RSBO

ISSN:
Electronic version: 1984-5685
RSBO. 2024 Jul-Dec;21(2):462-71

Case Report Article

Semi-direct restorative technique for aesthetic and functional restoration in posterior teeth: case report

Alice Chagas[1]
Sabrina Schmickler[1]
Evelise Machado de Souza[1]
Lucí Regina Archegas Panka[1]
Rafael Torres Brum[1]
Gisele Maria Correr[1]

Corresponding author:
Gisele Maria Correr
Universidade Federal do Paraná
Departamento de Odontologia Restauradora
Avenida Prefeito Lothário Meissner, 623 – Jardim Botânico
CEP 80210-170 – Curitiba – PR – Brasil
E-mail: gisele.nolasco@ufpr.br

[1] Department of Restorative Dentistry, Universidade Federal do Paraná – Curitiba – PR – Brazil.

Received for publication: March 8, 2024. Accepted for publication: March 8, 2024.

Keywords:
composite resins; permanent dental restoration; semi-direct restorative technique.

Abstract

Introduction: The semi-direct restorative technique using composite resin has gained increased popularity in clinical practice due to several advantages: reduced cost for patients, the feasibility of composite resin restorations in teeth with significant structural loss, time-saving, improved margin adaptation, polishing, polymerization, and aesthetics of the restoration performed outside the mouth. **Objective:** The aim of this study was to present a clinical case involving the restoration of posterior teeth with substantial coronal destruction using the semi-direct technique. **Case report:** The tooth was prepared (defective restoration removal) following onlay preparation guidelines. The preparation was then molded using alginate, and the model was obtained in elastomeric material (addition-polymerized silicone). A composite resin restoration was crafted on the model, photoactivated, and polished outside the mouth. Following the resin restoration on the silicone model, it was cemented onto the prepared tooth. Absolute isolation was employed, the temporary restoration was removed, and the preparation was cleaned. For cementation, sandblasting with aluminum oxide in the internal portion, etching with phosphoric acid, and the application of an adhesive system were performed. Subsequently, a dual polymerization resin cement was manipulated,

applied to the resin piece, and placed on the prepared tooth. Excess cement was removed, and the piece was photoactivated for 40 seconds on each surface. Finally, the piece's adaptation was verified, occlusal contacts were checked, and finishing and polishing were carried out. **Conclusion:** It can be concluded that the semi-direct composite resin restoration enabled achieving improved anatomy, marginal adaptation, polishing, and resistance, consequently enhancing clinical longevity with a better cost-benefit ratio for the patient.

Introduction

Over the years, composite resins have undergone modifications that improved their properties such as mechanical strength, polishing capability, and color stability. Nanoparticulate and nano-hybrid resins, with a high content of inorganic filler particles and smaller particle size, offer enhanced mechanical strength and excellent polishing, allowing their use in aesthetic restorations in posterior teeth [18]. Depending on the clinical situation and the amount of remaining dental structure, composite resin restorations in posterior teeth can be performed using direct, indirect, or semi-direct techniques [16-18].

Direct restorations are carried out by the clinician directly in the patient's oral cavity in cases with minimal tissue loss. However, in situations with substantial loss of dental structure, the clinician may opt for indirect techniques, where the restoration is fabricated in a dental laboratory and subsequently cemented onto the prepared tooth [3, 13, 15]. While indirect restorations such as inlays, onlays, or overlays are the primary choice, semi-direct restorations can be a viable treatment option for patients requiring a quick and cost-effective solution [7, 15, 17]. Semi-direct restorations can be intraoral or extraoral. The intraoral technique involves applying the restorative material directly to the prepared tooth, while the extraoral technique requires the dentist to create the preparation, take impressions, and fabricate the restoration on a model, bypassing the need to send it to the dental laboratory. The extraoral technique is suitable for patients requiring extensive reconstructions in posterior teeth within a short timeframe and at a lower cost [17].

