Optimizing the Cementation of Indirect Composite Restorations: A Clinical Case Using the Combo Technique

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Abstract: ***This article presents a clinical case highlighting an efficient and evidence-based cementation protocol for indirect composite restorations using the combo technique. Emphasis is placed on the appropriate selection of resin cements—light-curing for highly translucent restorations and dual-curing for low-light transmission scenarios. Through a step-by-step clinical application, the article demonstrates how proper material pairing and adhesive procedures can enhance the bond strength, reduce postoperative sensitivity, and ensure long-term durability. The discussed protocol serves as a practical reference for clinicians aiming to streamline workflow and achieve optimal esthetic and functional outcomes in adhesive restorative dentistry.***

Keywords: cementation, combo technique, indirect composite restoration, adhesive dentistry, restorative protocol

1. Introduction

Cementation agents are fundamental to dental restoration, facilitating adhesion between the restorative material and the tooth substrate while preserving the integrity of complex tissues. The choice of dental cement and the pre-placement conditioning of the restorative material are critical factors that significantly influence the long-term durability and adhesive performance of the restoration [0,[2]]. These materials must exhibit high resistance to tensile and compressive stresses, maintain mechanical stability, and endure cyclic loading fatigue. Additionally, optimal performance requires minimal shrinkage, strong bond strength to both tooth tissues and dental biomaterials, and effective prevention of caries development at the adhesive interface.

Various indirect restorative cements have been investigated alongside alternative materials, including different types of composite resins, for use as luting materials chosen by clinicians based on case-specific restorative challenges. Light-polymerized composite resins offer distinct advantages over dual-polymerized resin cements, such as superior stain resistance, enhanced color stability, and increased mechanical wear resistance, which are attributed to their higher inorganic filler content [[3],[4]]. Research indicates that increasing the concentration of inorganic fillers in resin-based cementation agents enhances the structural integrity of thin indirect restorations. However, the elevated inorganic filler concentration significantly affects the viscosity of the composite resin, reducing its fluidity and resulting in a thicker, less desirable cementation line at the adhesive interface [[5]] and offering improved mechanical properties for specific cementation applications. Clinicians must carefully consider these factors to optimize clinical outcomes in adhesive restorative procedures. This article presents a clinical case employing a combined paste- and flowable-resin cementation approach (combo technique) for cementing indirect composite restorations, highlighting its effectiveness, workflow efficiency, and the rationale behind material selection.

2. Case presentation

A 37-year-old female patient with no significant medical history presents for a dental visit five years after her last check-up. She reported difficulty in removing food residues in the interproximal areas of teeth #23, #24, and #25, particularly in relation to fractured composite restorations on #24.

The anamnesis reveals no painful symptoms. However, radiographic (Fig.1) and physical (Fig.2) examinations indicate the presence of secondary carious lesions affecting teeth #25 and #24, as well as a primary carious lesion on #23.

Figure 1: Preoperative radiographic observation

Figure 2: Intraoral preoperative view - teeth #24 and #25

The cold test performed on vital dental elements is positive, highlighting the absence of irreversible pulp pathologies. Diagnosis is a distal carious lesion on #23 and mesio-occlusal-distal carious lesions on #24 and #25. Since the patient requested aesthetic restoration, we decided the treatment plan to include a direct restoration #23 and indirect composite restorations cemented by the combo technique.

The operating field was isolated with Optragate (*Ivoclar, Liechtenstein*), and the removal of carious lesions and old obturation on teeth #23, #24, and #25. After the caries removal, a rubber dam was placed on the working field, and all prepared surfaces were blasted with 50 µm Al2O3. The next step involved immediate dental sealing protocol applying a total-etch adhesive system, Syntac (*Ivoclar, Liechtenstein*), to remove all undercuts, protect freshly cut dentin, enhance bonding, and to elevate the gingival margin using a flowable composite, Tetric Evoflow (*Ivoclar, Liechtenstein*) (Fig.3,4). The deep margin elevation (DME) technique represents a minimally invasive restorative approach designed to manage subgingival margins by relocating them coronally with a composite resin layer. This technique facilitates adhesive procedures, improves access for classical impression-taking or digital scanning, and supports optimal isolation during restorative treatment. By elevating deep margins to a position above or level with the gumline, DME enhances predictability of adhesive bonding, preserves sound tooth structure, and reduces the need for surgical crown lengthening, thereby contributing to long-term functional and aesthetic outcomes, as Keremedchieva et al. reported [[6]].

