of the matrix. This filling can be observed between the molar and the first premolar (Figs. 1C and 1D).

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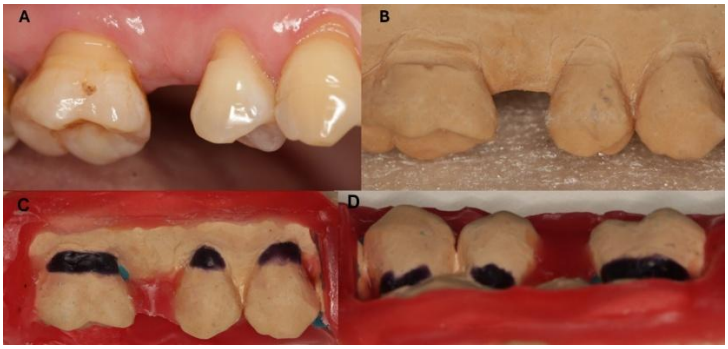
Figure 1

Initial clinical aspect of the non-carious cervical lesions in the right superior first molar, first premolar, and canine (A); the plaster cast obtained: the margins of the cavities were exposed after trimming the cast, allowing unrestricted access to all their details (B); and buccal and cervical views of the cast after wax box construction, retentive area filling, and the wax-up of the restorations (C and D).



Subsequently, a tray containing transparent silicone is prepared. The tray should be made of a rigid transparent plastic material that can be cut and drilled (to create retention). It should extend to at least half of the teeth adjacent to the teeth to be restored (when possible) to allow for a firm, stable fit and consistent reference. Its height should be approximately 2 mm greater than the cervical limit of the cavities and cover half of the vestibulolingual occlusal diameter of the teeth involved (Fig. 2A). After preparation, the impression tray should be coated with silicone adhesive (Universal Tray Adhesive, Zhermack, Italy) to ensure stability and resistance to displacement of the transparent silicone.

The next step is constructing the silicone index, which requires precision and attention to detail. Once Stela is self-cured, using a transparent material is not mandatory, but it can facilitate the visualization of the correct seating of the matrix and adequate filling of cavities (22-23). The index was constructed with a clear polyvinyl siloxane (PVS) material (Silic. One Clear, FGM, Brazil). Importantly, this technique can also be accomplished using traditional opaque elastomeric materials since the index is perfectly fitted and stabilized. For perfect adaptation, the impression material must be carefully applied to the plaster model using impression mixing tips, wetting all surfaces, and entering the interdental spaces sufficiently to induce an ideal fit without the possibility of movement or tilting. After careful silicon insertion, the transparent tray is placed over the impression material and compressed to the limit imposed by the wax box during curing to ensure good wetting of all details on the plaster model and wax-up surfaces (Fig. 2B).

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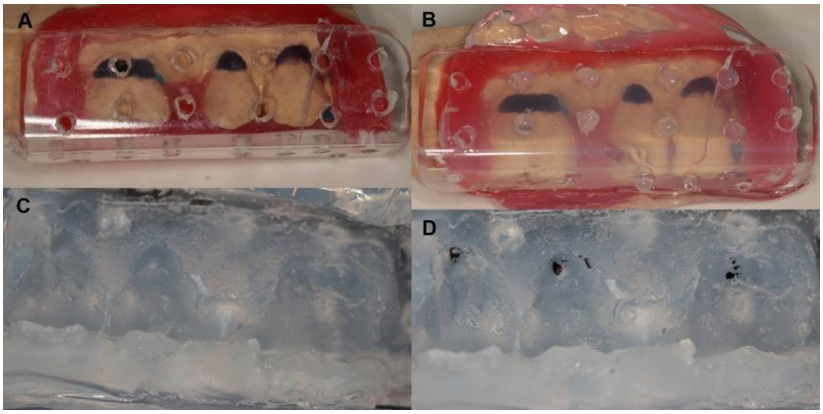
Figure 2

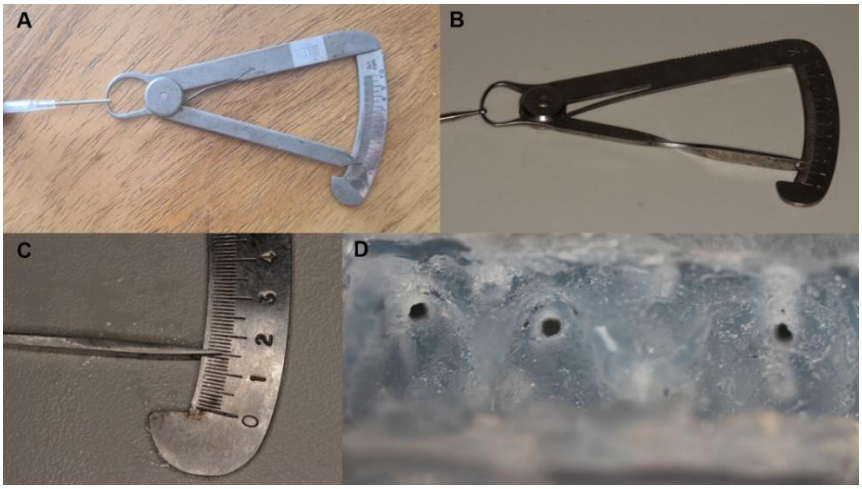
The transparent tray check (A); making the index with transparent silicone (B); internal view of the index (C); and marking of drilling points (D).