To perform a semi-direct restoration, the clinician needs to obtain an impression mold of the prepared teeth and adjacent teeth using alginate, and then pour the mold using another material, such as silicone, to obtain the model with the die [7, 17]. Subsequently, the dentist crafts the restoration using composite resin on the model [7, 17]. Thus, the semi-direct restorative technique in composite resin combines the advantages of both direct and indirect restoration techniques, where the restoration is fabricated outside the mouth and subsequently cemented onto the prepared tooth. This technique offers several advantages, including lower costs for patients, the ability to create composite resin restorations in teeth with significant structural losses, time savings, better margin adaptation, and improved aesthetics due to the restoration being crafted outside the mouth [1].

Moreover, the semi-direct technique allows for better polymerization efficiency by conducting the polymerization step outside the mouth, resulting in a higher resin conversion degree and, consequently, better mechanical properties of the resin [19]. Additionally, this technique reduces contraction stress on the cavity walls, minimizing the deleterious effects associated with this stress, such as marginal gaps and microleakage, which are major contributors to secondary caries and restoration failure over time [19].

Thus, the aim of this study is to present a clinical case report of a restoration in a posterior tooth with significant coronal destruction using the semi-direct technique.

Case report

Patient EPV, a 24-year-old female, sought treatment at the Integrated Clinic I of the Federal University of Paraná for a restoration on tooth 36. After conducting anamnesis and clinical examination, an inadequately adapted and extensive composite resin restoration involving the occlusal, distal, and vestibular surfaces, with recurrent caries in the distal region, was observed (figure 1). The restoration was causing discomfort, and the patient expressed dissatisfaction with its

appearance due to its noticeable color difference. The tooth exhibited satisfactory endodontic treatment, and periapical radiographs revealed no signs of pathology (figure 2).

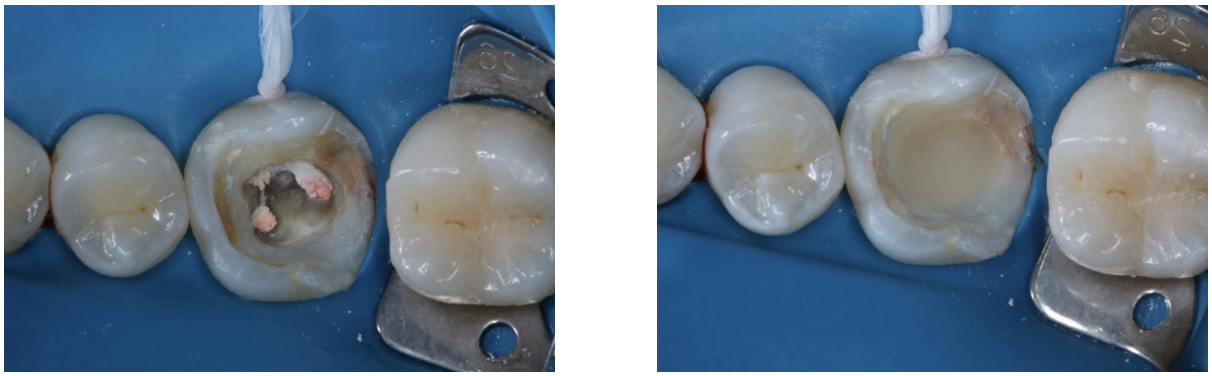
A B

Figure 1 – Initial clinical appearance of tooth 36. Note the presence of an old, poorly adapted composite resin restoration (A) with excess material in the cervical region (B)

Figure 2 – Periapical radiograph image of tooth 36, showing satisfactory endodontic treatment

The patient presented a high caries risk and reported a diet rich in fermentable carbohydrates, leading to frequent episodes of caries activity. The clinical and radiographic examinations confirmed that the restoration's marginal adaptation was compromised, with evident gaps between the tooth structure and the restoration. Based on the patient's history, complaint, and clinical evaluation, a treatment plan was proposed, involving a semi-direct restoration with composite resin on tooth 36.

