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AMALGAM - RESIN COMBO RESTORATION - A REVIEW

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ABSTRACT:

Amalgam has been the traditional material for filling cavities in posterior teeth for the last 150 years and, due to its effectiveness and cost, amalgam is still the restorative material of choice in certain parts of the world. In recent times, however, there have been concerns over the use of amalgam restorations , relating to the mercury released in the body and the environmental impact following its disposal. Resin composites have become an esthetic alternative to amalgam restorations and there has been a remarkable improvement of its mechanical properties to restore posterior teeth. Amalgam Composite combined restoration is a technique that combines the best of both the restorative materials. It could ease the process of restoration and could be a less expensive technique that combines the esthetic appearance of composite along with the mechanical properties of amalgam. Hence it's important to discuss an alternative combination restorative technique that enhances the esthetics of amalgam being used as a core material in stress-bearing areas with that of composite that finally improves the appearance of the tooth.

INTRODUCTION

Amalgam restorations have been known for their durability and reliability for more than a hundred years. Despite the availability of direct tooth-colored restorative materials, amalgam remains a material of choice for posterior restorations. Amalgam is more popular than composite as it is relatively easy to insert, less technique sensitive, and has reasonable adequate resistance to fracture[1]. It provides marginal sealing after a period of time in the mouth, has good mechanical properties, and is economical for the patient.

It has a long history of clinical usage with proven longevity. The dark color of these restorations presents an aesthetic quandary and has been the chief complaint of many patients. Apart from aesthetics, composite preparation requires less removal of sound tooth structure and improves fracture resistance of teeth. Composites show an annual failure rate similar to amalgam but the placement of composites is technique sensitive. In the case of larger cavities, there is a reduced survival rate of the restoration as when compared with smaller cavities.

Composite resin restorations have increased considerably in popularity and predictability, becoming routine in dental practice [2]. Some reasons for this development was the possibility of a minimally invasive dental treatment, improvement in the development of resins and adhesive restorative techniques and an increase in the number of patients who seek aesthetic restoration to replace the amalgam and in that context, composite resin has been widely used for this type of procedure, reaching a high-level of restorations obtained because of their physical and aesthetic properties. However, to achieve success with composite resin restorations, knowledge of the restorative and adhesive materials, and the use of appropriate techniques are required, otherwise, failure may occur quickly.

There is controversy over the best materials to use when restoring cavities caused by tooth decay in permanent teeth. Amalgam fillings have been successfully used for over 150 years and are cost-effective. However, their use has declined over recent years partly because of the way they look and because of the perceived risk of mercury that is used in them. Tooth-colored (composite resin) fillings are frequently used in the front teeth and also in permanent teeth at the back of the mouth [3].

Previously our team had conducted numerous clinical trials [4,5], carried out extensive in-vitro [6,7], in-vivo [8] and molecular studies [9], analysed the effect of various biological agents and its dental applications [10,11], threw some critical light on various recent advancements in the field of dentistry [12], conducted innumerable systematic reviews[13–15] and questionnaire based surveys [16–18]. Now we are focussing on relevant reviews to gain comprehensive knowledge on recent developments in the field of Restorative Dentistry. Amalgam-resin combo restoration is a recent development and can be a good alternative in many situations. The article reviews various aspects of an amalgam-resin combo restoration.

NECESSITY OF AMALGAM-RESIN COMBINED RESTORATIVE TECHNIQUE

Restoration of extensively carious teeth to an optimum state of health, function, and aesthetics, continues to be a challenge for all operating dental surgeons. Although numerous restorative materials have been tried in order to achieve adequate strength, restore aesthetics, and conserve the remaining tooth structure, a perfectly ideal restorative material has still eluded researchers [19]. Dental amalgam is versatile, with clinically acceptable mechanical properties and a long experience associated with its serviceability in the oral environment, although it does not strengthen the remaining tooth structure.

Other restorative materials such as resin-based composites require conservative cavity preparation to increase the fracture resistance of the teeth. However, the material shows an inability to achieve tight proximal contacts in the posterior teeth and polymerization shrinkage. Thus, many researchers have proposed combined amalgam and composite resin restoration to achieve the advantages of both restorative materials [20] .

Various research articles and studies indicate that there are higher failure rates with resin composite than amalgam restorations. The included studies date back to 2007 and composite dental restorative materials have advanced considerably since then. Since the proposed discontinuation of use of amalgam depends on quality improvement of non-mercury-based alternative restorative materials (BDA 2013), there is need for continued focus on new research demonstrating the long-term effectiveness of the latest improved composite materials, techniques, and instruments for placing them [21] .
Combined amalgam-composite restoration capitalizes on the advantageous properties of the two materials and nullifies their individual disadvantages.