After the silicone has set, the index is removed and examined internally to verify that all details were copied (Fig. 2C). Once the index has been approved, the locations for drilling the access channels into the cavities are marked using a marker pen (Fig. 2D). As the diameter of the resin application tip in this case was 1.4 mm (Fig. 3A), a #6 ball burr (with a diameter of approximately 1.5 mm (Figs. 3B and 3C) was used to make the holes. These should be made from marks on the silicone surface until they pass through the tray entirely.

Figure 3

Measuring the diameter of the resin application tip (A) and of a #6 ball burr (B and C); internal view of the holes (D).



A complete examination of the index must be carried out with internal (Fig. 3D) and external (Fig. 4A) views after drilling the holes and checking for the free passage of the resin

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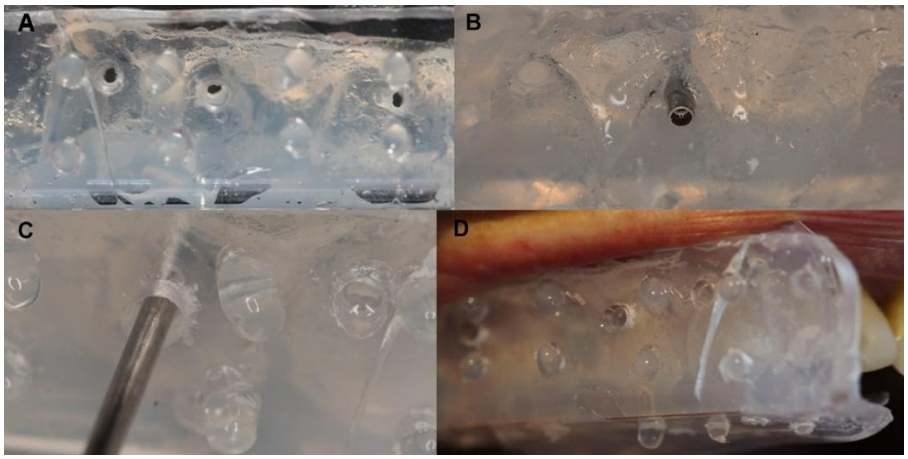
application tip (Figs. 4B and 4C). Finally, at the subsequent consultation, the fit of the index "*in situ*" should be clinically tested before implementing restorative procedures (Fig. 4D).

Figure 4

External view of the holes (A); checking the application tip's free access to the cavities through the holes: internal (B) and external (C) views; checking the fitting and stability of the index in situ (D).



After these steps, restorative procedures can be performed. Local anesthesia with 3% prilocaine solution (Citanest, Dentsply, Brazil) was used. The teeth to be restored were cleaned with a nonfluorinated prophylactic paste (UltraPro Tx Pure, Ultradent, USA) using a rubber cup and rinsed thoroughly with water. No color selection was necessary because Stela presents a chameleon effect (20). Relative isolation with cotton rolls was performed. A non-impregnated retraction cord (Ultrapak 000/Ultradent, USA) was used to isolate the area from the crevicular fluid and maintain a delicate spacing from the free gingiva. Acid etching was not performed because Stela Primer (SDI, Australia) is a self-etching adhesive (Fig. 5A). It is a fluid that does not polymerize until it contacts the resin composite. Consequently, no obstacles (such as thick adhesive pellicles) were created for complete insertion of the silicone index (20-22). Then, Stela Primer was applied to the cavity and margins. The operator waited for 5 seconds and dried the cavity gently for 2-3 seconds with an air blast. Subsequently, the silicone matrix was carefully positioned to ensure it was fully adjusted. Despite its reliable stability, it is recommended that the operator maintain the index in a stable position to provide a complete fit throughout the procedure.

Once the matrix was in position, the auto mixing system was activated. We recommend dispensing the first few millimeters of the extruded material, as it may be

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incompletely mixed. The Stela Automix syringe features rotating, bendable metal tips that enable precise extrusion into hard-to-access locations. The tip was then inserted into the tunnel corresponding to the difficult-to-access cavity (generally the most distal). As soon as the material filled the cavity, the injector tip was removed, and the next tunnel was filled until all cavities were restored (Fig. 5B).