Figure 3: Immediate sealing protocol with prepared surfaces for adhesive procedure.

Figure 4: Tooth #24and #25 after IDS and marginal elevation.

The next step was cavity preparation for indirect restorations with red diamond burr 845KR.FG.016.A2 (*Komet, Germany*). The remaining walls were solid, so there was no need for cusps reduction. The cavity margins were finished with red and yellow ring diamond cutters.

It was taken using an analogue impression technique with double impression and Addition Silicone (*Aquasil LV, Putty/Light Body, Dentsply, Germany*). After verifying the impression quality, a ceramic shade was selected using Vita Shade Classic, and the impression was sent to the laboratory. The composite used for the fabrication of inlays is SR Nexco Paste (*Ivoclar, Liechtenstein*). The indirect restoration, once received and verified for a proper fit, is treated according to the appropriate protocol. (Fig.5)

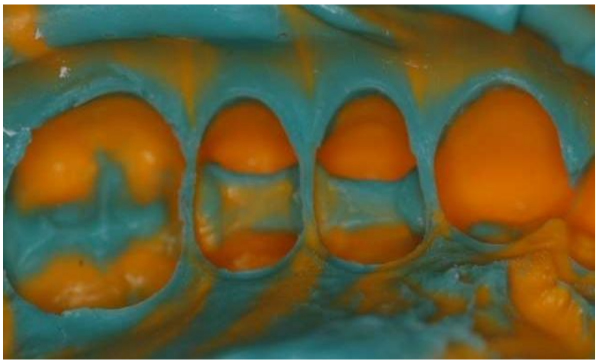

Figure 5: Analogue impression by the double impression technique.

The internal surface of the inlay was gently sandblasted with 50µm Al203, etched with 37% orthophosphoric acid, and then cleaned under running water, put in an ultrasound bath, rinsed, and air dried. A silane coupling agent, Monobond Plus (*Ivoclar, Liechtenstein*), was applied for 60 seconds (as per the manufacturer's instructions), and the bonding agent Heliobond, (*Syntac*, *Ivoclar, Liechtenstein*) and inlay were placed under a light-protecting box. Under the rubber dam placement, the tooth was blasted with Al2O3 29 microns, preserving adjacent teeth. The tooth surfaces are ready for the cementing procedure (Fig.6)

Figure 6: Isolated surfaces ready for the cementing procedure

The tooth was rinsed and lightly dried. For the dental substrate treatment, 37% orthophosphoric acid (*N Etch ®, Ivoclar, Liechtenstein*) was applied for 20 seconds followed by washing and air drying; three consecutive coats of the adhesive system Syntac (*Ivoclar, Liechtenstein*) were used for 20 seconds then gently dried after each step (Fig.7). During the cementation process, paste composite Empress Direct (*Ivoclar, Liechtenstein)* is applied to the proximal preparation margins (Fig. 8), while flowable composite Tetric Evoflow (*Ivoclar, Liechtenstein*) is uniformly applied across the entire preparation surface (Fig.9). Upon positioning and pressing the restoration into place, the paste composite extrudes from the proximal regions, facilitating controlled excess removal. Concurrently, the flowable composite disperses buccally and lingually, forming a thin, consistent layer between the preparation and the overlay [[7]].

Figure 7: Tooth surface after application of the adhesive system #24

Figure 8: Paste composite applied to the proximal preparation margins #24

Figure 9: Flowable composite applied across the entire preparation surface #24

Excess cement was removed using a brush, probe, and floss. Light-curing was performed for 20 seconds on each side, following a 5-second pre-polymerization phase. The luting agents began to harden, facilitating efficient removal of residual material [[8],[9]]. Polymerization was then performed for 60 seconds on the mesio-buccal, disto-buccal, mesio-lingual, disto-lingual, and occlusal surfaces. This process utilized the Bluephase style (*Ivoclar*, *Liechtenstein*), delivering a light intensity of 1200 mW/cm². To ensure complete polymerization, the restoration is covered with a liquid glycerin gel and then polymerized for 20 seconds on each side. (Fig. 10)

Figure 10: Final polymerization after replacing the glycerine gel #24

The same procedure was repeated for #25. The occlusion was checked, and the restoration was finished and polished (post-cementation instructions were given to the patient) (Fig.11, 12, 13, 14, 15). To conclude, the fit and adaptation of the indirect restoration were assessed using a dental radiograph. (Fig. 16)

Figure 11: Etching procedure #25.