VARIOUS TECHNIQUES EMPLOYED IN AMALGAM- RESIN COMBINED RESTORATIONS

1. Amalgam restoration followed by composite veneering

- **PROCEDURE** :

A case report published in Indian journal of dental sciences documented this technique that was performed for the first time, on a patient's mandibular molar tooth [22] . The article described how the patient's esthetic requirements were put into limelight without compromising the mechanical advantages of amalgam. According to this technique, carious dentin is removed using a round carbide bur under air-water cooling. The cavity configuration is self-retained. A layer of light cured calcium hydroxide (Septocal LC) was applied. Resin modified GIC was used as a base for the final restoration. A high-copper alloy (DPI Alloy) is used to restore the large cavity preparation. Patient is recalled the next day and polishing of the restoration is done [23] . The colour shade is determined and a rubber dam is placed. The buccal and occlusal amalgam surface is ground to a depth of 2 mm. Using diamond burs, two small holes are placed in the ground amalgam surface to improve mechanical retention (Figure 6). Resin-modified glass ionomer cement (GIC Gold label light patient's colored universal restorative) is mixed

according to the manufacturer' s instructions and a thin layer is applied into the retention holes and photo activation is conducted for 40 seconds. The enamel is conditioned with 37% phosphoric acid for 20 seconds followed by washing. Two layers of Adper Single Bond (3M/ESPE) are then applied, which are photo activated for 20 seconds. A layer of masking agent is applied and cured for 40 seconds [24] . The veneer is built with composite (Filter Z250, 3M/ESPE) of the selected tooth shade with two increments of 1 mm each which are polymerized for 40 seconds. Rubber dams are removed; premature contacts are checked and reduced accordingly. The finishing and polishing is completed with finishing burs and disks (Sof-Lex, 3M/ESPE) for the composite.

ADVANTAGES:

I) RMGIC has good bonding capacity.

II) The interface will be filled with a compatible material thus the composite- amalgam interface will be properly sealed [25] .

III) The gray color of amalgam is masked properly .

IV) Masking agent is used as a first layer of composite to enhance aesthetics. Acid etching was done only on the enamel surface since some studies have found reduction in bonding resistance between materials thus increasing micro leakage.

- **MECHANICAL** RETENTION BETWEEN AMALGAM AND COMPOSITE

In order to provide some mechanical retention between amalgam and composite, usually amalgam is ground with a diamond bur and small holes are prepared [26] . These holes improve the resistance to displacement of composite caused by occlusal forces. Retention Pins are also used.

2. <u>Hybrid</u> composite <u>Filtek Z250 (3M, ESPE) using self-etch adhesive Adper Prompt (3M, ESPE) and silver amalgam FusionAlloy (Heraeus Kulzer).</u>

- **PROCEDURE** :

The cavity preparation is complex and involves more than two surfaces, that is, the occlusal surface, any one proximal surface, and the buccal and / or lingual / palatal surfaces [27] . The faciolingual width of the cavity is more than one-fourth of the intercuspal distance. The depth and design of the cavity is determined by the extent of the carious lesion [28] . The cusps with undermined enamel are also included in the cavity preparation. Type II glass ionomer cement (Fuji II GC Corporation) is used as a base. A self-etch

adhesive Adper Prompt is used as per the manufacturer's instructions [12] . Filtek Z250 is placed in increments to restore the tooth. After restoring the tooth to its proper anatomic form, a class II cavity, for amalgam, is prepared. Using a sectional metal matrix band with a Bitine ring (The Palodent System, Dentsply), the cavity is restored with the silver amalgam FusionAlloy. Occlusal interferences if any, are adjusted. The restoration is polished, and the intraoral periapical radiograph and photograph are taken [29] .

3. Posterior packable composite Surefil (Dentsply) using Prime and Bond NT (Dentsply) and silver amalgam FusionAlloy (Heraeus Kulzer).

- **PROCEDURE**:

The procedure was similar to previous technique, except that the prepared cavity is etched with 37% phosphoric acid for 15 seconds, followed by application of bonding agent Prime and Bond NT, which is light cured for 10 seconds. The tooth is restored with composite Surefil using the incremental technique. Next, a conventional class II cavity for amalgam is made and restored with amalgam FusionAlloy, as in previous technique [30] .

- **ADVANTAGES** :

The combined composite–amalgam restorations performs better for contact and contour and retention than composite and amalgam restorations, respectively.

4. Metal adhesive resin cements

- **PROCEDURE** :

Tooth preparation is clean, dry and carries free. A lining, such as Vitrebond (3M ESPE), should be placed where indicated.