A crucial clinical tip at this stage is to avoid filling the feeding canal with injected resin. However, if this occurs, excess resin can be removed with a micro brush. This precaution is essential because the sprues resulting from insertion through the feeding canals, obtained by the drilling action of a bur, may not be parallel, making matrix removal difficult. When the professional observes that it is impossible to obtain parallelism between the feeding canals due to poor tooth positioning or the position of the cavity, it is recommended that each restoration be performed entirely separately, so that the lack of parallelism between them does not pose a challenge to the removal of the individual matrix.

Subsequently, a water-soluble gel was applied superficially to prevent oxygen (Oxiblock; FGM, Brazil) from inhibiting superficial curing.

Because Stela has a fast cure, the composite takes approximately 90 seconds to be injected into the holes, and the operator must wait for 4 minutes to remove the silicone matrix, which can be easily removed buccally. Once removed, the filled cavities and their respective “sprues” can be observed (Fig. 5C). The retraction cord can then be removed, and finishing and polishing procedures can be carried out (which involve removing the sprues). The operator must be prudent in applying minimal pressure during grinding. To avoid the impact of the burr blades, we initially used a fine 3118F and an extra-fine-grained diamond tip 3118FF (Microdont, Brazil), followed by green, yellow, and white polishing points (Jiffy, Ultradent, USA) with water cooling.

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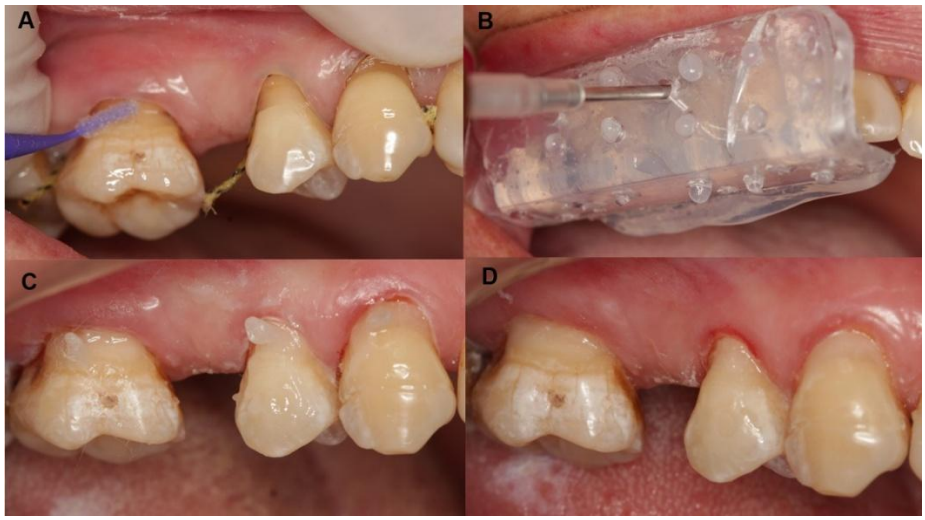
Figure 5

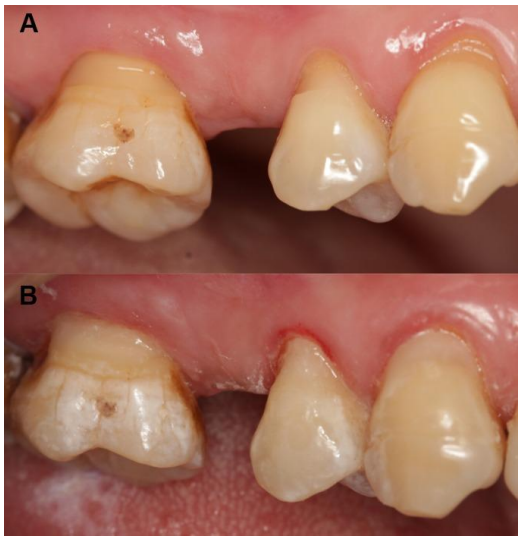
Adhesive application (A); application of Stela AUTOMIX self-cured flowable resin through the holes (B); aspect after removal of the index - note the presence of sprues of injected resin (C); and the final aspect of the three restorations after minimum finishing and polishing procedures.



The final aspects of the restorations are shown in Figure 5D. Figures 6A and 6B show the initial and final elements of the clinical case, respectively.

Figure 6

View of initial (A) and final (B) aspects of the clinical case.



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3 DISCUSSION

Restoration of NCCLs in posterior teeth, especially molars, presents considerable challenges. Some techniques have been developed to solve problems related to isolation, gingival retraction, access, and insertion without excess or gaps (4-8). Similarly, several different restorative materials can be used, each with its own indications and limitations (9-16).

