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Long-term survival data from a clinical trial on resin-bonded bridges

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ABSTRACT

Objectives: A clinical trial, involving 203 resin-bonded bridges (RBBs) was undertaken to investigate the influence of retainer-type and luting material on the survival of these restorations.

Methods: For this evaluation, 157 patients were available (14% of the original sample was lost to follow-up or excluded from the study following the stopping criteria). Fifty per cent of the patients were questioned concerning the fate of the RBBs and 59% of questioned patients were examined clinically. The patients that were seen for examination were representatives of the experimental groups. The findings from the clinical examination were compared with the data obtained from the questionnaire. Missing data were censored at the date of the last available information. Kaplan-Meier estimates were calculated to assess the survivals at the endpoints and compared using Cox's proportional hazards procedure.

Results: A significant difference was found between perforated (P-type) and etched (E-type) RBBs ($P=0.05$) for original bonded restorations but not when rebonded RBBs were taken into account. The results of the survival analysis were: anterior P-type, $49 \pm 7\%$ after 10.5 years; anterior E-type, $57 \pm 7\%$ after 10.5 years; posterior P-type, $18 \pm 11\%$ after 6.8 years; posterior E-type, $37 \pm 13\%$ after 10.2 years. Survivals of RBBs that were rebonded once during the evaluation period were $62 \pm 9\%$ (11.0 years) for anterior RBBs and $51 \pm 11\%$ (10.2 years) for posterior RBBs.

Conclusions: The factor location (anterior versus posterior) was, as in previous analyses, highly significant. Differences in survival between cementation materials were not significant. © Elsevier Science Ltd. All rights reserved

KEY WORDS: Resin-bonded bridges, Survival, Clinical trial

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INTRODUCTION

The general aims of the study have been discussed in the previously published 7.5 year report of this study¹. Although this study formally stopped after the 7.5 year follow-up, more longitudinal data are considered to be of importance from both clinical and scientific perspectives. The purpose of the present analysis was to collect long-term survival data of resin-bonded bridges inserted under controlled clinical conditions as a follow-up to previous reports.

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MATERIALS AND METHODS

The design of the trial, the patients involved, the materials used and the examination criteria have been described in detail in previous reports^{2,4}. For the convenience of the reader the main conditions will be mentioned briefly here.

One hundred and sixty-six resin-bonded bridges (RBBs) replacing anterior teeth and 37 replacing posterior teeth were inserted by five dentists in 183 patients between February 1983 and August 1984. Ninety-two bridges were perforated bridges (referred to as 'P-type RBBs') and 111 bridges were electrolytically etched NP₂ alloy (a Ni-Cr alloy) bridges (E-type RBBs). The luting materials used were: Clearfil F and Panavia Ex (Cavex/Kuraray, Haarlem, The Netherlands); and Silar and

Conclude (3M Dental Products, St Paul, MN, USA). The RBBs were a combination of non-precious metal and acrylic resin and were replacing one or two teeth. The clinical procedures were standardized including three sessions for the construction of each RBB. No tooth preparations were carried out, except in premolar and permanent molar teeth where guide planes and occlusal rests were prepared. Existing restorations in abutment teeth were replaced by composite restorations (Clearfil F). Experimental variables (i.e. 'type of RBB', 'luting material' and 'operator') were assigned using lists of random numbers.

The patients were regularly seen for clinical examination until 1992/1993 and were thereafter instructed to attend if they suspected or detected a failure themselves. For this evaluation, the patients were traced and as many as possible were interviewed. According to the criteria for definitive endpoints (multiple failures), 26 patients (14%) were excluded from the study. Therefore, a maximum of 157 patients were available for this evaluation (86% of the original sample). We were able to question 79 patients (50%) about the fate of their RBBs by telephone. For 78 patients no information was available following the 7.5 year follow-up. The questions requested information about bridge function, dislodgements, follow-up treatments and/or satisfaction. When necessary, the private dentists of the patients were contacted for further information. Fifty per cent of the patients could not be reached because they had moved to unknown addresses, had unlisted telephone numbers, never answered telephone calls or had no telephone at all. All patients were invited for clinical examination of their RBBs. However, 11 patients stated that their RBBs had been replaced by other restorations and were therefore not invited. Seventy-one per cent of the patients ($n=48$) questioned were willing to come to the Dental School for examination of which patients 40 patients were actually examined clinically (59%). The remaining patients refused to come for clinical examination but indicated that their refusal was unrelated to their RBB. As a result 42 bridges in 40 patients were clinically examined approximately 10 years after insertion.

