Original Article

A comparative evaluation of lingual retainer failure bonded with or without liquid resin

A randomized clinical study with 2-year follow-up

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ABSTRACT

Objective: To prospectively evaluate and compare the effect of liquid resin on lingual retainer failure after a 2-year follow-up.

Materials and Methods: Fifty-two patients (26 males, 26 females) with a mean age of 18.3 ± 1.3 years at follow-up, were randomized into two groups: the resin group and the nonresin group. The lingual retainers in the resin group were bonded to the enamel surfaces with two-step bonding resin, Optibond FL, and Tetric EvoFlow. The nonresin group followed the same procedure of bonding retainers but without applying the Optibond FL. Retainer failure, calculus accumulation, and discoloration of composite pads adjacent to the retainers during the 2-year observation period were registered, compared, and statistically analyzed with a Fisher's exact test and chi-square test.

Results: In the resin group, the incidence of retainer failure was 4% and occurred at the composite-wire interface; in the nonresin group, the incidence was 27% and occurred at the enamel-composite interface. The difference between the groups was statistically significant ($P = .049$). The incidences of calculus accumulation and discoloration adjacent to the composite pads were 27% and 69% ($P = .003$ and $P < .001$) higher in the nonresin group, respectively.

Conclusion: Application of resin in bonding of lingual retainers appears to reduce the incidence of retainer failure as well as the incidence of calculus accumulation and discoloration adjacent to the composite pads. (*Angle Orthod.* 2012;82:84–87.)

KEY WORDS: Lingual retainer failure; RCT; Liquid resin; Bonded retainer

INTRODUCTION

Permanent maintenance of the achieved result after successful orthodontic treatment is undoubtedly a great, if not the greatest, problem for orthodontic clinicians.[1] Retention is usually necessary to overcome the elastic recoil of the periodontal supporting fibers and to allow remodeling of the alveolar bone. The bonded orthodontic lingual retainer constructed from composite and multistrand orthodontic wire provides an esthetic and efficient system for maintained retention and has been shown to be an effective means of retaining aligned anterior teeth in the posttreatment position in the long term. This has been in popular use as a method of retention since the late 1970s.[2,3]

Failure or loss of the retainers often leads to relapse. The retainer failure can occur at the enamel-composite interface, composite-wire interface, or with wire fracture. Most failures have been reported at the enamel-composite interface,[4] and wire fractures are reported to be directly related to the age of the retainer: the longer it is in situ, the greater the chance of breakage.[2]

The use of liquid resin in bonding lingual retainers has been controversial in Scandinavian countries and parts of Sweden in particular. A series of Norwegian studies indicated that orthodontic personnel have a high incidence of dermatoses on their hands.[5] If orthodontic bonding could be accomplished without the use of liquid resin, it could be possible to reduce the risk of occupational exposure to liquid resin and its unpolymerized components. In addition, another advantage of not applying liquid resin is that it saves a step and therefore saves time. This could be crucial

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when bonding retainers because the longer it takes to place the retaining wire, the more possibility there is of moisture contamination that could potentially result in a bond failure. The works of Tang[5,6] suggested that bonding metal brackets using composite onto a healthy enamel surface worked with no clinical difference when the use of liquid resin was eliminated.

The exclusion of liquid resin from orthodontic bonding occurred in the early 2000s at the Department of Orthodontics in Orebro County Council, Sweden. The lack of evidence in this matter obligated us to study in a scientific manner the effect of eliminating liquid resin. We had noticed a high incidence of calculus accumulation and even discoloration adjacent to the composite pads and around the retainers in our department and wondered if this phenomenon was related to elimination of liquid resin. Thus, the aim of the present pilot study was to prospectively investigate the effect of liquid resin on the survival of fixed lingual retainers and to evaluate the incidence of calculus accumulation and discoloration adjacent to the lingual retainers.

MATERIALS AND METHODS

Fifty-two consecutive patients participated in this study, all of whom had received fixed appliance treatment in the retained arch with the Roth 0.018-inch prescription SWA appliance at the Postgraduate Dental Education Center, Department of Orthodontics, Orebro County Council, Sweden. The patients were treated at the clinic by different orthodontists and had different initial malocclusions and diagnosis. All of the patients met the following inclusion criteria: planned to receive a lingual retainer bonded to all six lower anterior teeth, had sound enamel on the lingual surface, and had a calculus-free lingual surface in the lower anterior segment.

After informed consent was obtained, the patients were randomized into two groups: the resin group (n = 26) and the nonresin group (n=26; Figure 1). The subjects were randomized as follows: a computer-manufactured block-randomization list was acquired by using SPSS software (version 15.0, SPSS, Chicago, Ill) and stored with a research secretary at the Postgraduate Dental Education Center. Each time a patient gave his or her consent, the secretary was contacted by e-mail, and the information about which group the patient was going to be included in was obtained.

