

Resin-bonded prosthesis: Modifications in design

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Resin-bonded prostheses were first described by Rochette in 1973. They achieved popularity because of their conservative and noninvasive nature. The success rate of these prostheses is related to the adhesive system and to the design of tooth preparation for optimum resistance and retention form. Tooth modification to improve retention of the retainers is one of the crucial factors that affects the strength and durability of the bonding. Tooth modification is affected by the enamel available for bonding and variations in the basic technique. This paper highlights the characteristics of tooth preparation and various modifications in the design of resin-bonded prostheses.

Key words: Design modifications, resin-bonded prosthesis, tooth preparation

Initial concepts of design of resin-bonded prostheses simply involved bonding cast retainers to the lingual surface of abutment teeth. It was thought that the bond to the enamel was sufficient to retain the prosthesis. However, in order to more completely resist occlusal forces, alternative designs were advocated.

Fundamental preparation considerations for resin-bonded prosthesis are:

1. Nearly parallel opposing walls or 6-degree taper
2. A specific path of insertion
3. Sufficient occlusal clearance
4. Vertical stops

In anterior resin-bonded prostheses, the preparation should have the following features:

1. Sufficient lingual clearance (1.0 mm).
2. Cingulum rest
3. Supragingival finish line
4. Proximal facial extensions for retention

In posterior resin-bonded prostheses, the preparation should have:

1. 180° wrap around
2. 1 mm-deep occlusal rests
3. A definite path of insertion^[1-8]

BENEFITS OF TOOTH PREPARATION IN RESIN-BONDED PROSTHESES

1. Prepared enamel provides a stronger resin-to-enamel bond than unprepared enamel.
2. Greater occlusal clearance is provided for the retainers of maxillary, anterior, resin-bonded, fixed, partial dentures.
3. Space is provided for the resin-bonded, fixed, partial denture retainers to improve their reproduction of

the original tooth contours.

4. A positive seat for the restoration is provided, which assures proper placement of the restoration during bonding and reduces shearing stress on the resin-to-enamel bond during function.
5. Tooth preparation provides a tooth-to-metal finishing line that is smooth and cleansable.^[9]

ENAMEL THICKNESS AND TOOTH PREPARATION DESIGN

Robert Olsen and associates compared the shear bond strength of etched metal retainers to enamel reduced varying depths and reported no significant influence of varying depth of preparation on strength of the bond.^[10] However, the preparation must be completely in enamel for maximum bond strength. It follows therefore, that in areas where the enamel thickness is low, minimal preparation should be done.

Maxillary anterior teeth

- The cervical finishing line of the retainer is a light chamfer between 1 mm incisal to the cemento-enamel junction to no more than 1 mm incisal to the free gingival margin, where the enamel thickness is approximately 0.25 mm.
- The finishing line on the proximal surface adjacent to the edentulous space should be placed as far facially as practical without altering the outline form of the tooth.
- A shallow groove 0.5 mm in depth should be placed slightly lingual to the labial termination of the proximal reduction. The tooth structure lingual to the groove should be prepared in a flat plane

terminating cervically in a knife-edge finishing line 1 mm from the free gingival margin.

Mandibular anterior teeth

- Lingual enamel thickness for mandibular teeth ranges from 0.05 to 0.25 mm.
- Lingual surfaces are not in occlusion therefore the preparation need only be enough to remove the surface enamel.
- The lingual and proximal cervical finish lines should be definite knife-edge or light chamfer and 1 mm to the cemento-enamel junction.

General considerations in posterior teeth

- The enamel thickness varies from 1.48 mm in the thickest part of the marginal ridge (1 mm from the crest) to 0.68 mm near the cemento-enamel junction surface.
- The proximal slices should be at least 2.5 to 3 mm in an occlusogingival dimension.
- Where a proximal slice with 2.5 to 3 mm occlusogingival dimension is not possible (i.e., in tilted teeth and teeth with short crowns), a shallow box or a groove should be placed as near the proximofacial line angle as possible.
- A knife-edged finishing line on the proximocervical surface is most desirable and least likely to expose dentin.
- The rest seat should have the dimension of 1 mm depth, a buccolingual width of 2.5 to 3 mm and a mesiodistal width of 1 to 1.5 mm.

