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Resin Bonded Bridges-Review

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ABSTRACT: Resin-bonded fixed partial dentures (FPDs) represent a significant advancement in prosthodontics, offering a conservative and minimally invasive solution for replacing missing teeth. This article reviews the principles, materials, design considerations, clinical techniques, and outcomes associated with resin-bonded FPDs. The resin-bonding technique allows for enhanced retention and reduced preparation of the abutment teeth, preserving more of the natural tooth structure. Additionally, the article discusses indications, contraindications, and the challenges associated with resin-bonded FPDs, such as debonding, fracture, and the importance of patient-specific factors in treatment planning. The outcomes of resin-bonded FPDs in terms of longevity, patient satisfaction, and functionality are also examined.

I. INTRODUCTION

The primary goal of resin-bonded FPD is replacing missing teeth with maximum conservation of tooth structure.[1] The success of this technique depends on the ability to etch specific, high-modulus non-precious alloys. After etching, the metal framework can be bonded to enamel with a composite resin. The attachment comprises three strategic areas: 1. Etched enamel surface, 2. Bonding resin, 3.Etched metal surface.[2]

DEVELOPMENT OF RESIN-BONDED FPD

BONDED PONTIC

Earliest resin-bonded prosthesis. Extracted natural teeth or acrylic resin teeth were used as pontic. composite resin connectors require supporting wires, a stainless steel mesh framework, and polyethylene fibre mesh to reduce brittle fracture.[1]

CAST PERFORATED RESIN BONED FPD (ROCHETTE BRIDGE -MECHANICAL RETENTION)

Introduced by Rochette in 1973. He first combined mechanical retention with a silane coupling agent by using wing like retainers with funnel shaped perforations. Composite resin was polymerized between the perforated cast metal retainer and tooth.[3] Primary use was periodontal splinting, but pontics were sometimes included. These FDPs (fixed dental prosthesis) were limited to mandibular teeth or situations with minimal occlusal contact. The restorations were bonded with a heavily filled composite resin as a luting medium.[1]

Livaditis expanded this concept to replacement of posterior teeth. Perforated retainers were used to increase resistance and retention. Cast retainers were extended interproximal into the edentulous areas and onto occlusal surfaces. The design included a defined occlusogingival path of placement by tooth modification, which involved lowering the proximal and lingual height of contour of the enamel on the abutment teeth. Despite this success, the perforation technique presents the following limitations:

- Weakening of the metal retainer by the perforations
- Exposure to wear of the resin at the perforations
- Limited adhesion of the metal provided by the perforations[3]

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ETCHED-CAST RESIN-BONDED FIXED DENTAL PROSTHESES (MICROMECHANICAL RETENTION: "MARYLAND BRIDGE")

A technique for the electrolytic etching of cast base metal retainers was developed at the University of Maryland by Thompson and Livaditis.[1] This technique had been used by Dunn and Reisbick in the study of ceramic bonding to base metal alloys. McLaughlin proposed much faster technique for etching retainers by immersing them in a beaker of combined solution of sulphuric and hydrochloric acids placed in an activated ultrasonic cleanser for 99 seconds while electric current is passed through the fixed partial denture and solution. [3]

Etched-cast retainers have definite advantages over cast-perforated restorations:

• Retention is improved because the resin-to-etched metal bond can be substantially stronger than the resin-to-etched enamel. The retainers can be thinner yet still resist flexing. The oral surface of the cast retainers is highly polished and resists plaque accumulation. During the course of this work, the need for a composite resin with a low film thickness for luting the casting became apparent. This led to the first generation of resin cements, which allowed micromechanical bonding into the undercuts in the metal casting created by etching, provided adequate strength, and allowed complete seating of the cast retainers. These methods were followed by simplified techniques, chemical etching, or gel etching. They all yield similar results, provided that the technique is optimized for a specific alloy.[1]

Electrochemical etching is technique sensitive. Overetching produces an electropolished surface and contamination of surface reduces bond strength.

