Thirteen-year follow-up study of resin-bonded fixed partial dentures

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Objective: The technique of resin-bonded fixed partial dentures (RBFPD) is a well-accepted clinical technique to replace missing teeth. The survival rates reported in the literature vary widely, and the conclusions are sometimes conflicting. This study presents the clinical long-term performance of silicoated RBFPDs and also determines the main cause of failure. Method and materials: Sixty-one patients with a total of 74 RBFPDs were either examined or requested to complete a questionnaire regarding their fixed partial dentures. Sixty-four were placed in the anterior region, and 10 in the posterior region. No more than one missing tooth in the posterior area and two missing teeth in the anterior region were replaced with RBFPDs. A retentive preparation was made on the abutment teeth. All the RBFPDs were adhesively seated. Results: Eighteen RBFPDs failed after a mean observation time of 7.8 years (nine retention losses of one or more retainers, six carious lesions, and three veneer fractures occurred). Seven RBFPDs were rebonded, whereas the remaining 11 failures had to be replaced with conventional FPDs. Fifty-six RBFPDs were primary restorations, and seven secondary RBFPDs were used after the loss of the primary restoration. A mean survival rate better than 69% after a 13-year observation period was calculated. Including the rebonded restorations, a mean functional survival rate of 83% was estimated. A total of 18 failures (24.3%) of all restorations were observed, the main cause being loss of retention. Conclusion: Silicoated RBFPDs are a viable treatment means with an acceptable success expectancy. (Quintessence Int 2004, 35:407–410)

Key words: adhesive, dental alloy, dental restoration, resin cement, resin-bonded fixed partial denture, silicate

Resin-bonded fixed partial dentures (RBFPD) are a conservative approach to the replacement of missing teeth. The technique has several advantages over conventional bridgework, especially in relation to conservation of tooth substance and reversibility,¹ which is of importance for the treatment of juvenile patients. Reduction of chairside time and the reduced costs of laboratory work are also advantageous.² According to earlier clinical studies,³⁻⁵ the indication for RBFPDs was limited to temporary adhesive-fixed partial dentures (FPDs) in juvenile dentition and in combination with small span lengths. Due to improved preparation techniques, as well as more effective adhesive procedures to condition the metal and tooth structure, the range of indications has been extended.⁶ Many articles address RBFPDs, but few clinical studies have reported about the long-term success (more than 10 years).⁷⁻¹¹ One of the problems involved in a prospective long-term study is the fact that usually the entire group of patients is no longer available for study. Rather, only a partial group of patients can be constantly observed over an extended period.⁶

CLINICAL RELEVANCE: When resin-bonded fixed partial dentures are properly designed and placed in selected patients, an acceptable survival probability can be expected.

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The main purpose of this study was to estimate the clinical outcome of RBFPDs, whose metal retainer surfaces were silicoated with the Silicoater (Kulzer) procedure.

METHOD AND MATERIALS

Patients

Seventy-four RBFPD units were placed for 61 patients treated at the Department of Prosthodontics of the University of Tuebingen, Tuebingen, Germany. Between 1986 and 1997, 64 restorations were provided for the anterior region and 10 for the posterior region (anterior: 48 maxillary, 16 mandibular; posterior: 8 maxillary, 2 mandibular). The distribution of RBFPDs according to the age of the patients at the time of placement of the restoration is shown in Table 1.

The most frequent indication was dental trauma. Conventional FPDs were not considered as an alternative because of the lack of restorations of the neighboring teeth and the juvenile age of the patients. Hypermobility of abutment teeth, parafunctional habits (e.g., bruxism), large interabutment spaces (diastemas), and incomplete transversal arch development were deemed as contraindications. Not more than one missing tooth in the posterior and two missing teeth in the anterior area of the mouth were replaced by RBFPDs. Sixty RBFPDs were three-unit, six were four-unit FPDs, and eight FPDs had more than four units with a maximum of four units. All abutment teeth were vital.

Clinical and laboratory protocol

The retentive preparation technique in the case of anterior teeth consisted of a clearance of 0.5 mm on the oral side with horizontal ledges and vertical grooves (Fig 1), allowing RBFPDs to be inserted only in a particular direction. For the restorations on posterior teeth (posterior to the canine) "wrap-around" preparations with occlusal rest seats and vertical grooves were made (see Fig 1). Wherever fillings or caries defects were present, they were completely removed down to dentin. These defects were included in the preparation.

All restorations were cast in nonprecious alloys, 60 in a nickel-chromium-alloy (Wiron 88, BEGO) and 14 in a cobalt-chromium-alloy (Remanium CD, Dentaurum). All were veneered with ceramics (Vita VMK 68, Vita VMK 95, and Vita Omega 900, Vita). The retainer surfaces were treated according to the manufacturer with the Silicoater procedure and silane (Silicoup, Heraeus Kulzer). The laboratory procedures for all restorations were performed in the laboratory of the Department of Prosthodontics, University of Tuebingen.

Prepared tooth surfaces were conditioned using a 37% phosphoric acid etching for 60 seconds. The enamel was rinsed with water for 30 seconds and then carefully air dried.

All RBFPDs were adhesively seated with double-curing resin-bonding agent (Microfill, Heraeus Kulzer) after isolating teeth with cotton rolls. Excess resin cement was removed using flame-shaped finishing burs. After bonding, occlusion and articulation were adapted and patients received special oral hygiene instructions.