Figure 12: Paste composite applied to the proximal preparation margins #25.

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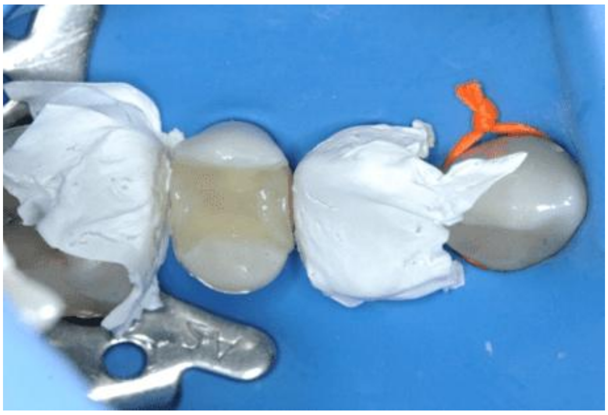

Figure 13: Flowable composite applied across the entire preparation surface #25.

Figure 14: Immediately after cementation #24, #25.

Figure 15: After removing the rubber dam, an occlusal check of #24 and #25.

Figure 16: Postoperative radiographic observation

3. Discussion

Contemporary dental practice encompasses a wide range of luting agents suitable for indirect restorations, each designed to address mechanical, adhesive, and aesthetic requirements across diverse clinical situations. The choice of cementation technique and properties of the luting agent play a pivotal role, and the nature of the restorative material used significantly impact the longevity of esthetic inlays. The choice of cementation technique, the properties of the luting agent, and the material used for the indirect restoration all significantly influence the durability of aesthetic inlays. The combo technique offers enhanced mechanical stability and improved long-term performance compared to conventional cementation methods. By integrating multiple bonding mechanisms, it addresses limitations inherent in traditional approaches, thereby providing a more robust and clinically reliable outcome [[7]]. This comparative rationale underscores the methodological superiority of the combo technique and its potential to redefine best practices in the field.

As the use of dentin bonding agents and resin cements has increased, inlays have become more popular in restorative dentistry. Resin cements, based on their polymerization mechanism, can be divided into three groups: chemically activated, light-cured, and dual-cured systems. Dentin bonding helps to create a strong seal between the restoration and the surrounding dental tissues [[10]]. Gateva et al. reported that etching time of dentin [[11]] and the application method of the adhesive system, as the manufacturer's recommendation, significantly affects the durability of bond strength [[12]].

However, factors such as the thickness of the restoration, time exposure, and the translucency of the restoration material can significantly impact the microhardness of the resin composites used as luting agents [[13]]. Currently, no universally accepted agent provides similar retention success across all dental tissues and all types of indirect restorations. The choice of cementation technique, properties of the used luting agent, and the material of indirect restoration heavily influence the durability of esthetic inlays [[14]]. With the increasing implementation of dentin bonding agents and resin cements, inlays have gained traction in restorative dentistry.

There is no single cement that has been universally accepted and can offer the same retention success in all dental tissues with all indirect restorations.

Light-cured adhesive resin cements have become a preferred choice for securing minimally invasive indirect aesthetic restorations, mainly due to their excellent mechanical strength, minimal solubility in oral fluids, long-lasting colour stability, and the benefit of a controllable working time [[3],[4],[15],[16]]. These properties make them particularly suitable for procedures demanding precision and durability. On the other hand, an inappropriate clinical protocol can trigger premature polymerization, sometimes accompanied by excess cement being trapped in unintended areas, which complicates cleanup and may affect the outcome [[7]]. The relatively low concentration of inorganic fillers in the formula, which improves flowability, may result in increased volumetric shrinkage during the polymerisation process. A coefficient of thermal expansion that is greater than that of natural tooth structures, such as enamel and dentin, combined with shrinkage, could affect the adhesive interface [[17]]. This interference can expose the cement to the oral environment, potentially compromising both the structural integrity and aesthetic longevity of the restoration. Several studies have investigated the effectiveness of various adhesives and bonding cements used in inlays made from identical restorative materials, emphasizing their impact on bond strength and clinical durability [[18], [19]]. Kramer et al. reported a 10% failure rate over eight years when applying protocol two light-cure resin cements: EBS Multi + Compolute (*3M ESPE, Seefeld, Germany*) and Syntac + Variolink II (*Ivoclar, Schaan, Liechtenstein*) [[20]]. In contrast, Sörgren et al. found that the survival rate of inlays cemented with a dual-cure composite resin (*Vita Cerec Duo Cement, Coltene-Whaledent, Altstetten, Switzerland*) was significantly lower (77%) compared to those cemented with a chemically cured composite luted ones(*Cavex Clearfil F2, Cavex, Haarlem, the Netherlands*), which demonstrated a 100% survival rate ($p < 0.05$) [[18]]. To further refine restorative strategies, the finite element analysis (FEA) method enables a detailed evaluation of cavity configurations, providing valuable insights into stress distribution within the restored tooth. By simulating different preparation designs, FEA supports the identification of the most favourable cavity geometry to ensure optimal biomechanical behaviour. This approach contributes to tissue preservation and enhances the long-term success of indirect restorations, offering a reliable tool for guiding minimally invasive and functionally durable restorative strategies and models for scientific investigations [[21]].