The tooth should be isolated with a rubber dam to ensure excellent moisture control required when working with any dental resin.

If a matrix band is required around the tooth, a thin layer of petroleum jelly should be applied to the inside of the band with a micro-brush to facilitate easy removal once the bonded amalgam has been placed.

The cavity is then etched with 35 percent phosphoric acid for 15 seconds and washed for 30 seconds to ensure that all the acid and the calcium phosphate precipitates created by the etching are washed away. The tooth is then dried with an oil-free air stream [31] .

The dentine is then re-hydrated with a dampened micro-brush to facilitate wet dentine bonding. If not, the drying of the dentine can cause collapse of the unsupported collagen architecture inhibiting adequate wetting and penetration of the primer [32] .

This is followed by the application of two layers of bonding agents, such as Scotchbond (3M ESPE), to the wet dentine. The first layer removes any

residual water and begins to infiltrate the adhesive monomers into the etched dentine so when the second layer is applied, the fresh monomers re-dissolve the resin globules leaving a homogenous penetrative film12. This is gently air-dried for two seconds before being light cured for 20 seconds according to the manufacturer's guidelines [33] .

The adhesive cement, in this case RelyX ARC (3M ESPE), is mixed as per the manufacturer's instructions and thinly applied to the cavity using a micro-brush. The resin is not light cured and the mixed amalgam is then packed immediately against the un-set resin.

Once the cavity has been bulk filled the matrix band can be removed and the restoration should then be burnished and carved using the same techniques as for a conventional amalgam. Time should be taken to carve and contour the amalgam to ensure that the cuspal anatomy is kept [34] .

The rubber dam is then removed and the patient's occlusion checked. It is important to give the patient an opportunity to rinse their mouth and relax their muscles. Swallowing reintroduces the patient back into the intercuspal position (ICP) after keeping their mouth open for long periods of time. The occlusion should not only be checked in ICP but also in lateral excursive movements to ensure there are no sliding movements or guidance is on the new restoration to prevent excessive forces during functional loading [35] .

Occlusion is best checked holding the articulating paper between Miller forceps and allowing the patient to close into ICP. A thin layer of petroleum jelly on the articulating paper helps the contacts to be clearly visible on the tooth and restoration surfaces. I would use one colour of articulating paper for ICP and a contrasting colour of articulating paper for lateral excursive movements. Any adjustments should be made accordingly.[36]

Finally, the restoration as seen in figure eight can be polished with green and brown stones or a prophy air jet.

- **AVANTAGES**

I) Reduced **costs** compared to cast restorations.
II) Simple technique.
III) Restorations can be placed in a single visit.
IV) More conservative compared to cast restorations.
V) More conservative compared to conventional amalgam restorations as mechanical retention features such as grooves or pins are not required.
VII) Reduced microleakage and risks of secondary caries
VIII) Reduced postoperative sensitivity
IX) Bonding can support weakened tooth structure.

CURRENT ADHESIVES USED TO BOND AMALGAM

Although numerous commercial products are available for adhesion to enamel and dentine, most of these are intended for use with resin composites [37] . Some of them also have metal bonding capabilities and may be used alone or with additional components for amalgam bonding. A few products have been

specifically developed for amalgam bonding. Recently, some dental adhesiveresins have shown excellent adhesive properties to both tooth structures and encouraging bonding to amalgam alloys [38] .

Also, in this respect, due to the method of condensing amalgam onto an unset adhesive resin liner, there is an intimate mechanical interlocking created. Some of the main adhesives used in amalgam bonding studies include ***All-Bond 2*** (Bisco), Amalgambond Plus with ***HPA*** (high performance additive) powder (Parkell), ***Optibond 2*** (Kerr), ***Panavia EX*** and ***Panavia 21*** (Kuraray).

When ***All-Bond 2*** is used, enamel and dentine are both etched with 10% phosphoric acid for 15 seconds. After etching and rinsing, the tooth surface is left visibly moist. This is because drying of the dentine can cause collapse of the unsupported collagen network, inhibiting adequate wetting and penetration by the primer. An unfilled chemically activated resin is placed after the primer [39] .

This material is under study in a prospective, controlled clinical trial along with the ***All-Bond C&B*** resin luting cement to bond ***Nordiska Scania 2000*** dental amalgam. The study includes bonded amalgam sealants placed into pits and fissures unprepared, apart from prophylaxis with pumice on a bristle brush and etching with phosphoric acid [40] .

CONCLUSION

Combi-restorations aim to use the positive properties of the two materials involved, providing an esthetically acceptable, strong, wear-resistant and durable restoration as a compromise to an indirect restoration where financial limitations do not permit an ideal type of treatment.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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