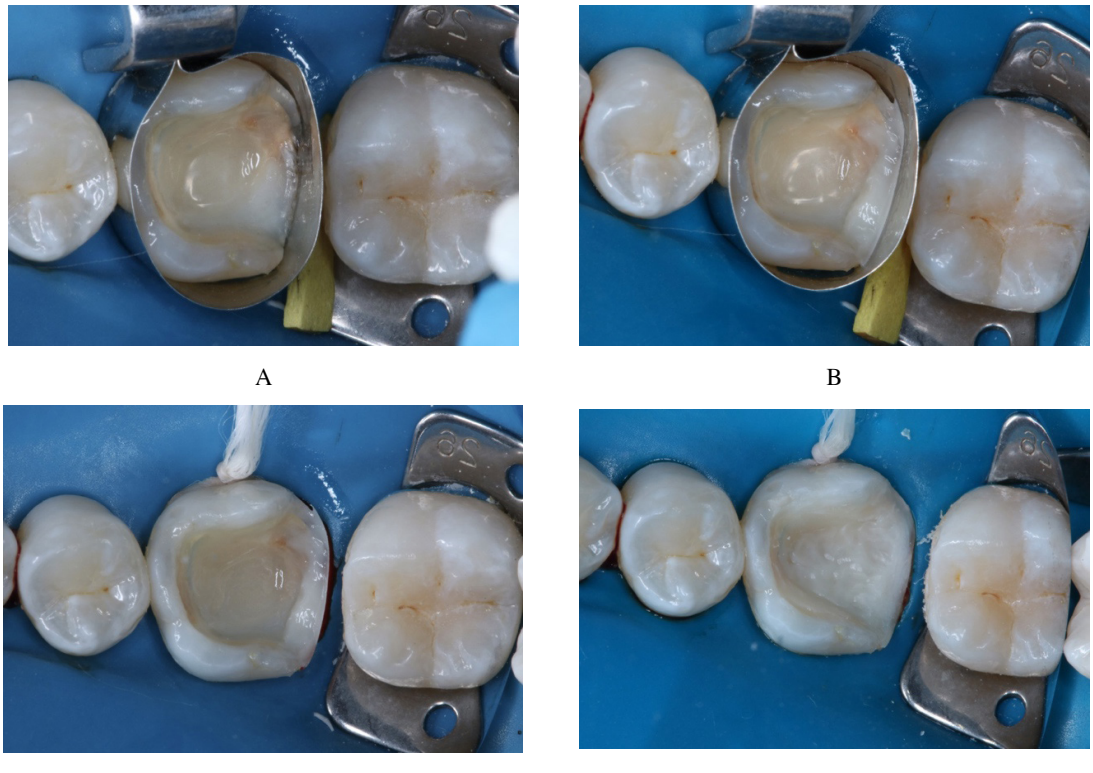
Initially, prophylaxis was performed, and under absolute isolation, the removal of the entire old restoration was carried out until the canal orifices were visible (figure 3A). Subsequently, the canals were sealed with resin-modified glass ionomer cement (Riva Light Cure, SDI, Melbourne, Victoria, Australia) (figure 3B).



A B

Figure 3 – Appearance of tooth 36 after removal of the old composite resin restoration and visualization of the canal orifices (A). Clinical appearance after sealing the canals with glass ionomer cement (B)

It was observed that the gingival margin still presented irregularities, necessitating the elevation of the gingival margin using composite resin (Opus Bulk Fill Flow APS, FGM, Joinville, SC, Brazil), with the aid of a metal matrix and wedge (figures 4A, B, and C). Conditioning with 37% phosphoric acid was done for 15 seconds on dentin and 30 seconds on enamel. Then, the adhesive system (Adper Scotchbond, 3M, St Paul, MN, USA) was applied in two layers with a gentle air blast between them and photopolymerization for 20 seconds. Afterward, the composite resin was applied in small increments, with each increment photopolymerized for 20 seconds. Excess material was then removed with a #12 scalpel blade. After adjusting the gingival margin, the inclination of the internal walls of the preparation was modified to ensure the expulsive characteristics of the preparation, using nanoparticulate composite resin (Filtek Z350, 3M, St Paul, MN, USA) in color A1D (figure 4D).



