

Repair or Replacement of Direct Restorations: Clinical Guidelines

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ABSTRACT

A significant part of general dentistry focuses on the repair or replacement of existing dental restorations to enhance their strength and functionality. In everyday dental practice, defective restorations are among the most common issues faced by professionals. Rather than completely replacing damaged restorations, repairing them has become an increasingly popular and effective alternative. When dealing with partially defective restorations, repair instead of full replacement is not only safe but also highly effective. This method often leads to greater retention of the tooth, as only the damaged portion is replaced. However, the repair's success is largely dependent on proper case selection, choosing the right materials, and applying the correct technique. It is also essential to consider factors such as the caries risk level, the type of restoration to be repaired, material selection, and both aesthetic and functional considerations to ensure the longevity of the restoration. This literature review focuses on repair or replacement of direct restorations, its clinical guidelines and minimally invasive approaches.

Key words

Amalgam repair, Repair of composites, GIC, Replacement of restorations, Direct restorations

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INTRODUCTION

Restorative materials commonly used in dental practice include amalgam, direct tooth coloured restorations such as resin-based composites (RBC), compomers, and glass ionomers, as well as indirect restorations like indirect RBC, ceramics, porcelain fused to metal, and gold or other metal castings.¹ A study by Yousef and Khoja (2009) found that composite materials were the most frequently used (71.3%), followed by amalgam (15.3%), and glass ionomers (8.7%), while indirect restorations were the least used restorative materials.² When dealing with partially failed restorations, there are two primary treatment options: complete replacement or repair.³

In dental practice, placing and replacing restorations are common procedures, with secondary caries being the leading cause for repairs or replacements.^{4,5} Minor defects caused by secondary caries, along with stained or degraded edges, can often be resolved through refurbishing or refinishing the restoration. However, for larger defects, a portion of the restoration may need to be removed to access the affected area.² This partial removal, done to the full depth of the restoration, allows for a more accurate diagnosis of the lesion's extent, as these defects are often well-defined. If the main part of the restoration remains intact and in good condition, the exploratory cavity preparation can be sealed with an appropriate filling material.⁶

Repair of Restoration

Minimally invasive dentistry emphasizes the importance of restoring rather than replacing dental restorations, which helps to extend their lifespan.^{4,7,8} This approach not only minimises the negative effects of invasive procedures on the tooth but also makes treatment less traumatic for both the patient and the tooth, offering significant benefits compared to complete replacement.⁹⁻¹¹

The essence of minimally invasive treatment is to address dental issues with the least amount of damage to the tooth structure.¹² From a clinical perspective, opting for repair over replacement is a more practical solution, as it preserves the natural tooth structure, reduces the likelihood of complications such as pulp damage, and can lower the overall cost of treatment.¹³ When a restoration is deemed clinically unacceptable, it can often be corrected with minimal intervention, typically by adding extra restorative material to the existing restoration.¹⁴ This method tends to be faster, more affordable, and in many cases, may not require local anesthesia, resulting in less stress and discomfort for the patient compared to fully replacing the restoration.⁹ It is vital to assess the clinical success of restoration repairs, particularly within the first twelve months following treatment, to ensure longevity and effectiveness.¹⁵

Repairing a dental restoration always involves adding new restorative material, regardless of whether any preparation

is done on the restoration or the surrounding tooth structure.¹⁵ Teeth with repaired restorations are less likely to need aggressive procedures like endodontic treatment or extraction, especially when compared to those with fully replaced restorations.^{4,7} Kanzow and Wiegand (2020) in their retrospective study stated that repairs are less invasive and can significantly prolong the retention of teeth.¹⁶ Resin-based composite (RBC) is the most commonly chosen material for repairing dental restorations, with various preconditioning techniques applied to ensure proper bonding.¹²

The numerous advantages of opting for repair over replacement of a dental restoration can be summarised as follows:

- No need for local anesthesia, as long as the repair is not extensive⁹
- Shortened treatment times^{8,15}
- Lower costs for the patient¹³
- Lower risk of iatrogenic damage to adjacent teeth¹³
- Reduced risk of damaging the dental pulp^{13,17}
- Preservation of tooth structure¹⁵
- Increased longevity of the restoration⁵
- High patient acceptance¹⁸