Mandibular posterior teeth

Molars

The thickness of enamel plate on the lingual surfaces of mandibular molars is approximately 0.39 to 1.0 mm and is ideal for resin-bonded prostheses.

These surfaces are prepared with knife-edge or light chamfer finishing line, at least 3 mm of occlusocervical dimension, with a shallow groove on the facial line angle opposite the edentulous space.

Premolars

Occlusal coverage of the lingual cusp is recommended for additional bonding for the following reasons:

- Cervical enamel is thin.
- Teeth have shorter lingual cusps and compensation is required for the reduced enamel surface.

Maxillary posterior teeth

- The shape of maxillary molars makes them more difficult to prepare for resin-bonded abutments than mandibular molars.
- The lingual surface tapers buccally in the occlusal two thirds of the tooth and the outer incline of the lingual cusp is usually in occlusion.

- The lingual surface is prepared in two planes. First, the cervical plane is prepared parallel to the long axis of the tooth and confluent with the proximal slice. Before preparation of the second plane, the centric contacts are marked with articulating paper. This plane is then prepared tangent to the external surface of the occlusal two thirds of the lingual surface and terminated in a beveled or light chamfer finishing line just apical to the marked centric contacts.

VARIATIONS IN BASIC TECHNIQUE

Abutment teeth with restorations

Proximal amalgam restorations in posterior teeth do not always contraindicate resin-bonded prostheses. However, compensation is required for the loss of a significant amount of available enamel-bonding surface. A shallow box should be prepared in the restored surface with the facial, lingual and cervical walls just beyond the amalgam in sound enamel. The axial wall of the box will usually be in amalgam [Figure 1].

If the restoration is shallow, occlusal reduction compromises the retention of the restoration or can expose the dentin. Placement of a new restoration involves deepening the cavity at the expense of sound dentin and bonding the resin-bonded, fixed, partial denture (FPD) directly on the dentin is not recommended. This situation can be solved by the following procedure:

1. A hollow ground bevel is prepared on the cavosurface margins of the occlusal restoration [Figure 2].
2. The occlusal restoration is reduced by 0.5 mm and the lingual and proximal surfaces are prepared normally to include 180 degree extensions.
3. Glass ionomer cement is placed on the occlusal restoration as a temporary restoration after making the impression. The hollow ground bevel is left uncovered.
4. The occlusion is adjusted.
5. The glass ionomer cement aids in retention of the amalgam restoration.

Advantages of technique

1. The technique allows a provisional restoration to be placed while the resin-bonded prosthesis is made.
2. The color of the glass ionomer cement aids identification and removal.^[11]

Large occlusal restorations will necessitate a change in the basic outline by incorporating intracoronal and extracoronal components. By removing some of the amalgam, a shallow occlusal inlay component is utilized as the occlusal rest. The inlay portion bonds to enamel at the cavosurface, whereas amalgam serves as the base.^[12]

Resin-bonded prosthesis with nonrigid connectors-retainer design

This is indicated in three- or four-unit, fixed, partial dentures in situations where one abutment tooth is a candidate for a bonded retainer and the other abutment tooth requires a conventional crown.

Anterior preparation

Lingual reduction must allow sufficient bulk in the casting to place a lingual rest for the pontic. A cingulum depression or “dimple” is created to:

- Provide accurate alignment and seating
- Prevent facial rotation
- Provide positive anterior rest

Posterior preparation

A proximal box or groove approximately the size of a small cast precision attachment positioned adjacent to the edentulous ridge, will provide resistance to vertical and lateral displacement of the pontic and also eliminate the need for an occlusal rest.^[13]

Proximal slots and grooves

An increase in the resistance form can be obtained by incorporation of proximal slots and grooves which would interfere with the rotational movement of the prosthesis.^[9,11,12,14-18]

Grooves are 1 mm in depth, 2 mm in length and 1 mm in width in comparison to proximal slot cavities which measure 3 mm, 2 mm and 1.5 mm in height, width and depth respectively [Figure 3].^[14,15]