The patients seen for examination were representatives from all experimental groups. The clinical findings were compared with the data obtained from the questionnaire.

The variables analysed were: (1) 'type of RBB' (perforated versus etched), (2) 'luting material' (Clearfil, Panavia EX, Silar and Conclude), (3) 'location of the RBB' (anterior versus posterior and mandible versus maxilla), and (4) 'anterior spatial relationship' ('deep bite' versus 'normal bite').

Survival was defined at two levels: (1) completely survived (S_c) and (2) functionally survived (S_f). The RBBs were considered to have completely survived when no loss of retention was detected during the follow-up period by either the observers or by the

patient. Where a bridge was dislodged from one or both of the abutment teeth it was considered to be a failure. The RBBs were considered to have functionally survived when loss of retention had occurred on one occasion and when this was treated successfully by rebonding the original RBB and no further debonds occurred. Missing data were censored at the date of the last available information. By contrast with earlier analyses, other failures such as fracture of the pontic, aesthetic deterioration or caries in the abutment teeth, were considered as end-points in cases where this led to the replacement of the RBB.

Influences of the variables were tested by Cox's proportional hazards procedure (PH model)⁵. Observed influences were expressed as conditional-relative-risk (CRR). The formula for CRR between two levels (A, B) of a variable is $CRR = \lambda_A(t) / \lambda_B(t)$, in which $\lambda(t)$ is the hazard function. Kaplan-Meier curves⁶ were presented to display the influence of location graphically.

RESULTS

Comparison of the data obtained from the questionnaire with the data from the clinical evaluation showed 100% agreement. Therefore the data from patients who answered the questionnaire but were not seen for the clinical examination were considered to be reliable and subsequently used for survival assessment.

In 11 cases the RBB was replaced by a new prosthesis, four were replaced by a conventional bridge, three by a removable partial denture and another four by a new resin-bonded bridge. In nine of these cases the reason for replacement was either pontic failure or caries. In two cases the reason was unknown. The replaced RBBs came from all experimental groups and were equally distributed over the tested variables.

The CRR values (95% confidence intervals) and P -values of the tested factors with influences on the survival ratios S_c and S_f are given in *Table I*. Influences of other factors were not significant and therefore not displayed in the table. The duration and corresponding survival ratios of RBBs according to the variable 'location' are given in *Table II*. *Figure 1* presents the S_c and S_f rates of anterior and posterior RBBs as a function of time.

DISCUSSION

As mentioned in previous reports, longitudinal clinical studies suffer several difficulties¹. In this evaluation there was a substantial loss to follow-up during the final years. However, since the main reason for loss to follow-up was inability to contact patients rather than non-cooperation, this was considered to be independent from the functionality of the RBBs. The sample of non-retrieved patients is therefore considered non-selective. Subsequently, the missing data were censored

Table I. Factors with expected influences on the survival ratios, including level of significance, conditional risk ratios (CRR values) and 95% confidence intervals (CI)

Factor	S_c			S_f		
	P-level	CRR value	95% CI	P-level	CRR value	95% CI
Post-Ant	***	2.6	1.5-5.6	***	2.6	1.4-6.7
P-type-E-type	*	0.6	0.4-1.3	NS	0.7	0.4-1.8

S_c , completely survived; S_f , functionally survived; NS, not significant.

* $0.01 < P < 0.05$.

*** $P < 0.001$.

Table II. Duration and corresponding survival ratios ('completely survived' and 'functionally survived') of RBBs according to the variable 'location', subdivided for the variable 'retainer type' (\pm S.E.M.)