Criteria for repair¹⁹

- Treatment of early secondary caries lesions
- Correction of small marginal openings and cavo-marginal ditching
- Management of localised marginal staining
- Chipping of restoration margins
- Correction of unacceptable aesthetics
- Repair of fractures that do not compromise the integrity of the remaining restoration or tooth structure
- Management of wear

Steps involved in repairing of various restorative materials

Repair protocols for dental restorations depend on factors such as the material used, manufacturer guidelines, the strength of the achieved adhesion, and the location within the oral cavity.¹⁴ Below is an outline of the typical steps involved in repairing different types of dental restorations.

- 1. Surface Preparation:** Start by cleaning all surfaces of the restoration to be repaired using pumice or a polishing paste.²⁰ Remove any loose or cracked areas from the surface and smooth them out using fine-grit diamond burs.^{14,21}
- 2. Conditioning:** Different materials require specific physical conditioning methods
 - Resin Composite and Amalgam:** Use air-borne particle abrasion with alumina or silica-coated alumina particles.²⁰⁻²⁴
 - Hybrid Composite Resins and Silicate Ceramics:** Use silane coupling agents.^{22,25-27}
- 3. Adhesion and Polymerization:** Apply adhesive resin to the conditioned substrate and ensure thorough photopolymerization.²²
- 4. Application of Repair Material:** Apply resin composite to the physico-chemically conditioned surfaces and photopolymerize.^{17,22}
- 5. Finishing and Polishing:** The success of a repaired restoration largely depends on the crucial final step of

finishing and polishing.²⁸ The primary goal of polishing is to smooth the surface of the restoration, reducing plaque deposition and ensuring healthy periodontal maintenance.^{18,29} A wide variety of finishing and polishing devices are available, including aluminum oxide-coated abrasives (Sof-Lex), silicone discs, tungsten carbide finishing burs, abrasive-impregnated rubber cups, abrasive strips, diamond rotary instruments, and polishing pastes.¹⁸ Proper finishing and polishing of the repaired area significantly enhance the longevity of the restorations.³⁰

6. Check the occlusion and remove any occlusal interferences present¹⁷

Repair of Amalgam

The combination of low cost and lasting durability has made amalgam a staple in general dental practices for many years.^{31,32} Repairing amalgam restorations is often more conservative in preserving the tooth structure compared to completely replacing the restoration.¹ In a long-term cohort study on failed amalgam restorations, it was found that repair, rather than replacement, was a successful approach for restorations with marginal defects.²⁰ Amalgam restorations may become defective due to secondary caries, fracture in the amalgam, fracture in the tooth itself, or marginal defects such as gaps between the restoration and the tooth surface.⁹

Repair of amalgam Restoration with Composite:^{17,33}

- Administer local analgesia: As indicated clinically.
- Remove undermined tooth tissue
- Prepare retention features: within the amalgam restoration to provide mechanical retention for the composite material.
- Achieve moisture control by applying rubber dam or using cotton rolls and salivary ejectors.
- Use an intraoral aluminum oxide sandblaster (Microetcher), which is effective at pressures as low as 45psi with 50 microns aluminum oxide abrasives or a diamond bur to prepare the adjacent amalgam and tooth tissue surfaces.
- Provide pulp protection, if necessary
- Etch the tooth surface for 15-30 seconds, wash and dry the preparation
- Apply Adhesive Bonding System to tooth surface
- Apply Alloy-Resin Bonding Agent to restorative surface
- Place Repair Composite, finishing and polishing.

Repair of old amalgam with amalgam:

When repairing amalgam restorations, it is recommended to enhance mechanical retention by roughening the remaining amalgam surface with a diamond bur before applying new amalgam.³⁴ Amalgam bonding agents are widely used in posterior tooth restorations due to their advantages, such as improved tooth reinforcement, reduced postoperative sensitivity, better marginal adaptation, decreased microleakage, lower risk of secondary caries, and the ability to preserve more tooth structure.³⁵

To ensure a strong bond between new and old amalgam restorations, steps to be followed are:³⁶