Composite resins have naturally high viscosity, and this often results in a thicker cement layer during luting procedures, compromising the marginal adaptation of indirect restorations and potentially leading to microleakage, reduced bond integrity, and long-term clinical failure [[22]].To address these challenges, the use of preheated composite resins as cementation agents has gained popularity. Preheating significantly reduces the viscosity of the resin [[23], [24]], thereby improving its flow characteristics and enabling deeper penetration into etched ceramic or composite surfaces. This enhanced adaptation promotes stronger micromechanical interlocking and improves overall bonding efficiency [[25]]. However, this technique is not without its drawbacks.

The polymerization of preheated composites can generate substantial internal stress within the cement layer, especially in restorations with thin walls [[26]]. These stresses may increase the risk of crack formation or debonding in delicate indirect restorations such as veneers or onlays. Given the extended working time of photopolymerized resin, some clinicians may find this method more efficient and user-friendly than alternative luting techniques. Zeller researched the effect of increasing temperature on the viscosity and polymerization behaviour of composite resin cements and found considerable variation in their rheological responses due to differences in polymerization kinetics [[27]]. Ayub et al. reported that the protocol of preheating composite reduces viscosity, ensures better adaptation, improves microhardness, and reduces the placement of restorations [[28]]. Confirming previous reports, Nascimento et al. found that increasing temperature significantly reduces viscosity across various composite formulations, with notable differences in thermal response among brands [[29]]. This approach is preferred because of the smooth cleaning of excess material and its higher filler content compared to conventional resin cements. The universally accepted optimal thickness of the cement layer, as recommended by the manufacturer, is considered critical for ensuring the longevity and stability of dental restorations [[30]]. The recommended thickness of the cement layer is below 120 μm to enhance restoration performance and longevity [[31]].

Similarly, the criterion for clinically acceptable marginal gap values remains a subject of ongoing debate in the literature [[31]]. Campaner et al. investigated resin cement thicknesses of 100 μm and 400 μm, concluding that increased cement thickness significantly influences cusp deflection. Some studies suggest a cement thickness below 100 μm, whereas others propose a cement thickness of more than 120 μm [[32],[33]]. Cement layers with insufficient thickness are associated with increased stress and subsequent deformation within the tooth structure [[17]]. This recommendation is essential for optimizing adhesive performance, minimizing mechanical stress on restorative materials, and preventing premature failure of the restoration [[34]].

Numerous studies have evaluated the performance of flowable composites as luting agents in comparison to conventional resin cements, examining a wide range of parameters including color stability and opacity, micro-tensile bond strength [[35]], compressive strength [[36]], radiant exitance, degree of conversion [[5], [37]] shrinkage strain, polymerization stress, elastic modulus [[5]], fluorescence [[38]], and shear bond strength to both feldspathic porcelain [[30]] and lithium disilicate [[39]]. Despite these investigations, the comparative bonding efficacy of flowable composites to polymer-infiltrated ceramic networks and nano-hybrid resin-matrix ceramics remain unclear. Ashe et al. established that when cementing resin nanoceramic inlays, clinicians have to consider the type of adhesive resin cement used, as different cements exhibit varying marginal and internal gap formation at the inlay–tooth interface [[40]].