Laviditis reported acceptable results with nonelectrolytic technique that requires Ni-Cr-Be alloy to be placed in an etching solution for 1 hour in water bath at 70^0C

Air abrading the metal with 250-micron abrasive increases strength when used in conjunction with silane.[3]

CERAMIC RETAINERS (ZIRCONIA CANTILEVER RESIN BONDED FPD)

High-strength ceramics, particularly zirconia have been used as retainers for resin-bonded FDPs. These restorations exhibit better esthetics than do metal retainers, which can discolor, particularly with thin abutment teeth. Zirconia retainers and connectors can be larger since they are tooth-colored, esthetics will not be compromised.[1]

CHEMICAL-BONDING RESIN-BONDED FIXED DENTAL PROSTHESES (ADHESION BRIDGES)

The first of these resin systems (Super-Bond C&B, Sun Medical Co., Ltd.; C&BMetaBond, Parkell, Inc.) is based on a formulation of a methyl methacrylate polymer powder and methyl methacrylate liquid modified with the adhesion promoter 4-methacryloxyethyl-trimellitic anhydride (4-META). It was developed with a unique tri-n-butylborane catalyst system that is added to the liquid before combining with the powder. Examples- superbond C&B, bis-GMA–based composite resin luting cement (Panavia, Kuraray America, Inc.) that is modified with the adhesion promoter 10-methacryloxydecyl dihydrogen phosphate (MDP). Changing the method of attachment of the resin to the metal framework does not change the design of the framework itself because the limiting factor in the system is still the bond of resin to enamel.[1]

VIRGINIA BRIDGE

Moon and Hudgins et al produced particle roughened retainers by incorporating salt crystals into the retainer patterns to produce roughness on inner surfaces. This method is also known as the lost salt technique for producing Virginia bridges.[3]

II. DESIGN CONCEPTS

The principle underlying these restorations has always been that it is necessary to cover as much enamel surface as possible, as long as occlusion, aesthetics, or periodontal health is not compromised. The initial designs of etched-cast retainers included an "interproximal wraparound" concept developed to resist occlusal forces and provide a broader area for bonding. Enamel preparations consisted of creating occlusal clearance, placing occlusal/cingulum rests, and lowering the lingual and proximal height of contour, thus creating proximal extensions. Frameworks should seat in an occlusogingival direction and should have no facial-lingual displacement. The contemporary design has improved retention with well-placed and precise grooves on abutment teeth.

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Three principles are fundamental to achieving predictable results with resin-bonded FDPs: proper patient selection, correct enamel modification, and framework design. The treatment is not a panacea, and if any contraindications are present, the patient should be treated with a conventional FDP or an implant-supported prosthesis.

ADVANTAGES[1,2,3]

- Minimal removal of tooth structure
- Minimal potential for pulpal trauma
- Anesthesia is not usually required
- Supragingival preparation
- Easy impression making
- Interim restoration is not usually required
- Reduced chair time
- Reduced patient expense
- Rebonding possible

DISADVANTAGES[1,23]

- Education needed on concepts of microretention
- Demanding techniques and tooth preparation with discerning diagnosis
- There is heavy dependence on laboratories for treatment of cast metals
- Graying out of teeth that are thin labiolingually at incisal surfaces.
- Reduced restoration longevity
- Enamel modifications: required
- Space correction: difficult
- Good alignment of abutment teeth: required
- Esthetics compromised on posterior teeth
- Patient expectations are high but routine results are fair to good not outstanding.

INDICATIONS[1]

- Replacement of missing anterior teeth in children and adolescents
- Short edentulous span
- Unrestored abutments
- Single posterior tooth replacement
- Significant clinical crown length
- Excellent moisture control

SPECIFIC INDICATIONS[2]

- Retainers of FDP for abutment teeth with sufficient enamel to etch for retention.
- Splinting of periodontally compromised teeth
- Stabilizing dentitions after orthodontics
- Medically compromised, indigent, and adolescent patients
- Prolonged placement of interim prosthesis to augment surgical procedures like craniofacial anomalies.