A B

C D

Figure 4 – Adaptation of the metal matrix in Tofflemire matrix holder and wooden wedge for gingival margin elevation in composite resin (A). Appearance after application of composite resin in Opus Bulk Fill Flow APS (B). Final appearance of gingival margin elevation (C). Final appearance of the preparation after adjustments of internal walls in composite resin (D)

After completing the preparation, absolute isolation was removed, a retraction cord (000, Ultrapack, Ultradent, South Jordan, UT, USA) was placed for impression. The impression was made with alginate (Cavex Cream Alginate, RW Haarlem, Netherlands), and a provisional restoration was crafted with temporary restoration resin (Temp-it, Spident, Korea). In the same session, the color selection was made using the Vita Classical shade guide (Vita, Zahnfabrik, D-Bad Säckingen) for the fabrication of the composite resin restoration, with A2 chosen for dentin and B1 for enamel.

The alginate mold was poured using addition silicone for modeling (Modellsilikon/Die Silicone, Voco, Cuxhaven, Germany). The base of the model was made with heavy addition silicone (Take 1 Advanced, Kerr, Brea, CA, USA) and with the help of a Lego-type mounting piece. This process facilitated the die preparation and the fabrication of the composite resin piece (figure 5).

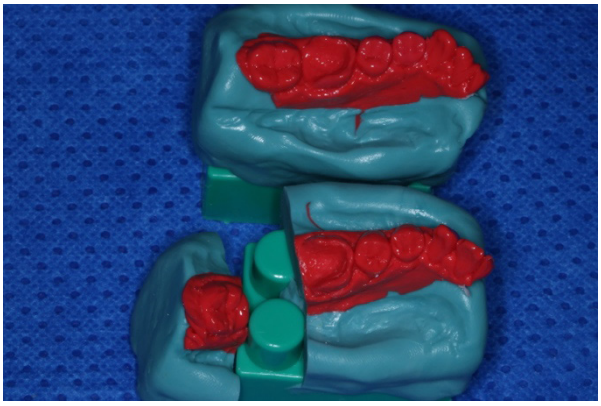
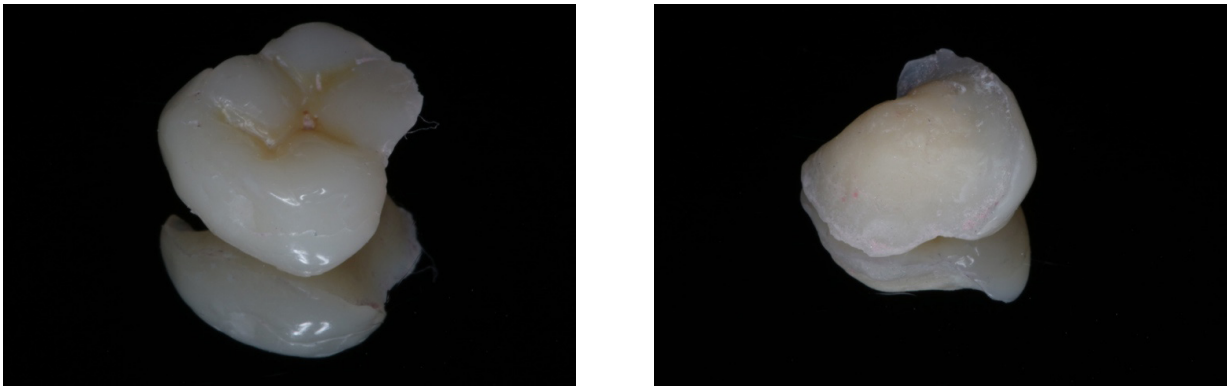


Figure 5 – Troquelized silicone model for the fabrication of the composite resin piece

The restoration was crafted on the silicone model using nanoparticulate composite resin (Filtek Z350, 3M) in the aforementioned colors. Additionally, IPS Empress Direct Color stains (Ivoclar, Schaan, Liechtenstein) in white, brown, and ochre were used for characterization. The sealing of the stains was done by applying Fortify Composite Surfaces resin.