Comparative research between dual-cured resin cements and light-cured ones proves that mechanical characteristics, enhanced flexural strength, surface hardness, and elastic modulus are better in the first one [[15], [41]], and they are primarily connected to their dual activation mechanism, which ensures a higher degree of monomer conversion and results in more favorable mechanical and esthetic properties [[15]]. Limitations of these materials include reduced working time and time-dependent color change, which can affect their suitability for aesthetic restorations [[15], [41]]. Consequently, alternative cementation systems have been explored to address these shortcomings. Light-polymerized resin cements exhibit superior adhesion to tooth substrates compared to dual-polymerized resin cements [[42]]. Mondal et al. investigated the shear bond strength of lithium disilicate using one light-cured and two dual-cured resin cements. They demonstrated the superior performance of dual-cured resin cements, which yielded the highest shear bond strength values [[42]]. These results corroborate earlier findings by Alqahtani et al. [[44]], reinforcing the reliability of dual-cure systems in high-stress clinical scenarios.

The longevity of restorative materials remains a cornerstone of clinical decision-making in restorative dentistry. This research focuses on the performance of indirect composite restorations in comparison to direct composites and ceramics, with an emphasis on longevity, failure rates, and clinical applicability.

Indirect composite restorations have demonstrated promising long-term outcomes, with survival rates ranging from 84% to 91% for 5-9 years [[45], [46]]. One of the primary benefits of indirect composite restorations is controlled polymerization, reduced polymerization shrinkage, and enhanced physical properties achieved through laboratory processing. Pallesen and Qvist reported that 88% of composite resin inlays remained clinically acceptable after 11 years of service, demonstrating promising long-term performance in posterior restorations [[47]]. This finding aligns with the results of a 10-year clinical trial by Barabanti et al., which showed that approximately 90% of indirect composite resin inlays and onlays used to restore extensive tooth defects remained effective after a decade in clinical use [[48]]. Galiatsatos et al.[[46]] and Ozturk et al. [[49]] reported high durability of indirect composite restorations in both posterior and anterior applications, particularly when proper case selection and bonding protocols are followed.

Comparative research has found no statistically significant difference in survival rates between the two modalities, suggesting that the choice may depend more on clinical context than material performance [[50], [51]].

The versatility of lithium disilicate and zirconia makes them a predictable choice in modern dentistry, offering high esthetic and mechanical properties in combination with a minimally invasive approach. However, ceramics are more brittle and prone to catastrophic failure, whereas composites tend to fail more conservatively, allowing for repair rather than replacement. The survival rates of ceramic inlays and onlays were 90% at 5 years, 89% at 8 years, and 85% at 10 years [[45]]. The success rates of ceramic inlays and onlays were 88% at 5 years and 77% at 10 years [[52]]. Gusiyska et al. published similar results for 5 years [[53]] and 10 years [[54]].

Clinically, the choice between these materials and cementation protocol should be guided by the extent of tooth damage, occlusal load, esthetic demands, and patient-specific factors such as parafunctional habits and hygiene. Indirect composite restoration is an acceptable and less invasive solution than ceramics, yet more durable than direct composites in extensive restorations. Contemporary dental medicine explores sophisticated approaches to managing demineralized enamel and dentin [[55], [56]], as well as applying adhesive systems with antibacterial properties [[57], [58]]. Building on these advancements, this study underscores the clinical value of aligning cementation protocols with restorative material properties to enhance long-term outcomes, offering a reproducible and evidence-based approach for indirect restorations.

4. Conclusion

In summary, an optimal cementing protocol must ensure biological integration, mechanical stability, and clinical efficiency to provide the long-term success of indirect restorations combining biocompatibility and antimicrobial protection. Supporting effective marginal sealing and low solubility is mandatory for contemporary dental cements. Following clinical protocol, ease of application, minimal film thickness, and suitable working and curing times are required. The ability to remove excess cement efficiently also enhances procedural workflow and treatment outcomes.

As indirect composite restorations are increasingly favored for their conservative and aesthetic benefits, the choice and implementation of the cementing protocol become critical. Clinical studies have demonstrated that the indirect techniques showed overall satisfactory survival rates over 5 and 10-year periods. Researchers have confirmed that, with the appropriate method and material choice, indirect composite restorations can provide long-lasting results, making them a promising solution in contemporary restorative dentistry. This synthesis not only reinforces clinical best practices but also contributes to the academic foundation of dental education, offering a reference point for curriculum development and evidence-based instruction

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Author Profile

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