A Literature Review of Two-Unit Cantilevered FPDs

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Purpose: This review article evaluated the clinical performance of two-unit cantilevered, single-abutment, single-pontic, resin-bonded fixed partial dentures (FPDs) by comparing them to noncantilevered resin-bonded FPDs with two abutments and a single pontic. ***Materials and Methods:*** One publication on design principles and 11 clinical research studies were selected by searching two databases. ***Results:*** Six of the studies dealt exclusively with two-unit cantilevered resin-bonded FPDs, and five studies compared fixed-fixed design resin-bonded partial dentures with cantilevered resin-bonded FPDs. Two-unit cantilevered resin-bonded FPDs for single-tooth replacement appear to be reliable and predictable restorations, provided their preparations meet the right standards. ***Conclusion:*** According to the studies reviewed, two-unit cantilevered FPDs show better longevity than resin-bonded fixed-fixed partial dentures in similar situations. *Int J Prosthodont 2004;17:281–284.*

Adhesively bonded splints with macromechanical retention through perforated retainers created the basis for the first resin-bonded fixed partial dentures (RBFPD) designed by Rochette.[1] Reduction of biologic damage to the tooth was the leading principle behind the development of the Rochette fixed partial denture (FPD).[2] Livaditis and Thompson[3] developed an etching technique providing micromechanical retention for resin cement on nonperforated, nonprecious metal retainers.

Without abutment preparation, RBFPDs were temporary restorations with unpredictable longevity.[2–5] With grooves, guide planes, 180-degree wraparound, and a chamfer, retention increased impressively.[4–8] Increasing the number of retainers on RBFPDs decreases the functional longevity.[7,9,10] Functional longevity is defined as the time span between first cementation and replacement of the restoration, including rebondings in between.

The purpose of this review was to judge the behavior of two-unit cantilevered RBFPDs against noncantilevered RBFPDs for single-tooth replacement. Two databases, PubMed (1973 to 2003) and ISI Web of Science (1988 to 2003), were searched with the key words "(cantilever) resin bonded bridges" and "(cantilever) fixed partial dentures." From 1991 to 2003, almost 400 articles were dedicated to RBFPDs. Five clinical studies and one article on design principles focused exclusively on two-unit cantilevered RBFPDs.[10–15] Five other publications[4,9,16–18] compared resin-bonded fixed-fixed partial dentures (FFPD) and cantilevered RBFPDs (Table 1). Table 2 shows the mean age of all two-unit cantilevered RBFPDs per study at the time of publication and the percentages of first debondings. After eventual rebonding, the functional longevity reaches beyond the moment of first debonding; Table 2 therefore cannot be read as indicating the mean functional longevity. Five retrospective studies[10,11,15,17,18] in Table 2 present results regardless of the influence of a preparation, use of various cements, different surface treatments, and use of various alloys. Two studies[16,19] are prospective. The different nature of the studies reviewed made a meta-analysis impossible.

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Table 1 Clinical Research Studies into Two-Unit Cantilevered Resin-Bonded Fixed Partial Dentures (RBFPD)

Study	No. of cantilevered RBFPDs
Djemal et al[4]	120 + 265 fixed-fixed partial dentures
Dunne and Millar[9]	47 + 250 fixed-fixed partial dentures
Hussey and Linden[10]	142
Briggs et al[11]	54
Brabant[12]	102
Botelho[13]	Cantilevered RBFPD design principles
Botelho et al[14]	33
Botelho et al[15]	82
Chan and Barnes[16]	13 + 12 fixed-fixed partial dentures
Gilmour and Ali[17]	43 + 81 fixed-fixed partial dentures
Hussey et al[18]	70 + 263 fixed-fixed partial dentures
Rashid et al[19]	84

Table 2 Debonded Two-Unit Cantilevered Resin-Bonded Fixed Partial Dentures (RBFPD)

Study	Mean age (mo)*	First debonding
Hussey and Linden[10]	37	12% (17/142)
Briggs et al[11]	27	20% (11/54)
Botelho et al[15]	37	5% (4/82)
Chan and Barnes[16]	34	0% (0/13)
Gilmour and Ali[17]	25	28% (12/43)
Hussey et al[18]	32	17% (12/70)
Rashid et al[19]	44	7% (6/84)

*At time of publication.

Prosthodontic Considerations

Prosthesis and Preparation Design

Prosthesis and preparation designs for RBFPDs, both fixed-fixed and cantilevered, vary from study to study. The simplest preparation on a maxillary incisor covers most of the palatal surface combined with a cingulum seat.[4] The most extensive preparation includes complete palatal coverage with 180-degree wraparound, chamfer, and proximal guide planes and grooves on anterior teeth, while premolar and molar preparations include occlusal rests.[4,12,15,20] Five studies agree on the cause of debonding.[4,10,12,14,16] When mastication forces are applied on a resin-bonded FFPD, the abutments are subjected to twisting forces, thus causing enormous stress within the interface between tooth and FPD. With every additional abutment, the chance for debonding increases.[7,9,10] A maximally retentive preparation, as described above, increases the survival rate dramatically.[4–8] With only one abutment present, theoretically the twisting forces are reduced to a minimum, thus preventing early debonding.

A remarkable development has taken place in the Dental School of Hong Kong. Botelho et al[15] announced that the prescription of two-unit cantilevered RBFPDs has become standard clinical teaching practice to undergraduate students, based on previous evidence-based information.[4,10,11,14,16,18]

Surface Treatment

After casting, the adhesive surfaces of the RBFPD are sandblasted in the dental lab for cleaning purposes prior to any other surface treatment. Verzijden and coworkers[21,22] report on four surface treatments: sandblasting, electrolytic etching, tin plating, and silane coating.