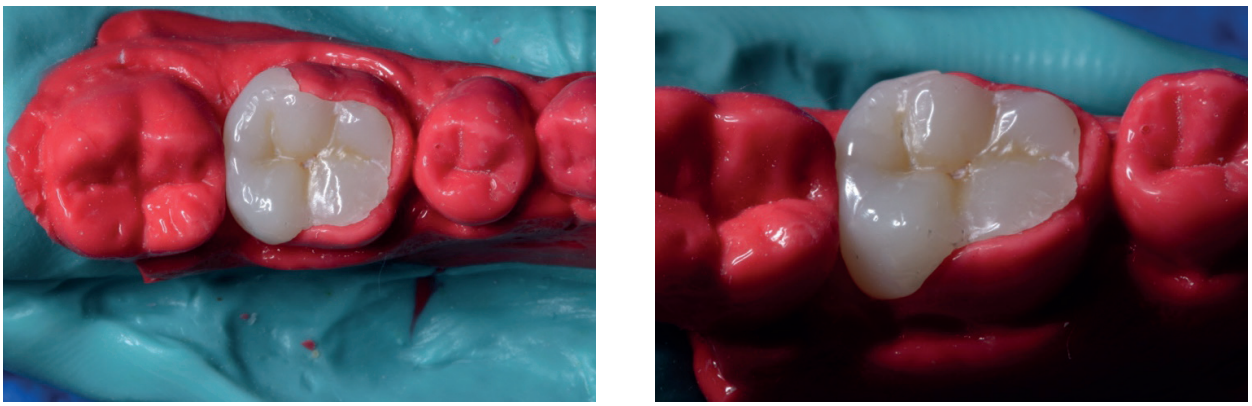
Photoactivation in all restorative procedures was performed using a light-curing device (LD Max Gnatus). After photopolymerization, the piece was placed in a microwave, immersed in a cup of water for 10 uninterrupted minutes. Finishing and polishing were done with rubber finishing tips and a silicon carbide brush from American Burrs in conjunction with felt disc and polishing paste (Poligloss). Figure 6 illustrates the final appearance of the composite resin piece after polishing.



A B

Continued...

Continuation of figure 6

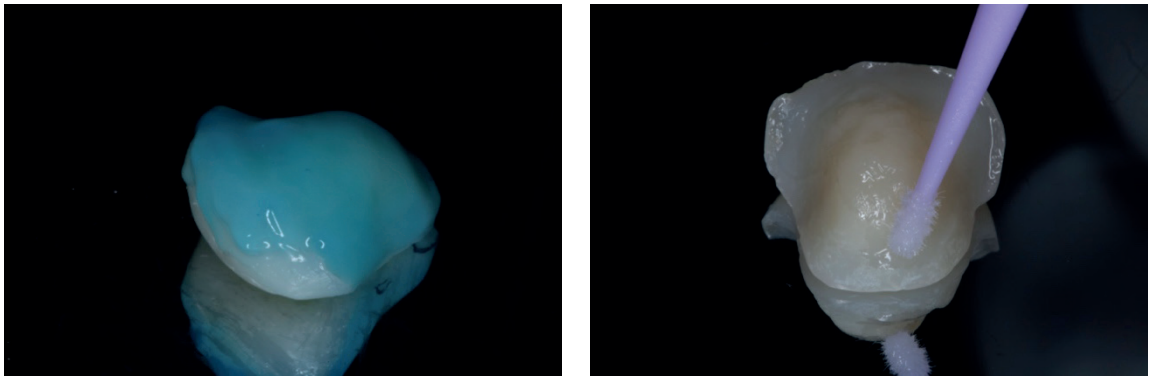


C D

Figure 6 – Final appearance of the resin restoration after polishing. Internal appearance of the composite resin restoration (A). Distal aspect of the restoration. Vestibular aspect on the silicone model and proximal adaptation (C and D)

In the next session, under absolute isolation, the provisional restoration was removed, and the piece was tried in (figure 7). Afterward, the piece was treated for subsequent cementation. Firstly, aluminum oxide blasting was performed, and conditioning with 37% phosphoric acid for sixty seconds (figure 8A), silane application, and a single layer of adhesive system (Adper Scotchbond, 3M), with thinning of the layer by air spray and subsequent photopolymerization for 20 seconds (figure 8B).