1. Apply pressure vertically to the repair surface
2. Use a condenser smaller than the repair site to maximise pressure.
3. Use an amalgam material with a different composition for the repair to achieve greater strength.
4. Reduce the size of the repair site to improve repair strength. At the repair/restoration interface, the bonded amalgam technique may sometimes lead to increased microleakage.³⁵ Hickel et al (2013) in their study have shown that repaired

and replaced amalgam restorations have similar survival rates after five years. However, after ten years, repaired amalgam restorations tend to perform less effectively.¹ Placing retention grooves in the proximal slot preparation significantly improved fracture strength compared to slots without retention grooves.³⁶ Additionally, it is important to assess the tightness of the proximal contact points in a reproducible manner. Weak physiological contact points can lead to issues such as food impaction or discomfort.³⁷

Repair of composite

Known for their excellent aesthetic appeal and impressive mechanical properties, composite resins have gained widespread acceptance among clinicians for direct restorations.^{3,38,39} Over recent decades, composite resins have become the preferred choice for restoring posterior teeth, gradually replacing amalgam as the material of choice.^{40,41} A key factor in the success of repairs involving composite resins is the establishment of a strong and durable bond between the new and existing restorative materials.³ From an economic standpoint, repairing composite restorations is typically more cost-effective than repairing amalgam restorations.⁴² Repairing existing composite restorations accounts for nearly half of all dental procedures performed.⁴³ One of the key advantages of repairing a defective restoration with composite resin is the ability to preserve the intact portion of the direct composite restoration (DCR) that shows no signs of failure, whether clinically or radiographically. This makes it a preferable alternative to full restoration replacement.⁴⁴

For a successful composite repair, achieving strong adhesion between the existing aged restoration and the newly applied composite is crucial. Utilising a separate silane coupling agent remains an important step to enhance the repair potential.⁴⁵ The overall success of the composite restoration relies not only on the material used but also on its smooth finish, the quality of polishing agents, and the specific composition of the composite material.¹⁸

Intraoral Repair Protocol for Chipping or Fracture in Composite restoration²⁰

- Use a fluoride-free paste or pumice for cleaning the surface
- Use a fine-grit diamond bur with water cooling and create a bevel for roughening the margins.
- Etching is done by using 37% phosphoric acid for 15-20 seconds, rinse for 60 seconds, and dry.
- Apply a single layer of silane coupling agent and dry gently. Applying silane coupling agents is crucial as it forms chemical bonds between inorganic fillers and organic matrix, enhancing composite adhesion to repaired surfaces. Insufficient or excessive drying can negatively impact this adhesion leading to premature repair failures.
- Apply adhesive resin, air dry, and photo-polymerize.
- Apply resin composite incrementally, photo-polymerize, finish, and polish.

Repair of Glass Ionomer Cement (GIC)

GIC bonds chemically to tooth structure, forming an acid-resistant attachment that enhances caries inhibition. Its fluoride release helps prevent decay, making it a cost-effective and easy-to-use option, especially beneficial for low-income or high-caries-risk populations.⁴⁶

Procedure for repair

With GIC:

Phosphoric acid is the most effective surface conditioning agent for repairing glass ionomer cements, resulting in

repairs with higher flexural strength.⁴⁷ After conditioning, freshly mixed glass ionomer cement was applied to the treated surface and allowed to set.

With composite:

Repairing Resin modified GIC (RMGIC) with resin composite is generally considered the preferred method. Studies have shown that resin composites bond effectively to RMGIC, with failure primarily occurring cohesively within the RMGIC itself.⁴⁸

Longevity of repaired restorations

Repairing dental restorations can greatly improve their lifespan, with studies showing a reduction in the annual failure rate (AFR) by as much as 50%.¹³ Repairs performed on restorations that fail due to caries generally have a better long-term outcome compared to those failing because of fractures.⁴⁹ Several studies highlight that repairs are not only straightforward and quick procedures but also improve the clinical properties of defective materials.⁵⁰ When it comes to materials, repairing amalgam and composite restorations has been shown to significantly enhance the survival rate of the original structure, with repairs sometimes lasting as long as full replacements.³⁴ Opting to repair defective composite resins, rather than replacing them entirely, has proven to be a safe and effective method for extending their functionality over time.⁵⁰

Contraindications for repair

- Extensive secondary caries extending beneath the restoration margins.
- Significant structural compromise risking fracture post-repair.
- Aesthetic demands not achievable through repair.