Variable	Subdivision	S_c		S_f	
		Duration (years)	Survival (%)	Duration (years)	Survival (%)
Anterior	All	10.5	53 \pm 5	11.0	62 \pm 9
	P-type	10.5	49 \pm 7		
	E-type	10.0	57 \pm 7		
Posterior	All	10.2	29 \pm 9	8.8	51 \pm 11
	P-type	6.8	18 \pm 11		
	E-type	10.2	37 \pm 13		

S_c , completely survived; S_f , functionally survived.

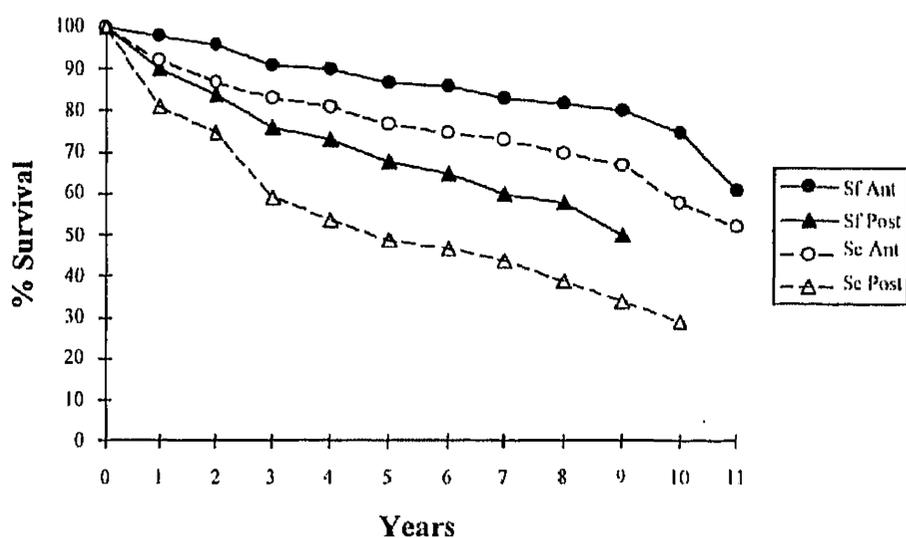


Fig. 1. Survival curves S_c and S_f (Kaplan-Meier) of anterior (Ant) and posterior (Post) resin-bonded bridges.

at the dates of the last available relevant information, allowing assessment of the survival with the Kaplan-Meier method for the period. Although this method leads to justified findings, the number of drop-outs consequently resulted in wide confidence intervals.

With respect to the effect of the luting material, the findings of the 7.5 year evaluation could not be statistically confirmed in this analysis. In the 7.5 year evaluation, the combination of E-type bridges with Clearfil F was significantly more retentive than the combinations P-type/Clearfil F and E-type/Conclude. The reason for the lack of statistical significance may be due to the different failure characteristics over time. In contrast with earlier evaluations, a substantial number of RBBs

($n=11$) reached their endpoints as a result of unacceptable aesthetics rather than as a result of dislodgement.

Comparison of P-type bridges with E-type bridges revealed a statistically significant difference between the groups. This difference was also seen in earlier evaluations. However it seems that this difference is decreased with time. This phenomenon, a high initial but decreasing debond rate in P-type RBBs, was also seen in a study by Boyer *et al.*⁷

Again the relation between anterior or posterior location and survival was highly significant. This is still in contrast with other studies, where such a prominent risk factor (CRR: 2.6) or clear difference in survival between anterior and posterior RBBs was not found. In fact, in some studies posterior RBBs were as retentive or even more retentive than anterior RBBs⁸⁻¹². In the 7.5 year report of this study it was suggested that this deviation might be a result of the adopted 'minimal preparation' design for the posterior RBBs. This still may be relevant, but data from other studies do not endorse this¹⁰⁻¹⁷. Although it was concluded in a previous report¹⁸ that rebonded RBBs were prone to debonding, this evaluation demonstrates that rebonding of failed RBBs is advisable. Rebonding is relatively easy and inexpensive, and leads to longer functionality, especially in posterior RBBs. This finding supports the earlier conclusion that the factor 'anterior' versus 'posterior' has no effect on rebonded bridges. Although there is still a significant difference in survival between these groups, it is not as prominent as in the group of originally bonded RBBs.

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