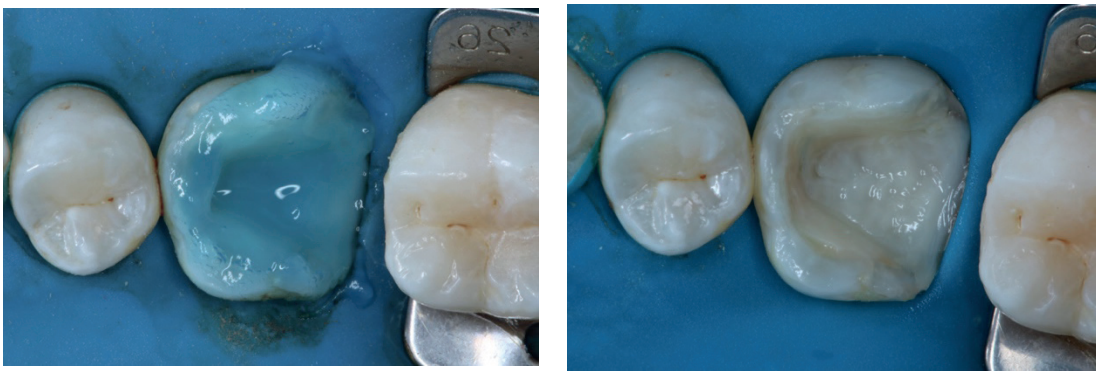
Figure 7 – Adaptation of the restoration on tooth 36



A B

Figure 8 – Preparation of the composite resin piece for cementation. Conditioning with 37% phosphoric acid (A). Appearance after applying a thin layer of adhesive system (B)

For the tooth, conditioning with 37% phosphoric acid for 30 seconds on enamel and 15 seconds on dentin was done, followed by rinsing and drying, application of Adper Scotchbond adhesive system in two layers with a gentle air spray between layers, and subsequent photopolymerization for 40 seconds (figure 9).



A B

Figure 9 – Tooth preparation for cementation. Conditioning with 37% phosphoric acid (A). Appearance after applying a thin layer of adhesive system (B)

Cementation was carried out with dual-curing resin cement (Allcem Core, FGM), with photoactivation for 60 seconds on each surface (occlusal, vestibular, lingual, disto-lingual, and disto-vestibular). After cementation, excess material was removed, and the adaptation of the piece to the tooth was verified. Occlusal adjustment was performed with finishing burs type F and FF, and polishing with rubber finishing tips and a silicon carbide brush. Figure 10 illustrates the final appearance of the piece after cementation and completion of finishing and polishing.

A B

Figure 10 – Final appearance of the piece after cementation (A). Appearance after occlusal adjustment and polishing (B)

Discussion

The case presented highlights the successful application of the semi-direct restorative technique for the rehabilitation of a posterior tooth with significant coronal destruction. The semi-direct technique provides various advantages, making it a suitable alternative in certain clinical scenarios.

One of the key benefits of the semi-direct technique is the ability to perform the majority of the restorative procedures outside the oral cavity. This includes the crafting, polymerization, and polishing of the restoration, resulting in improved adaptation, anatomy, and surface smoothness [9, 10, 12, 14]. Crafting the restoration on a model allows for better control over the restoration's contour and occlusal anatomy, contributing to better aesthetics and function [7, 12, 17].

Various materials can be employed in the fabrication of models for semi-direct restorations, including addition silicones, polyether, and type IV gypsum. The selection of the material hinges on several critical factors, such as flowability, dimensional stability, rigidity, and the resin's ability to be compacted with minimal deformation on the model [7].

In a study by Costa *et al*. [7], different materials, namely addition silicones and type IV gypsum, were assessed for their efficacy in creating models for semi-direct restorations and their impact on the fracture resistance of composite resin restorations. The findings revealed that models crafted with addition silicone for modeling (Silicone Die, Voco) exhibited superior fracture resistance in the resin piece compared to alternative materials. Notably, this material was also utilized in the illustrated case report, showcasing excellent flowability for creating a detailed and faithful replica. Furthermore, post-polymerization, the model demonstrated increased rigidity, preventing deformation during the fabrication of the resin piece outside the oral cavity and ensuring optimal adaptation within the mouth [7].