Replacement

The replacement of a restoration involves completely removing the defective or failed material, along with any nearby tooth tissue that is discolored or compromised aesthetically or functionally.⁵ This process creates a uniform restoration, which enhances aesthetics and provides a better marginal seal. However, it often comes with downsides, including potential pulp irritation and the unnecessary removal of healthy tooth structure.⁴³ Additionally, complete restoration replacement can be both costly and time intensive.²⁰ Considering these factors, replacement should be viewed as a final option, reserved for situations where no other effective treatment alternatives are available.^{7,17}

Despite some limitations in the use of amalgam, both composite and amalgam remain the primary materials used for direct restorations, with similar annual failure rates for both.⁴⁰ In general dental practice, the most common reasons for replacing restorations are the diagnosis of recurrent or secondary caries, as well as fractures of the restorations.^{1,51}

The presence of secondary caries under the restoration likely contributed to the preference for replacement over repair.¹² It is important to note that the term "secondary caries" is often poorly defined, and lesions labeled as such may, in fact, be areas where repair is possible rather than requiring complete replacement. The longstanding belief that microleakage of oral fluids into marginal or interfacial defects leads to secondary caries or pulpal issues has historically supported the practice of replacing restorations rather than opting for repairs.¹¹

Steps to remove amalgam restorations:

Replacement involves completely removing the old amalgam, along with any base or lining materials, which carries the risk of inadvertently removing healthy tooth tissue.⁹

The removal of amalgam should be done as follows:⁵²

- A new dental bur is used in the handpiece to ensure easy removal
- High volume suction and a continual addition of water spray are supplied to the site where the amalgam is being extracted
- If possible, the amalgam restoration is sectioned and then scooped out to reduce the release of mercury vapor. Amalgam separators should be used to capture mercury-containing waste dental amalgam from waste water, preventing it from entering sewer systems.

Criteria for replacement¹⁹

- The restoration exhibits unacceptable qualities, with a high likelihood of further clinically significant deterioration or lesion progression.
- Repair is not a viable option.
- The chances of achieving a favorable clinical outcome are high.

Each time a restoration is replaced^{9,53}

- The cavity may expand as more healthy tooth structure is removed, often far from the area where the restoration has failed, which can weaken the tooth.
- It reduces the chances of maintaining pulp vitality.
- The overall cost of treatment is likely to increase.
- There is a higher risk of future failure.

Reasons for restoration failure

To improve patient dental care, it is essential to identify the risk factors that contribute to the failure of restorations.^{54,55} The criteria for evaluation included: marginal adaptation, marginal staining, surface staining, postoperative sensitivity, translucency, and fractures.^{37,56} Secondary or recurrent caries was the leading cause for the replacement of all types of restorations studied.¹³ Other common reasons for replacement included restoration fractures-particularly bulk fractures, discoloration (both bulk and marginal), fractures at the restoration margins, and the presence of degraded margins.^{1,15,17,53} Additional factors influencing replacement were the loss of tooth structure due to non-carious lesions, fractures in multi-surface restorations, loss of anatomic form, pain or sensitivity, unacceptable aesthetic appearance, absence of retention form, pulpal disease, debonded restorations, material or aesthetic changes (specifically for amalgam restorations), and complete loss of the restoration (for amalgam only).^{19,32,39,41,57}

CONCLUSION

In restorative dentistry, there is a growing consensus that repairing a defective, clinically unacceptable restoration is often a better option than opting for a complete replacement. This approach, which focuses on repair rather than full replacement, is minimally invasive and can significantly prolong the lifespan of the original filling, reducing the risk of pulp-related complications. Repair should be prioritized in cases of limited restoration defects, particularly to conserve tooth structure and manage costs effectively. However, clinical judgment considering long term prognosis, extent of secondary caries and patient specific factors must guide the ultimate decision.

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The Continuing Professional Development (CPD) section provides for twenty general questions and five ethics questions. The section provides members with a valuable source of CPD points whilst also achieving the objective of CPD, to assure continuing education. The importance of continuing professional development should not be underestimated, it is a career-long obligation for practicing professionals.