CONTRAINDICATIONS[1]

- Patients with acknowledged sensitivity to base metal alloys
- When facial aesthetics of abutment required improvement
- Insufficient occlusal clearance
- Incisors with tin faciolingual dimensions
- Parafunctional habits
- Long edentulous span
- Restored or damaged abutments

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- Compromised enamel
- Significant pontic width discrepancy
- Deep vertical overlap

FABRICATION

In the fabrication of resin-bonded FDPs, attention to detail in the following three phases is necessary for predictable success:

- Preparation of the abutment teeth
- Design of the restoration
- Bonding

PREPARATION OF THE ANTERIOR ABUTMENT TEETH

The fundamental considerations for anterior RBP include

- Sufficient lingual surface clearance of 0.6 to 0.8mm (1mm is optimal)
- Development of cingulum rest
- Creation of an incisogingival proximal surface path of insertion with an identifiable supragingival finish line about 1mm from the crest of tissue.
- Additional 0.2 mm to accommodate protrusive excursion of mandible.
- Proximal-facial extensions for retention without a metal display.
- Possible rotational path of insertion with one proximal surface slightly undercut

All modifications should be consistent with the predesigned path of insertion.[2]

On anterior teeth, the procedure is similar in many ways to the lingual reduction needed for a pinledge preparation, but the amount of reduction is significantly less because the enamel must not be penetrated. Nonnoble alloys are usually used because they provide a strong framework in thin metal sections. Nonnoble metal also provides a strong margin, and so there is no need to prepare the tooth with a distinct margin; thus the enamel is preserved in this area.[1]

III. STEP-BY-STEP PROCEDURE

Retainer retention can be substantially improved by the placement of additional strategically placed grooves. Two additional grooves are usually positioned on mesiolingual and distolingual aspects of the tooth, just inside the marginal ridges on the incisors in occlusogingival direction which need not to be parallel. However, the depth and width are critical for clinical success. They should be 0.75 mm wide, 1 mm deep, and approximately 5 mm long. An additional groove is placed on the interproximal surface next to the pontic space. This groove extends vertically from the gingival margin and exits on the lingual side of the incisal edge. The position of this groove is usually more lingual to avoid involving or undermining the incisal enamel.

The size and shape of the grooves are critical for retention. Large grooves are less effective. All grooves should be narrow and have flat parallel sides. They are placed with burs of very narrow diameter. The interproximal groove resists displacement in the buccolingual direction, and the lingual (railroad-track) grooves resist displacement in the incisogingival direction.

A cantilever pontic design for resin-bonded FDPs is recommended. This has been successful in the anterior region and is particularly useful for the replacement of lateral incisors, for which cantilevers from either the central incisor or canine are possible. The choice is based on providing the best retention and the best aesthetics. When properly designed, the cantilever approach has been shown to have better fatigue bond strength than a two-abutment design.[5]

Cantilevered designs have significant advantages:

• The preparation is simplified.

• The problems associated with the occlusion and differing mobilities of abutment teeth, which tend to place excessive stresses on the cement and retentive features, are avoided. Cantilevered resin-bonded FDPs work well on mobile teeth.

• If a cantilevered resin-bonded FDP with a single abutment becomes loose, it falls out of the mouth. The dentist can then reassess the situation in terms of occlusion, retentive features, and cementation. A much more difficult situation is if a

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resin-bonded FDP becomes loose at one end. Many patients return to the dentist only when caries are established under the loose abutment. A cantilevered resin-bonded FDP either is cemented or falls out. The risk to the patient of caries under a loose retainer is eliminated. The most effective way to replace a missing mandibular incisor with a resin-bonded FDP is an FDP cantilevered from the adjacent tooth. If two mandibular incisors are being replaced, it is recommended that two separate FDPs are made. Connecting the pontics increases the risk of failure.[1,6]

IV. POSTERIOR TOOTH PREPARATION AND FRAMEWORK DESIGN

The fundamental considerations for posterior RBP

- Selective axial reduction lingually at the height of contour
- 1 mm deep occlusal rest inclined towards the centre of abutment teeth
- 180 degree proximal extensions approximately 0.6mm thick
- A predesigned path of insertion
- Facial proximal retention on the posterior abutment[2]

The basic framework for the posterior resin-bonded FDP consists of three major components: the occlusal rest (for resistance to gingival displacement), the retentive surface (for resistance to occlusal displacement), and the proximal wrap and proximal slots (for resistance to torquing forces) A spoon-shaped occlusal rest seat, similar to that described for a partial removable dental prosthesis is placed in the proximal marginal ridge area of the abutments adjacent to the edentulous space. An additional rest seat may be placed on the opposite side of the tooth. The rest is an important retention feature that simultaneously resists Occlusal and lateral forces. It should be designed to function as a shallow "pin."

