Lingual retainers bonded without liquid resin: A 5-year follow-up study

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Introduction: The aim of this in-vivo study was to evaluate the effect of excluding the liquid resin component of a composite bonding product that is based on bisphenol A diglycidylmethacrylate when bonding lingual retainers. Methods: The material comprised 40 metal multistrand lingual retainers bonded onto the lingual surfaces of maxillary and mandibular anterior teeth. Transbond LR composite paste and liquid resin (3M Unitek, Monrovia, Calif) were used to bond retainers in the control group (20 retainers). The same bonding material was used in the test group (20 retainers), but the liquid resin component was excluded. The durations (in months) of retainer survival were analyzed by using the Kaplan-Meier product limit method and the log rank test. Results: Fifty percent of the retainers in the control group and 60% of those in the test group had no bond failures during the 5-year observation period; the difference was not statistically significant. Bond failures were recorded in 13.6% of the bonded tooth surfaces in the control group and in 14.9% in the test group; the difference was not statistically significant. On average, the retainers stayed intact in the control and test groups for 36 and 32 months, respectively. The median survival times of the control and test groups were 43 months and more than 47 months, respectively. Neither the survival analysis nor the 95% confidence intervals (24-49 months in the control group, 24-40 months in the test group) suggested any statistically significant difference between the groups. Conclusions: Metal lingual retainers can be successfully bonded without liquid resin and serve the patient equally as well clinically as retainers bonded with the conventional bonding technique. (Am J Orthod Dentofacial Orthop 2013;143:101-4)
overall BPA release from clinical materials by reducing the amount of polymer content of composite resins. One way to accomplish this goal is to avoid the clinical use of liquid resin.

Several studies have indicated that the exclusion of liquid resin seemed neither to reduce the in-vitro bond strength of bonded metal brackets to enamel nor to increase the failure rate of metal brackets in vivo up to a 2-year period of active orthodontic treatment.\textsuperscript{13,14} However, bonded fixed retainers sometimes must stay in place indefinitely, and it is therefore of interest to know how long fixed retainers bonded without liquid resin can last in vivo.

The aim of this investigation was to study whether the exclusion of liquid resin from a bis-GMA-based composite would impair the clinical performance of bonded fixed retainers.

**MATERIAL AND METHODS**

The first author (A.T.H.T.) treated all the patients in this study and bonded all the retainers in the test and control groups between January 1998 and February 2000 at the Unit of Orthodontics, Department of Dental Medicine, Karolinska Institutet, Huddinge, Sweden, and the Specialist Orthodontic Clinic, Uppsala County Council, Uppsala, Sweden. The reviewing of the status of the retainers took place from June 2002 to August 2003 by 2 of the other authors (A.A.S. and C.M.F.), who were not aware of the test or control identity of the patients. The longest time interval between the bonding and the reviewing of the retainers exceeded 5 years.

Forty-five young patients treated with fixed appliances by the first author were randomly chosen for the study. The test group comprised 22 retainers in 18 patients, and the control group comprised 31 retainers in 27 patients. In the test group, 1 patient, with 2 retainers bonded from the maxillary right to the left lateral incisors, and from the mandibular right to the left canines, left the study. Consequently, 20 retainers in 17 patients were evaluated in the test group. In the control group, 2 patients, with 1 retainer each, both bonded from the mandibular right to the left canines, dropped out of the study. For the sake of statistical comparisons, the remaining 29 retainers in 25 patients in the control group were randomly reduced to 20 retainers in 18 patients (Table I).

<table>
<thead>
<tr>
<th>Table I. Descriptive statistics of the test (20 retainers in 17 patients) and control (20 retainers in 18 patients) groups</th>
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<tbody>
<tr>
<td>Test group</td>
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<tr>
<td>Female:male ratio</td>
</tr>
<tr>
<td>Maxillary retainers bonded (n)</td>
</tr>
<tr>
<td>Mandibular retainers bonded (n)</td>
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<tr>
<td>Retainers bonded in university clinic (n)</td>
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<td>Retainers bonded in public health clinic (n)</td>
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In the test group, the retainer wire was tried on to check for fit. They were then bonded according to the same protocol described for the control group. The liquid resin was applied to the ends of the metal retainer wire free. In the clinic, the teeth on which the retainers were to be bonded were cleaned and dried before the silicon index with the metal retainer wire was tried on to check for fit. They were again isolated from moisture contamination and dried with compressed air until the enamel appeared frosty white.

Liquid resin (Transbond LR; 3M Unitek, Monrovia, Calif) was applied to the 2 teeth at the ends of the metal retainer. The liquid resin was light cured for 20 seconds with a Demetron VCL 400 (Kerr Corporation, Orange, Calif). The silicon index carrying the metal retainer was then adapted to the teeth, and Transbond LR composite paste (3M Unitek) was syringed onto the lingual surfaces of those 2 teeth and the ends of the metal retainer and light cured for 40 seconds. After removal of the silicon index, liquid resin was applied to the remaining teeth involved in the fixed metal retainer and light cured for 20 seconds. Composite paste (Transbond LR) was then syringed onto the tooth surfaces, and each surface was cured for 40 seconds. Finally, the composite was finished with a multifluted tungsten carbide bur in a high-speed hand piece and white stone, followed by a rubber cone in a low-speed hand piece.