Concerning the choice of composite resin, a nanoparticulate resin was chosen for the restoration in this case. According to Alzraikat *et al*. [2], nanoparticles present in nanoparticulate composite resins alter the resin's structure, enhancing its mechanical, chemical, and optical properties. This makes such materials suitable for a wide range of restorations, including both anterior and posterior [11]. Studies indicate that nanoparticulate composite resins used in direct restorations may exhibit superior mechanical properties and lower failure rates in indirect restorations compared to indirect composite resins [6, 8]. In a study by Cetin *et al*. [6], the evaluation of restorations in posterior teeth over a five-year period, involving nanoparticulate composite resins and indirect composite resins, demonstrated that restorations performed with indirect resin had a failure rate of 2.5%, while those utilizing nanoparticulate composite resin exhibited a lower failure rate of 1.6%.

An advantage of semi-direct restorations is the potential for additional polymerization, which could enhance the resin composite's conversion rate and consequently improve its mechanical properties, color stability, wear resistance, and overall restoration longevity [6, 11]. Conducting the polymerization process outside the oral cavity allows for the initiation of polymerization contraction and related stress before cementing the restoration to the tooth, thereby enhancing adhesion and sealing. This approach contributes to improved adaptation and longevity of the restoration [6, 11].

Grazioli *et al*. [11] investigated the effectiveness of different equipment (dry oven, autoclave, and microwave) for auxiliary heat treatment in resins. They observed significant improvements in the degree of conversion and mechanical properties using any of the three equipment options, primarily attributed to the heat's ability to increase the mobility of non-reacted monomers in the polymerization network. In the presented case, the microwave oven was chosen due to its widespread availability, making the thermal treatment procedure straightforward, cost-effective, and predictable.

Another critical aspect for the success of resin restorations in posterior teeth is achieving proper sealing of the preparation and its margins. In the context of semi-direct restorations, immediate dentin sealing and reinforcement of the remaining structure in resin are essential. These procedures were meticulously performed in the presented case, contributing to adhesive stability and the long-term success of composite resin restorations [8].

For effective marginal sealing, the preparation margins should preferably be located supragingivally and well-finished. In the presented case, after the preparation, deep margin elevation was necessary to achieve a more suitable marginal adaptation, addressing irregularities in the deep margin. According to Bresser *et al*. [4], this technique allows for the attainment of a supragingival cervical margin, reducing the risk of recurrent caries and improving long-term restoration stability.

Regarding cementation, a dual-polymerization resin cement was selected. Burey *et al*. [5] compared

two types of dual-polymerization resin cements, Alcem Core (FGM), a conventional resin cement requiring the application of a dentin adhesive agent, and RelyX U200 (3M), a self-adhesive resin cement eliminating the need for a bonding agent. The study concluded that Alcem Core exhibited lower pore concentration, greater surface uniformity, and smaller particle size, making it more suitable for the cementation of indirect restorations.

In the presented case, successful outcomes were observed at various stages. The restoration displayed proper adaptation to the preparation, requiring minimal adjustment time, and exhibited favorable anatomical characteristics. The final result pleased the patient, providing not only an aesthetically pleasing appearance but also restoring the functionality of the tooth. This comprehensive approach ensures the longevity and success of the semi-direct resin restoration in posterior teeth.

The successful outcome of the case emphasizes that the semi-direct restorative technique can be a valuable tool in the clinician's armamentarium, offering a cost-effective and time-efficient solution for the restoration of posterior teeth with extensive damage. However, it is crucial for clinicians to carefully assess each case, considering factors such as the amount of remaining tooth structure, patient's oral hygiene habits, and the desired aesthetic outcome [11].

Conclusion

The semi-direct restorative technique using composite resin proved to be a successful and viable option for the rehabilitation of a posterior tooth with significant coronal destruction. The combination of extraoral crafting, polymerization, and polishing steps contributed to improved restoration adaptation, anatomy, and aesthetics. The use of a dual polymerization resin cement further enhanced the bond strength, ensuring the longevity of the restoration. The semi-direct technique presents itself as a valuable alternative in specific clinical situations, providing a cost-effective and time-efficient solution for the restoration of posterior teeth with extensive damage.

References

1. Alharbi A, Rocca GT, Dietschi D, Krejci I. Semi-direct composite onlay with cavity sealing: a review of clinical procedures. J Esthet Restor Dent. 2014 Mar-Apr;26(2):97-106.