The restoration is designed to maximize the bonding area without unnecessarily compromising periodontal health or aesthetics to resist occlusal displacement. Proximal and lingual axial surfaces are reduced to lower their height of contour to approximately 1 mm from the crest of the free gingiva. The proximal surfaces are prepared so that parallelism results without undercuts. In the interproximal area, a gingival chamfer margin is not desirable; a knife-edge margin is better for avoiding enamel penetration. Occlusally, the framework should be extended high on the cuspal slope, well beyond the actual area of enamel recontouring (provided that it does not interfere with the occlusion). Tooth structure when viewed from the occlusal aspect. This proximal wrap enables the restoration to resist lateral loading by engaging the underlying tooth structure and is assisted in this regard by grooves in the proximal surface just lingual to the buccal line angle. Distal to the edentulous space, the retainer resistance is augmented by a groove at the linguoproximal line angle. Preparation of grooves in abutment teeth for posterior resin-bonded bridges is beneficial to their chance of survival. Moving a properly designed resin-bonded FDP in any direction except parallel to its path of placement should not be possible, nor should it be possible to displace any tooth to the buccal aspect from the framework. Resin-bonded bridges in the maxilla have a better prognosis than those in the mandible. [9]

Occasionally a combination restoration can be used. This type of FDP includes a resin-bonded retainer on one of the abutment teeth and a conventional cast restoration on the others. This type of FDP has been very successful in clinical studies.[10]

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LABORATORY PROCEDURES

Waxing of framework

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Investing

↓

Casting with favorable metal for adhesive resin

↓

Clinical evaluation

↓

Glazing

↓

Clean the fitting surface with a particle-abrasion Unit, using aluminum oxide (50 µm at a minimum Of 0.3 MPa [40-psi] pressure

↓

Bonding

BONDING THE RESTORATION

Cements (Bonding Agents)

Composite resins play an important role in bonding the metal framework to etched enamel. Conventional bis-GMA–type resins (e.g., Comspan, Dentsply Caulk) originally used for luting resin-bonded FDPs have been replaced by these more recently developed resin-metal adhesives, which continue to improve.

Panavia 21 exhibits excellent bond strengths with base metal alloys and tin-plated noble metals. It has an anaerobic setting reaction and thus does not set in the presence of oxygen. To ensure complete polymerization the manufacturer provides a polyethylene glycol gel (Oxyguard II) that can be placed over the restoration margins. The gel creates an oxygen barrier and can be washed away

after the material has been completely set.[3] Bridges cemented with Panavia showed the highest survival rate (67%) among the luting cements in a study analyzed for 5 years.[10]

POSTOPERATIVE CARE

All resin-bonded restorations should be scrutinized at the regular recall examinations. Because partial debonding can occur without complete loss of the prosthesis, visual examination and gentle pressure with an explorer should be performed to confirm such a complication. Because debonding is most commonly associated with biting or chewing hard food, patients should be warned about this danger. If the patient perceives any changes in the restoration, he or she should seek early attention. Early diagnosis and treatment of a partially deboned FDP can prevent significant caries

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THE SUCCESS RATE OF RBPS IS IMPRESSIVE IF THEY ARE PRESCRIBED RETENTION AND RESISTANCE IN THE FORM OF

- Nearly parallel opposing walls (6-degree taper)
- A specific path of insertion
- Sufficient occlusal clearance
- Maximum coverage of virginal enamel
- Vertical stops

Debonding of the restoration (78%) is the most common type of failure followed by porcelain fracture (13%). Retentive tooth preparation, preparation confined to enamel, silicoating, supra gingival margins, Ni-Cr or Co-Cr alloys, and no occlusion on pontic in lateral excursions have been reported to be associated with better survival rates. Anterior RBBs were found to be more retentive than posterior RBBs. [10]

Despite the high survival rates, technical complications like de-bonding and minor chipping were frequent. RBBs with zirconia framework and RBBs with one retainer tooth showed the highest survival rate.[11]

V. CONCLUSION

Resin-bonded retainers in prosthodontics provide an effective, conservative approach for restoring and maintaining tooth function and aesthetics. These retainers offer several advantages, such as preserving healthy tooth structure, being minimally invasive, and providing a discreet, aesthetically pleasing solution for patients. They are particularly beneficial in cases where full-coverage crowns or bridges are not necessary, and they can help maintain the stability of restorations while preventing further tooth movement or shifting. However, as with any dental treatment, the success of resin-bonded retainers depends on proper case selection, accurate bonding techniques, and diligent patient care.