Sandblasting is considered a surface treatment by itself on nonprecious alloys. Electrolytic etching requires a precise casting technique to obtain a homogeneous crystalline surface. Briggs et al[11] compared these two methods. Of 54 cantilevered RBFPDs, 11 debonded; 6 were sandblasted and 5 were electrolytically etched, but because of these low numbers no final conclusion was drawn. Tin plating provides the adhesive RBFPD surface with a layer of tin oxide. This enables chemical bonding with the composite cement and micromechanical retention because of the formation of tin crystals. Van der Veen[23] reports good results using tin plating. Silane coating consists of applying a layer of 0.1-μm silica with a Silicoater (Heraeus Kulzer) in the dental lab. Immediately prior to cementation, the clinician applies a layer of silane to enhance the bond strength between metal and cement.

Influence of Cement Used

Six studies[10–12,14,16,17] report on the influence of the luting cement used, but not in such a way that conclusions can be drawn. Gilmour and Ali[17] also looked into the effect of the use of rubber dam during cementation. During their 4-year research period, 35% of the rubber dam–assisted RBFPDs debonded. Without rubber dam, this percentage went up to 43%. These numbers are also small, so conclusions were not drawn.

Operator Influence

Djemal et al[4] and Hussey et al[18] report on operator influence. Compared to senior staff, both postgraduates and junior staff demonstrated a higher risk for their RBFPDs to debond.

Gender and Age

One study looked into the influence of patient age.[9] The age group of 11 to 20 years showed significantly more debonding, but no reason was given. The other studies reviewed did not look into gender- and/or age-related influences.

Location of Pontic and/or Abutment

Only three studies[10,11,16] specify the debonded two-unit RBFPDs according to location in the mouth. Hussey and Linden[10] followed 142 FPDs—116 mandibular and 26 maxillary ones. All debonded FPDs were in the maxilla. The maxillary central incisor was most endangered, followed by the canine and lateral incisor. Briggs et al[11] followed 54 FPDs—46 maxillary and 8 mandibular ones. Ten maxillary FPDs (7 anterior, 3 posterior) and 1 mandibular posterior FPD debonded. Chan and Barnes[16] looked into the longevity of 25 FPDs—13 two-unit cantilevered FPDs and 12 FFPDs. Pontics were exclusively maxillary central and lateral incisors. One FFPD debonded and was turned into a two-unit cantilevered FPD, which was still functioning 40 months later. No other FPD in that study debonded.

Periodontal Consequences

The periodontal consequences of cantilevered RBFPDs have only been investigated in two studies.[19,24] Rashid et al[19] and Boening[24] found slightly less healthy gingiva at abutments compared to control teeth in the same mouth. The authors warn against overcontouring in cases of no or only minor preparation. Rashid et al[19] found minor statistically significant disadvantages of the abutments as far as pocket depth is concerned, whereas no differences in mobility were found. Only 13% of the abutments had pocket depths of 3 mm or more. This is equivalent to the findings on conventional bridgework.[19] Botelho[13] warns against using abutment teeth with bone loss in an uncontrolled periodontal situation because of possible drifting.

Discussion

This review aimed to evaluate the clinical performance of two-unit cantilevered RBFPDs. Extensive studies on the longevity of resin-bonded FFPDs have been carried out.[4–8,21,23,25,26] Thompson et al[20] found that RBFPDs have achieved such clinical success in studies in the United States and Japan that their longevity approaches that of conventional bridgework, thanks to refinement of the preparation design. On resin-bonded FFPDs, sufficient retention for a lasting restoration can be obtained with maximum coverage of the palatal or lingual surface, 180-degree wraparound with grooves, and light chamfering to prevent overcontouring.[5,7,8,23] Retention no longer depends mainly on the luting cement, but also on the resistance form. It is not clear yet that these design principles also apply to two-unit cantilevered RBFPDs. A modest amount of literature specifically on two-unit cantilevered RBFPDs is available.[10–15] Although there are substantial differences in both results and study design among the various studies reviewed, evidence of the reliability of this restoration is growing.[15] Better esthetics, easy cleaning, less biologic damage, and no chance of an undetected debonded retainer with decay underneath are good reasons to consider application of this restoration technique.

Table 3 Debonded Two-Unit Cantilevered Resin-Bonded Fixed Partial Dentures (RBFPD) and Fixed-Fixed RBFPDs

Study	Debonded cantilevered RBFPDs	Debonded fixed-fixed RBFPDs
Dunne and Millar[9]	21% (10/47)	34% (115/335)
Chan and Barnes[16]	0% (0/13)	8% (1/12)
Gilmour and Ali[17]	28% (12/43)	41% (33/81)
Hussey et al[18]	17% (12/70)	25% (65/263)

Table 3 shows four studies comparing two-unit cantilevered RBFPDs to resin-bonded FFPDs. However, none of them was a randomized control study. Each of the studies reviewed shows a better clinical performance of the two-unit cantilevered RBFPDs than of their fixed-fixed counterparts in similar situations. Djemal et al[4] conclude that, in their study, the risk of a failing FFPD was nearly twice that of a cantilevered one. As most authors recommend, more research has to be carried out on various aspects like preparation design, influence of luting cement, and pretreatment of adhesive surfaces of FPDs. RBFPDs decrease tissue damage and patient expenses, making them a patient-friendly treatment.

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