Recently, a chemically cured resin (Stela; SDI, Australia) for Class V cavity restoration was developed. According to the manufacturers, it has innovative and advantageous properties for this clinical situation. It is essential to highlight properties that promote reliable adhesion and gap-free interfaces. This adhesive is a BPA- and HEMA-free self-etching system that does not require light curing and contains a catalyst that initiates curing at the restoration interface once the composite is applied. Stela Primer also contains 10-MPD and has been shown to provide sound clinical and laboratory results for restoring NCCLs, although some clinical results have not yet been conclusive (25-27).

As it is self-etching, it does not require prior acid conditioning (which involves a sequence of washing, removal of the gingival retraction cord, replacement of the isolation, drying, and placement of a new retraction cord). In addition, the adhesive initiates curing only upon contact with the composite, preventing the formation of a rigid adhesive film that could impede the complete installation of the index.

As a flowable composite, Stela is ideal for injections. It has a low elastic modulus that can absorb the stresses generated in the cervical region during the masticatory cycle and eventual parafunction (10,15,16). Moreover, the manufacturers claim that Stela has reduced contraction and, as a self-curing resin, offers an extended pre-gel phase, reducing problems related to polymerization shrinkage. It also eliminates the need for a curing light (which is often challenging to place in posterior regions) and provides uniform polymerization, evenly reaching the entire material.

The chameleon effect is advantageous because the aesthetic demands in this situation are less challenging, and the results observed are favorable (20,21).

The success of the presented technique depends on the correct execution of the laboratory and clinical steps. It is important to highlight that a rigid transparent tray is essential for the accuracy and reliability of the transparent silicone index. Unlike similar techniques used for other purposes, the index structure must have adequate containment provided by a

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rigid tray wall. Without this, silicone may undergo minor distortions due to its elastic nature, which would be unacceptable for a technique seeking the best possible fidelity.

This technique has some intrinsic aspects that can be considered disadvantages or challenges. First, it involves two appointments, whereas, in general, a restoration can be obtained in a single consultation. However, the two-appointment system offers several benefits. The first consultation allows for initial impressions, which can be crucial for restoration planning. In the second appointment, the time is critically reduced because several cavities are restored simultaneously, with finishing and polishing maneuvers restricted to the sprue regions. This approach can lead to a more efficient use of time and resources.

The laboratory stage is also disadvantageous because it requires additional work not present in conventional restoration techniques. However, it is essential to emphasize that this technique is indicated when traditional direct techniques may pose difficulties. The laboratory stage allows free access to all cavity details and allows waxing with maximum detail. In addition, the clinical time is significantly reduced, and several cavities can be restored simultaneously. In this way, a complex process can be considered as a different approach that solves problems, makes the use of the material in question viable, and simplifies the clinical procedure.

Every new technique is expected to have a learning curve. However, no significant difficulties are expected when the proposed method is used. Furthermore, this technique makes the clinical procedure more straightforward, faster, and predictable if performed within specifications.

This technique combines the advantages of a matrix for injecting a flowable material into difficult-access areas and for isolation with the innovative and advantageous characteristics of a new chemically activated restorative composite (Stela, SDI, Australia). Relative field isolation with cotton rolls, combined with a retraction cord and precise adaptation of the silicone matrix, ensures and maintains adequate moisture control throughout the procedure.

Building a silicone matrix from a wax-up has additional advantages, including the ability to inject flowable material and fill the planned area with excellent predictability. Finishing and polishing are restricted to areas related to sprues. Multiple cavities can be restored in one step, saving valuable clinical time (22-24).

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Finally, the self-cured composite (Stela/SDI) exhibits properties that enhance this technique. Eliminating the need for photoactivation in specific regions enables more adaptable applications, as this step can be challenging. Self-curing materials have a slower polymerization rate, thereby delaying the gel point, allowing more resin to flow from the unbonded surface, extending the viscous phase, and lowering shrinkage stress values (20,21).

Additionally, Stela contains fluoride, calcium, and strontium to enhance its biomimetic and bioactive properties, adding an extra layer of protection during acid challenges (21).

4 CONCLUSION

The proposed technique is a viable option for cervical restorations and is particularly beneficial in regions where traditional restorative methods have limitations or intrinsic difficulties. It is a practical solution, especially in challenging situations, such as cavities in posterior teeth with irregular contours, particularly in molars. Despite involving an additional appointment for the impression and laboratory steps, it significantly accelerates the procedure, making it more practical and allowing the restoration of several teeth in a single clinical appointment. Finally, it drastically reduces the need for finishing and polishing in difficult-to-access areas, delivering controlled, highly predictable results.

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