Resin Bonded Bridges: From Crust to the Core – A Review Article

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ABSTRACT

For more than 30 years resin bonded bridges have proved to be one of the best treatment option for restoration of anterior teeth in most of the cases. During this period there has been a lot of research, modifications and advancement in this field to increase the success rate of resin bonded prosthesis and decrease its failure rate. The dentists are turning towards more cost and time effective management of cases and resin bonded bridges considerably satisfy these needs. This review article therefore includes the history and evolution of the resin bonded fixed dental prosthesis (RBFDP), the type of RBFDP, and the design variations in the resin bonded bridges.

Keyword: Resin bonded prosthesis

INTRODUCTION

There are several treatment dilemmas where conventional fixed or removable prosthesis do not appear completely satisfactory. In the adolescent, many factors influence the prosthetic therapy, tooth development, occlusal development and esthetics. It should preserve tooth structure and should not limit the future treatment options in adulthood. Tissue supported acrylic removable partial dentures have some disadvantages, particularly soft tissue and periodontal inflammation. Fixed prosthesis also has a certain amount of failure rate due to insufficient crown length, also in young teeth that possess large pulp chambers tooth preparation becomes difficult. Therefore, a resin bonded fixed dental prosthesis is a suitable treatment option.

Resin bonded or resin retained bridges are minimally invasive fixed dental prosthesis which rely on composite resin cements for retention. First described in 1970s, the resin bonded bridges have evolved significantly. This article reviews the types of resin bonded bridges, their applications, and clinical considerations.

EVOLUTIONARY CHANGES IN RESIN BONDED BRIDGES

Bonded pontic

These are the earliest resin bonded prosthesis, introduced by Ibsen and Portnoy in 1973. Extracted/ natural or acrylic teeth were used as pontics. These are bonded directly to the etched enamel. Composite resin connectors are used reinforced with wire or stainless steel mesh framework. These are limited to short anterior spans.[1]

The drawback of this type of prosthesis is degradation of composite resin bond and subsequent fracture. Hence should be given as short term or provisional replacement.

Rochette bridge

Rochette in 1973, introduced the concept of bonding a metal retainer to enamel using adhesive resin. His application was to splint periodontally involved mandibular anterior teeth using a cast gold bar bonded to the lingual surfaces of the teeth. The cast metal splint described had perforations to provide mechanical interlocking between the cement and the metal. His introductory article made reference to modifying the technique for application as an RBFPD.

Howe and Denehy modified this application to introduce the first form of RBFPD. Their design recommendation was:

1) extending framework to cover maximum area of lingual surface,
2) little or no tooth preparation, and
3) limitation to mandibular teeth or teeth with minimal occlusal contact.[2]

Livaditis proposed abutment preparation, including reduction of proximal and lingual surfaces to create a path of insertion, along with occlusal rest seat preparation to resist tissueward displacement of the retainer. These modifications enhanced the retention and resistance forms of the metal retainer to the tooth.

Virginia Bridge

It was first developed at Virginia Commonwealth University, School of Dentistry by Moon and Hudgins in 1984. It has a macroscopic mechanical means of retention.

Fabrication: It is fabricated with the help of a *Lost salt crystal technique.* In this technique specialized salt crystals 150 – 250 u, are sprinkled within the outlines of the retainer leaving a 0.5mm border without crysatals on the periphery on a working cast, over which the pattern ia adapted. During its fabrication, the salt is dissolved from the pattern giving a rough surface for resin tag formation.

Maryland Bridge

Maryland bridges are resin bonded bridge using electrolytic etching of metal to retain the metal framework. Thompson and Livaditis in 1983 developed a technique of electrolytic etching of Ni-Cr and Co-Cr alloy.[3]

Advantages of etched cast retainers over cast perforated retainers:

1) Improved retention; resin to etched metal bond is strong-

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er than resin to etched enamel. The resin to alloy tensile bond strength was determined to be greater than 20 MPa (2900 psi), while the accepted resin to acid etched enamel bond is approximately 8-10 MPa (1160-1450 psi).

2) Oral surface of cast retainers is highly polished which resists plaque accumulation.

But etching is alloy specific. Only non-precious alloy which can be etched is used. Precious alloys cannot be etched. Micromechanical retention in noble alloys is achieved by electrolytic tin plating.