In the test group, except that no liquid resin was used, the metal retainers were bonded according to the same protocol described for the control group.

**Statistical analysis**

The dates when the retainers were bonded and failed were retrieved from computerized (Ortus 2.0; RDT Soft, Uppsala, Sweden) and typewritten patient records. Both the test and control groups consisted of complete and censored observations. For the complete observations, the duration of retainer survival was counted between the month of retainer placement and
the month in which an accidentally debonded surface was recorded.

For the censored observations, retainers that remained intact throughout the observation period were counted from the month of their placement to the end of the reviewing period of each patient (June 2002-August 2003).

Survival analysis, the Kaplan-Meier product limit method, was used to analyze the data obtained. The log rank test was used for statistical differences between the test and control groups. All statistical procedures were carried out with SPSS software (version 10.0; SPSS, Chicago, Ill).

RESULTS

According to the log rank test, there was no statistically significant difference in the survival pattern (P >0.05) between the test and control groups. The 95% confidence intervals (24-49 months in the control group, 24-40 months in the test group) also indicated no statistically significant difference between the groups.

On average, the retainers stayed intact in the control and test groups for 36 and 32 months, respectively. Approximately, 60% and 50% of all patients in the test and control groups, respectively, had no bond failures during the observation period, and the difference was not statistically significant (P >0.05).

The bond failure rates of all bonded surfaces were 14.9% in the test group and 13.7% in the control group, and the difference was not statistically significant (P >0.05) (Table II). The recorded bond failures all occurred at the tooth-composite interfaces.

The median survival time of the control group’s retainers was 43 months (Fig). The median survival time of the test group was not available because the survival probability did not drop below 50% in the period of observation. For the test group, the median should be more than 47 months, since the longest observation ended at 47 months.

DISCUSSION

These findings indicate that the bonding of lingual retainers does not need to involve liquid resin. The bonded retainers in the test group remained in place for a clinically acceptable time without liquid resin. The retainers in the test group even tended to show a more favorable survival rate than those in the control group. Statistically, however, there was no significant difference between the groups.

In these aspects, our results are remarkably similar to those of a previous study that dealt with brackets bonded in vivo without liquid resin. The only difference was that, in our study, the observation period was 3 years longer. Data of the control group in this study also seem to match well with other European studies with larger sample sizes. This indicates that the design of our controlled clinical trial was randomized enough for testing of fixed retainers bonded without liquid resin. It is likely that the success of this bonding technique was influenced by variables: eg, clinician’s skill, patient’s diet, and so on. Further understanding of this bonding technique would rely on taking these and other similar variables into account in randomized clinical trials and multivariate analyses to study the extent of each variable that might contribute to the success of the bonding technique without liquid resin.

Table II. Descriptive statistics of the retainer failures of the test (20 retainers in 17 patients) and control (20 retainers in 18 patients) groups

<table>
<thead>
<tr>
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<th>Test group</th>
<th>Control group</th>
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<td>Total tooth surfaces bonded to the metal retainer (n)</td>
<td>74</td>
<td>110</td>
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<tr>
<td>Accidentally debonded tooth surfaces in the study period (n) (percentage of debonded tooth surfaces)</td>
<td>11 (14.9%)</td>
<td>15 (13.65%)</td>
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<tr>
<td>Loosened retainers in the study period (n) (percentage of total patients)</td>
<td>8 (40%)</td>
<td>10 (50%)</td>
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Fig. Kaplan-Meier survival curves of the test (n = 20) and control (n = 20) groups.

In this study, the censored observations leveled off from 20 to 47 months in the test group and from 43 to 66 months in the control group. In other words, after the first 20 months in the test group, no retainer experienced a further failure. In the control group, the last retainer to fail was in the 43rd month after its placement.
These results have at least 2 implications. The prevailing hypothesis of the mechanism of enamel adhesion states that lasting enamel adhesion relies on mechanical interlocking. For this reason, bis-GMA adhesive materials provided by the manufacturers contain both liquid resin and paste. However, our results seem to indicate that clinically acceptable bonding can be achieved without liquid resin. If, in the future, more in-vivo data are eventually published to duplicate the success of lasting enamel adhesion without liquid resin, more biologic materials might be provided by manufacturers. Further investigations of the exact mechanism of enamel adhesion are desirable.

Apart from the President’s Cancer Panel report, the health implications of BPA have also been highlighted by the ban of the European Union on the manufacturing of baby bottles containing BPA on March 1, 2011, after such bottles had previously been banned in Denmark and France. The impact of these bans on dental and orthodontic patient care and the food-packing industry in the future cannot be easily forecasted. However, we hope that research that elucidates the clinical and laboratory characteristics and biologic effects of adhesive materials will provide sufficient evidence for our specialty to discuss these issues in a relevant manner.

Considering the potential hazards of BPA, elimination of the contribution of the liquid resin in the overall BPA release without compromising the clinical longevity of the retainer therefore would imply a more biologic approach of bonding procedures for the benefit of clinicians and, more importantly, for patients.

CONCLUSIONS
Exclusion of the liquid resin component in the bonding of lingual retainers with bis-GMA–based composite resin does not have a negative effect on the longevity of the retainers in vivo.
Bonding of lingual retainers, therefore, does not seem to require the use of liquid resin.

REFERENCES