Proximal slots

Slot cavities with these dimensions could aid in thickening the wrap-around arms, subsequently reducing the high stress which develops at connector sites.^[19]

Grooves

A combination of 180-degree wrap-around and opposing groove placement at line angles and occlusal coverage results in good bonding values. Retainers with full grooves are as retentive as posterior, three-quarter crowns.^[15]

Besides added retention, a distinct groove may compensate for the exposed dentin and loss of resistance when enamel is perforated by providing additional resistance form. The use of grooves also results in more esthetic restorations with less encroachment on the mesiodistal dimension and labial contour.^[17] Modifications include addition of an additional groove at the distolingual line angle to increase the resistance form and formation of lingual rest seat by tapering the walls and flattening the base [Figure 4]. This positive rest seat increases the area for bonding.^[18]

In posterior tooth preparation, vertical grooves at the lingual line angles serve to accommodate the lingual arm extension beyond the mesioproximal or distoproximal line angles.

RETAINER DESIGN IN SPECIAL SITUATIONS

Use of undercuts

This new design divides the conventional Maryland bridge into an upper and lower pontic part with separate paths of insertion^[20] and works on the principle of undercuts present on the abutment teeth that can play a major role in retention during function [Figure 5].

It is indicated if undercuts of abutments are excessive and in patients with decreased endurance to tooth preparation.

Disadvantages include complexity of the wax-up and precision of the casting technique.

Similarly, a three-piece, resin-bonded prosthesis (golden gate bridge) with incorporation of stress relievers to counteract the problem created by the mobility of abutment teeth during function, has improved the retention especially in mandibular, anterior, resin-bonded prostheses.^[21]

The general procedure includes using a surveyor to identify the undercuts and paths of insertion on the lingual and the facial surfaces separately. A two- or three-piece prosthesis is fabricated. This is inserted simultaneously from opposing sides and interlocked. In these types of prostheses, the abutment teeth need only be finished with minimal tooth reduction retaining the abutment's natural undercuts.

Modifications for fractured teeth as abutment

Minimal occlusal modifications should be performed at the fractured cusp. A positive seating for the casting should be prepared by “shoeing” the fractured cusp site. If the fracture line includes the central fossa, the preparation should be extended to the inner aspect of the intact cusp and restricted to enamel only. The preparation should be extended interproximally to include the contact area so as to enhance the resistance form.^[22]

Pin-retained, resin-bonded, fixed, partial dentures

In anterior teeth, the placement of grooves adjacent to the edentulous space is easily accommodated, but the placement of an opposing groove in the proximal space next to an adjacent tooth is often more difficult. As an alternative, cingulum pin is used to enhance resistance form [Figure 6].

Procedure

- The cingulum area is prepared and the margins are defined.
- Proximal grooves are placed in the abutment teeth next to the edentulous space
- A depression is made that penetrates the enamel