Patients were re-examined at least once a year; clinical factors such as checking for debonding through finger pressure and explorer; sensitivity; veneer fractures; and incidence of caries of retainer teeth were registered.

RBFPD loss or retainer loosening of one or more retainers, carious lesions of the abutment teeth, or veneer fractures were considered failures.

In 1999, all patients with RBFPDs were recalled for examination. Sixteen of 61 patients with a total of 20 RBFPDs responded. Patients who did not respond to the recall examination were sent a postal questionnaire to return to the department. Twenty-two patients with 24 bridges returned the questionnaire. Twenty-three patients (30 bridges) could not be reached.

Statistical analysis

Statistical analyses were made with a statistical program (JMP, SAS Institute). Because some patients contributed multiple survival data, a dependence of the data could not be excluded. Therefore, a mean survival estimation according to Aalen et al. was performed.
This approach overcomes possible dependency problems that may be created by multiple time-to-event data. A restoration from a dropout patient was censored whenever the restoration was not considered a failure at the last follow-up. The date of the last follow-up defines the length of the censored time.

**RESULTS**

**Dropout rate**

Twenty-three patients of the 61 (37%) were declared dropouts, as they did not appear for recall in 1999.

**Survival rate**

Figure 2 shows the mean survival curve (based on Aalen et al[12]) for 20 FPDs after the last clinical examination. The maximum observation time of all 20 restorations was 147 months. The estimated mean survival rate after 12 years was 72% (95% confidence interval: 59%-89%) with a mean observation time of 6.7 years.

Fifteen failures (20.3%) were observed, the main cause being loss of retention (9), followed by carious lesions (3), and fractures of the veneering ceramic (3). Twenty-two patients with 24 bridges returned the questionnaire regarding the survival of their restoration(s). They did not attend the last annual checking. This amounted to a total of 44 RBFPDs including the 20 FPDs after the clinical examinations. The estimated mean survival rate after 13 years was 69% (95% confidence interval: 56%-84%) with a mean observation time of 7.4 years (Fig 3). Three of the 24 RBFPDs showed carious lesions on the abutment teeth and were treated with conventional FPDs. This resulted in a total of 18 failures (24.3%) of all restorations.

Seven of the 18 RBFPDs were rebonded; thus, a mean survival rate of 83% (95% confidence interval: 73%-94%) of functioning restorations was calculated after 13 years (Fig 4). The 11 other failures were treated with conventional FPDs. The age distribution histogram (Fig 5) shows that 25 RBFPDs (54%) were in function for more than 10 years.
DISCUSSION

Only a few longitudinal clinical studies with an observation period of more than 10 years have been published,\textsuperscript{7,11} and the success rates in these reports vary considerably. The great variety in restoration design and in methods of presenting data makes comparison difficult. A major difficulty for the present study is the loss to follow-up as years pass, which is due to loss of contact of the patients for clinical examination. Therefore, using data from a questionnaire in this study, seemed justifiable. All responses were cross-checked against the subject clinical records. It is assumed that the high response rate ensures that the results give a good representation of the function of RBFPDs.

Creugers et al\textsuperscript{8} found a significant difference between perforated anterior FPDs with a survival rate of 49\% and etched anterior FPDs with a survival rate of 57\% after 10.5 years. A calculated survival rate of 60\% after 10 years was published by Pröbster and Henrich.\textsuperscript{8} Their study showed that base metal alloys, silicoating, mesh retention, and immobile abutments were positive factors for success. In contrast to other reports,\textsuperscript{7,13} Pröbster and Henrich\textsuperscript{8} reported that retentive abutment preparation did not result in a higher survival rate than unprepared abutments.

Williams et al\textsuperscript{10} reported a 64\% survival rate after 10 years. In their study, 72\% of the restorations had perforations as the retentive mechanism, the other 28\% were retained with the electrochemically etched-metal method. Both groups had similar debonding rates at 31\% for perforated and 32\% for etched restorations. Barrack and Bretz\textsuperscript{10} reported a 93\% success rate over an 11-year period. In the first period of their study, they made changes in tooth preparation to obtain more retentive framework and materials over time. They assumed that a retentive framework would limit the stresses placed on the resin and the bonded interface and add to the longevity of the restoration. Behr et al\textsuperscript{8} confirmed the positive effect of abutment preparation. Other potential factors, such as the type of metal framework conditioning, the location of the RBFPDs, and span length had no demonstrable influence compared to the preparation factor.

In the present study, most complications occurred with loss of retention (9 of 18 failures). Caries on retainer teeth (6) and veneer fractures (3) were minor. The probable cause for debonding could have been contamination or incomplete dryness of the etched enamel, degradation of the composite, or hydrolization of the silane. Results of the study showed an overall mean survival rate of 83\% for restorations in function after 13 years. Considering the 95\% confidence interval (confidence interval: 73\%–94\%), the current results are comparable to previously reported results.\textsuperscript{7,11} On the other hand, it is an optimistic estimation since data from patients rated as dropouts were considered to be censored (see dropout rates).

CONCLUSION

Prosthetic replacement of teeth using silicoated RBFPDs, properly designed and placed in selected patients, are a viable treatment choice with an acceptable survival probability.

REFERENCES