REFERENCES

1. Rosenstiel SF, Land MF, Walter RD. Contemporary fixed prosthodontics. 6th ed. 2001.Pg no 757-77.
2. Malone W F P, Koth D L, Cavazos E, Kaiser D A, Morgano S M.Tylman’s theory and practice of fixed prosthodontics. 8th ed. Pg no 219-28.
3. Shillingburg HT, Hobo S, Whittset LD, Jacobi R, Brakett SE. Fundamentals of fixed Prosthodontics. 3rd ed. Pg no 179-90.
4. Livaditis GJ. Cast metal resin-bonded retainers for posterior teeth. J Am Dent Assoc. 1980 Dec;101(6):926-9.
5. Wilkes PW, Shillingburg HT Jr, Johnson DL. Effects of resistance form on attachment strength of resin-retained castings. J Okla Dent Assoc. 2000 Winter;90(3):16-20, 22, 24-5.
6. Livaditis GJ, Thompson VP. Etched castings: an improved retentive mechanism for resin-bonded retainers. J Prosthet Dent. 1982 Jan;47(1):528.
7. Baylis M, Thomas GD. The use of salt crystals to achieve an identifiable retentive surface for resin bonded bridges. Dent Tech. 1985 Aug;38(8):16-20.
8. Saunders WP. Resin bonded bridgework: a review. J Dent. 1989 Dec;17(6):255-65.
9. De Kanter RJ, Creugers NH, Verzijden CW, Van't Hof MA. A five-year multi-practice clinical study on posterior resin-bonded bridges. J Dent Res. 1998 Apr;77(4):609-14.
10. Balasubramaniam GR. Predictability of resin bonded bridges - a systematic review. Br Dent J. 2017 Jun 9;222(11):849-858.
11. Thoma DS, Sailer I, Ioannidis A, Zwahlen M, Makarov N, Pjetursson BE. A systematic review of the survival and complication rates of resin-bonded fixed dental prostheses after a mean observation period of at least 5 years. Clin Oral Implants Res. 2017 Nov;28(11):1421-1432.
12. Creugers NH, Käyser AF, Van't Hof MA. A seven-and-a-half-year survival study of resin-bonded bridges. J Dent Res. 1992 Nov;71(11):1822-5.
13. Creugers NH, Käyser AF. An analysis of multiple failures of resin-bonded bridges. J Dent. 1992 Dec;20(6):348-51.
14. Creugers NH, De Kanter RJ, van 't Hof MA. Long-term survival data from a clinical trial on resin-bonded bridges. J Dent. 1997 May-Jul;25(3-4):239-42.

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

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15. De Kanter RJ, Creugers NH, Verzijden CW, Van't Hof MA. A five-year multi-practice clinical study on posterior resin-bonded bridges. J Dent Res. 1998 Apr;77(4):609-14.
16. Ei-Mowafy OM. Posterior acid-etch bridge--a modified retentive design. J Can Dent Assoc. 1996 Nov;62(11):862-5.
17. Dummer PM, Gidden JR. Two-part resin bonded cast metal bridges for use when abutment teeth have unequal effective root surface areas. Restorative Dent. 1990 Aug;6(3):9-14
18. Wilkes PW, Shillingburg HT Jr, Johnson DL. Effects of resistance form on attachment strength of resin-retained castings. J Okla Dent Assoc. 2000 Winter;90(3):16-20, 22, 24-5.
19. el-Mowafy O, Rubo MH. Retention of a posterior resin-bonded fixed partial denture with a modified design: an in vitro study. Int J Prosthodont. 2000 Sep-Oct;13(5):425-31.
20. el-Mowafy O, Rubo MH. Resin-bonded fixed partial dentures--a literature review with presentation of a novel approach. Int J Prosthodont. 2000 Nov-Dec;13(6):460-7.
21. Wyatt CC. Resin-bonded fixed partial dentures: what's new? J Can Dent Assoc. 2007 Dec;73(10):933-8.

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