2. Alzraikat H, Burrow MF, Maghaireh GA, Taha NA. Nanofilled resin composite properties and clinical performance: a review. Oper Dent. 2018 Jul/Aug;43(4):E173-90.

3. Blasi Beriain M, Rocca GT, Franchini L, Dietschi D, Saratti CM. Rehabilitation of worn dentition with direct resin composite restorations: a case report. Dent J (Basel). 2022 Mar 23;10(4):51.

4. Bresser RA, Naves LZ, van der Made SAM, Cune MS, Gresnigt MMM. Deep margin elevation. Int J Esthet Dent. 2023 May 11;18(2):142-60.

5. Burey A, Reis PJ, Santana Vicentin BL, Dezan Garbelini CC, Grama Hoeppner M, Appoloni CR. Polymerization shrinkage and porosity profile of dual cure dental resin cements with different adhesion to dentin mechanisms. Microsc Res Tech. 2018 Jan;81(1):88-96.

6. Cetin AR, Unlu N, Cobanoglu N. A five-year clinical evaluation of direct nanofilled and indirect composite resin restorations in posterior teeth. Oper Dent. 2013 Mar-Apr;38(2):E1-11.

7. Costa PVM, Oliveira AA, Silva VASE, Torres ÉM, Silva MAGS, Veríssimo C. The effect of the die material used in the indirect technique on the fracture resistance of a restored molar. Braz Oral Res. 2023 Feb 13;37:e017.

8. de Carvalho MA, Lazari-Carvalho PC, Polonial IF, Souza JB, Magne P. Significance of immediate dentin sealing and flowable resin coating reinforcement for unfilled/lightly filled adhesive systems. J Esthet Restor Dent. 2021 Jan;33(1):88-98.

9. Dietschi D, Spreafico R. Evidence-based concepts and procedures for bonded inlays and onlays. Part I. Historical perspectives and clinical rationale for a biosubstitutive approach. Int J Esthet Dent. 2015 Summer;10(2):210-27.

10. Dietschi D, Spreafico R. Evidence-based concepts and procedures for bonded inlays and onlays. Part III. A case series with long-term clinical results and follow-up. Int J Esthet Dent. 2019;14(2):118-33.

11. Grazioli G, Francia A, Cuevas-Suárez CE, Zanchi CH, Moraes RR. Simple and low-cost thermal treatments on direct resin composites for indirect use. Braz Dent J. 2019 Jun;30(3):279-84.

12. Ribeiro AEL, Dias JDN, Melo AMDS, Borges BCD, Assunção IV. Direct and semi-direct resin composite restoration in large cavity preparations: analysis of dentin bond strength stability and bottom/top microhardness ratio in a cavity model. Odontology. 2022 Jul;110(3):482-8.

13. Ritter AV, Fahl Jr N, Vargas M, Maia RR. The direct-indirect technique for composite restorations revisited. Compend Contin Educ Dent. 2017 Jun;38(6):e9-12.

14. Rocca GT, Rizcalla N, Krejci I, Dietschi D. Evidence-based concepts and procedures for bonded inlays and onlays. Part II. Guidelines for cavity preparation and restoration fabrication. Int J Esthet Dent. 2015 Autumn;10(3):392-413.

15. Silva AF, Lund RG. Dentística restauradora: do planejamento à execução. 1. ed. São Paulo: Santos; 2016.

16. Tew IM, Ho EHT. Minimally invasive rehabilitation of posterior erosive tooth wear: two case reports of the one-stage dahl approach. Cureus. 2022 Feb 15;14(2):e22235. doi: 10.7759/cureus.22235.

17. Torres CRG, Zanatta RF, Huhtala MFRL, Borges AB. Semi-direct posterior composite restorations with a flexible die technique: a case series. J Am Dent Assoc. 2017 Sep;148(9):671-6.

18. Torres CRG. Odontologia restauradora: estética e funcional. 1. ed. São Paulo: Santos; 2013.

19. Yoshikawa T, Burrow MF, Tagami J. A light curing method for improving marginal sealing and cavity wall adaptation of resin composite restorations. Dent Mater. 2001 Jul;17(4):359-66.