Figure 1: Proximal amalgam restoration modified by shallow inlay preparation

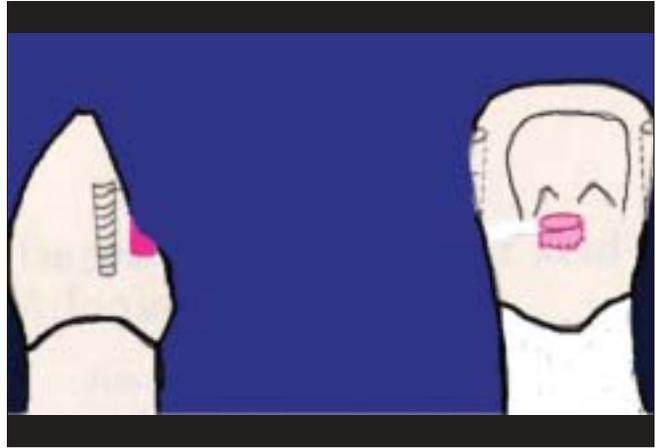


Figure 4: Modified lingual rest seat

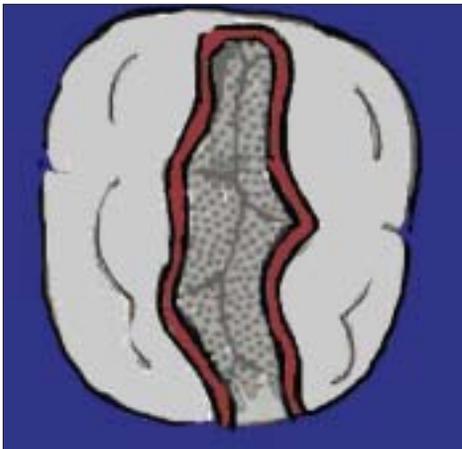


Figure 2: Bevel at cavosurface margin

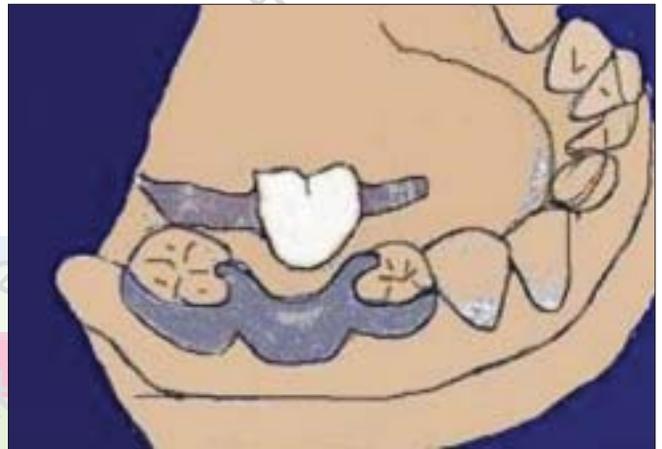


Figure 5: Two-part resin-bonded prosthesis

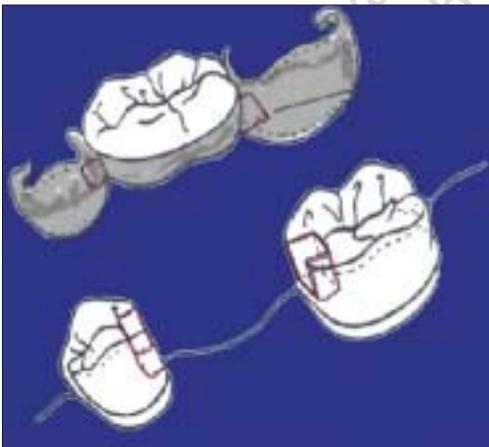


Figure 3: Tooth modification with proximal slots

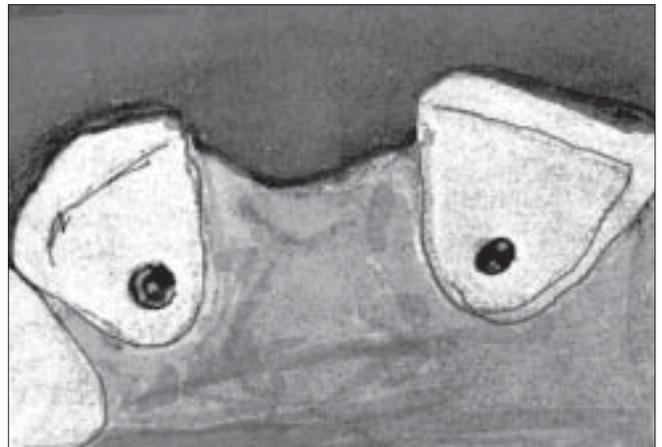


Figure 6: Cingulum pins on the abutment teeth

with a round bur; lingual to the central axis of the tooth, a 2 mm-deep hole is drilled.

- The pinhole is made with a no. 701 slow speed bur to receive a plastic pattern used for pin ledge restoration.^[23]

CONCLUSION

The resin-bonded prosthesis is not a “prepress” technique as once thought, but one that requires careful treatment planning and technical skill. Tooth

preparation should be designed to counteract the tensile forces with adequate resistance and retention form and due consideration should be given to the enamel available for bonding.

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