Other means of micromechanical etching are Sand blasting 50-250 u Aluminium oxide. Chemical etching can be achieved by Hydrofluoric Acid gel and Aqua Regia Gel.[3]

Electrolytic etching: The procedure can be outlined as follows: the polished bridge is mounted on an electrode (the electrode to the lingual of the retainers), electrical continuity is assured by use of a conductive paint at the contact point, and all areas not to be etched land the electrode are then masked with sticky wax. The electrode and bridge are mounted opposite a stainless steel electrode and immersed in an appropriate acid. The bridge is made anodic and current passed at a given density for a prescribed time. The etching acid, its concentration, the current density, and etching time must be carefully determined for a given alloy in order to get maximum resin to alloy bond strengths. Use of the wrong acid can result in electropolishing rather than etching. The conditions for etching a commonly used Ni-Cr alloy are: 10% sulfuric acid at a current density of 300
milliamperes per square centimeter of surface to be etched for a period of 3 minutes followed by cleaning with 18% hydrochloric acid in an ultrasonic bath for 15 minutes.[3]

A stress-relieved resin bonded fixed partial denture: A modification of the Maryland bridge is given by Sanford Plainfield, Vincent Wood and Ralph Podesta[4], for stress relieving that has been proved effective in preventing debonding of the prosthesis during function. Their observation of failures of resin bonded bridges indicated that there was a problem often with the mobility of the abutment teeth during function and not due to the bonding of the prosthesis.

The design they proposed included the matrix(female) portion of stress reliever within the pontic section of the prosthesis. The patrix(male) was attached to the abutment section to be bonded to the abutment tooth. They came up with the term "The Golden Gate Bridge."[4]

The Procera Maryland Bridge[5]: The Procera Maryland Bridge represents a further evolution of Livaditis's initial concept. The one-piece zirconia framework incorporates an all-ceramic incisor
pontic connecting two wings that are bonded (or cemented) to the lingual of the adjacent teeth. Preparation is restricted to the lingual surfaces and the lingual
aspect of the interproximal and is minimal, limited to 0.5 mm or less of the enamel layer. The framework is precision milled from a solid piece of zirconia. Zirconia cannot be acid-etched. To further increase the bond strength capability of the wings, the Drake Precision Laboratory has developed a proprietary process for coating them with porcelain, etching the porcelain, and bonding the porcelain surface to the teeth with composite, veneer cement, or a composite-based luting system.[5]

Carolina Bridge[6]: Developed at university of North Carolina, it is also a tooth colored version of maryland bridge. It is an all-pocelain bonded pontic that is used as an interim prosthesis. Uses little or no tooth preparation at all.

Adhesive Bridge

As a result of extensive research chemically active adhesive cements were developed for direct bonding to metal. Developed in early 1990s, these cements rely on chemical adhesion to the metal and not on microretention in the surface of the metal for bond strength. Etching was no longer necessary. Adhesive bridge shows chemical bonding between the metal and the resin luting agent.

Metabond is first of these resin systems.[1] It is based on formulation of Methylmetha acrylate (MMA) polymer powder and MMA liquid modified with adhesion promoter 4- META (4-methacryloxyethyl trimellitate anhydride). Unique tributyl borane catalyst is added to liquid. Superbond has highest initial bond strengths of any adhesive resin systems. But, it gives weak bond with high gold alloys. Introduction of Metabond was followed by Panavia which can be used both with high gold and base metal alloy.[1]

Design and tooth preparation: Based upon the work of Livaditis the elements of design that are essential for successful restorations have evolved. The following design elements should be included in any posterior bridge.[3]

1. *Path of insertion:* A distinct path of insertion must be created in an occlusogingival direction. This is accomplished by parallel modification of proximal and lingual surfaces.
of the abutment teeth. The height of contour is lowered to within one millimeter of the gingival margin where possible, provided that such modification
will not penetrate the enamel. Thus in some proximal areas, due to the concavity created by the coronal narrowing in a gingival direction, the height of
contour may only be lowered sufficient to provide occlusogingival depth for the connector — generally a minimum of 2 mm.[3]

2. *Proximal resistance form*: The alloy framework must extend buccally beyond the distobuccal and mesiobuccal line angles of the respective
abutments. If esthetics are compromised by the buccal extent of the alloy, then judicious modification of the buccal enamel allows the proximobuccal line
angle to be moved lingually. The alloy only needs to extend just buccal to this line angle to establish the resistance form and is easily hidden with proper contour of the buccal porcelain.[3]

3. Occlusal rest: The rest should be small but well defined and not a broad
spoon shape similar to classic removable partial denture occlusal rests. Usually a number 5 or 6 round bur is employed and the rest created is 1-1.5 mm in the buccolingual direc-

tion, 1-1.5 mm in the mesiodistal direction and 1 mm deep. The location of the rest is not critical and can be placed anywhere along the marginal ridge to remove it from an area of occlusal contact. When a distinct Cusp of Carabelli is present, this can be modified to function as a rest.

4. Margins of the preparation: Enamel is removed gingivally only to the extent

that a knife-edge supragingival margin results. Thus the gingival contour of the restoration should duplicate the enamel removed during preparation.

These fine margins are aided by the 0.3 mm minimum thickness commonly employed for the lingual portion of the retainer.[3] There is no attempt made to create a chamfer margin at the gingival; this only removes enamel unnecessarily.

The other features of tooth preparation as described by Vimal Arora, M.C. Sharma, Ravi Dwivedi[7]; in their study Comparative evaluation of retentive properties of acid etched resin bonded fixed partial dentures include:

Replacement of single missing tooth
Young patients with large pulp chamber
Periodontally compromised teeth
Sound or minimally restored abutments

Table-1: Indications for resin bonded bridges[9,10]

Long edentulous spans
Unfavourable occlusal scheme/ parafunctional habits
Heavily restored abutment teeth
Significant pontic width discrepancy
Abnormal quality and quantity of enamel
Nickel sensitivity

Table-2: Contraindications for resin bonded bridges[9,10]

Reduced cost
Supragingival margins
Minimal tooth preparation

Table-3: Advantages of resin bonded bridges[10]

Uncertain longevity
No space correction
No alignment correction
Difficult temporization

Table-4: Disadvantages of resin bonded bridges[10]

Figure-1: Bonded pontic; **Figure-2:** Rochette bridge

Figure-3: Virginia bridge; **Figure-4:** Maryland Bridge

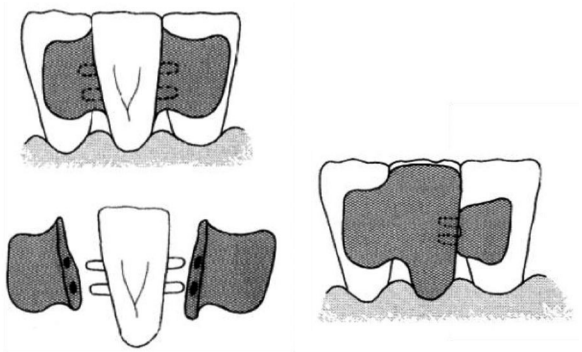

Figure-5: Three-piece "Golden Gate Bridge"

Figure-6: The Procera Maryland Bridge

Figure-7: Carolina bridge

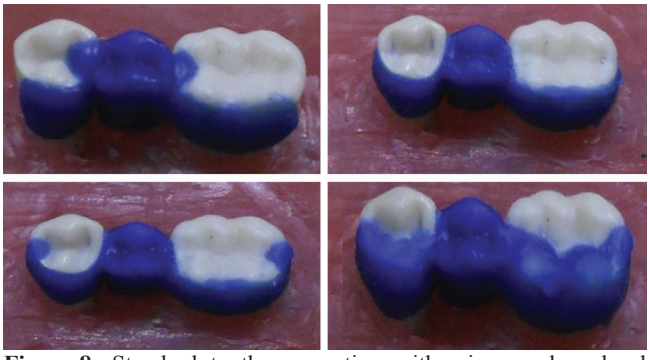

Figure-8: Standard tooth preparation with wings and occlusal rest; Tooth preparation with proximal slice; Tooth preparation with wings, proximal slice and grooves; Tooth preparation with wings, proximal slice,grooves and occlusal coverages

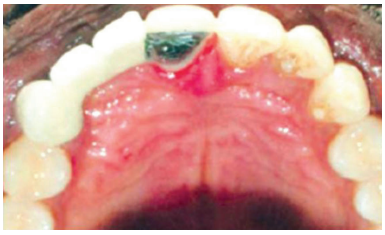

Figure-9: Mary – lever prosthesis

Mary- lever Posthesis or hybrid resin bonded prosthesis
It was described by Venkat Aditya Sunki et al[8] in 2013, in this kind of prosthesis a combination of conventional fixed dental prosthesis and resin bonded prosthesis.
It is given in cases where the edentulous span is long where an ideal resin bonded prosthesis cannot be given.[8]

SUMMARY

The RBB requires less clinical time and, in most cases, is less demanding to fit than all other forms of tooth replacement. Failure is generally far less catastrophic than with conventional bridges or implant retained prostheses. RBBs can now be considered to be a minimally invasive, relatively reversible, aesthetic and predictable restoration for prescription in general dental practice.[11]

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