After taking impressions and when the working models were cast in hard stone, all of the retainers, 0.0195-inch multistranded Penta-one wire (Masel Orthodontics, Bristol, Penn), were contoured by the same dental technician at the orthodontic dental laboratory in Orebro County Council.

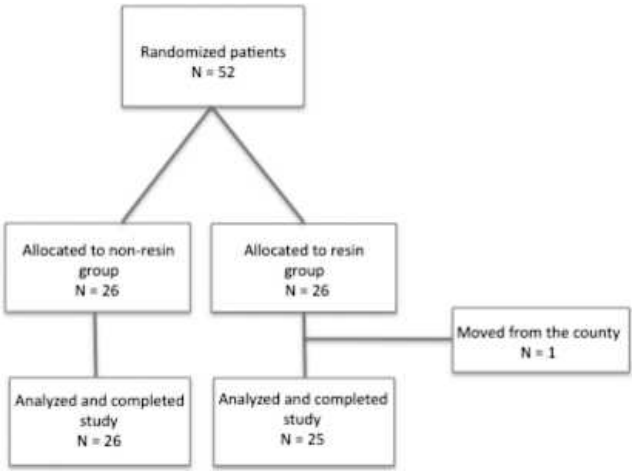

Figure 1. Flow chart.

All of the retainers in the study were bonded by the same operator using the following sequence of construction.

The fixed appliance was debonded, and the teeth were thoroughly cleaned and polished using oil-free pumice. After adequate moisture control using dental cotton rolls in the anterior segment, parotis dental rolls in the lateral segments, and saliva ejector, the lingual surfaces were etched with Ultra-Etch 35% phosphoric acid gel (Ultradent Products Inc, South Jordan, Utah), for 30seconds and thoroughly rinsed.

In the resin group, the lingual surfaces were then air dried, and very thin layers of primer and adhesive, two-step bonding, Optibond FL (KerrHawe, Orange, Calif), were applied and blown into the etched prisms with the 3-in-1 syringe and then light-cured with Demetron 2000 (Demetron, Danbury, Conn), Quartz tungsten halogen type for 30 seconds. The fit of the retainer was checked, and the retainer was held into place with dental floss. Small amounts of composite Tetric Evo-Flow (Ivoclar Vivadent, Schaan, Liechtenstein) were applied to the lingual surfaces of the six anterior teeth over the retainer, ensuring maximum coverage of the wire surface. The composite pads were light cured, both incisally and cervically, for 30 seconds per tooth. The surface of the retainer was checked, and polishing was usually unnecessary. The nonresin group followed the same procedure excluding the Optibond FL step, where the composite Tetric EvoFlow was directly applied to the etched lingual surfaces.

The patients were then followed for 2 years (mean $\pm$ SD, 24.4 $\pm$ 4.7 months), and the incidences of retainer loss or breakage, which was noted in the patients' records during the observation period 2008–2010, were compiled by another coauthor and thus was blinded to the operator and the other coauthor. Furthermore, the incidence of calculus accumulation and discoloration adjacent to the composite pads and

Figure 2. Pattern of discoloration adjacent to the composite pads.

the lingual retainers was noted during the observation period and registered from the patients' records.

The discolorations around the composite pads were noted when examining the retainers and the composite pads during the observations period. The discolorations were assessed when yellowish or brownish shades of discoloration were present like a halo adjacent to the composite pads at the interface with the enamel surface (Figure 2). If the discolorations or calculus were present, it was noted in the patients' records. The assessments were done subjectively by the same operator without using any assessment scales; thus, the discoloration of the composite pads, calculus, or both was rated either present or not. None of the patients had their teeth cleaned professionally at least 6 months prior to their visits to the Orthodontic Department.

The regional ethical review board in Uppsala, Sweden, which follows the guidelines of the Declaration of Helsinki, approved the study protocol.

Statistical Analysis

The data were statistically analyzed using SPSS software (version 18.0, SPSS, Chicago, Ill). Numerical variables, arithmetic means, and standard deviations were calculated. Fisher's exact test was used to calculate the failure rate of the retainers between the groups, and a chi-square test was used to compare the calculus accumulation and discoloration in association with usage or elimination of liquid resin in the two groups. Differences with probabilities of less than 5% ($P < .05$) were considered statistically significant.

Table 1. Sample characteristics

Group	Age, Mean ± SD, y	Gender, M/F, n	Retainer In Situ, Mean ± SD, mo
Resin group (n = 25)	18.4 ± 1.6	14/12	24.2 ± 4.0
Nonresin group (n = 26)	18.2 ± 1.6	12/14	24.7 ± 5.4

Table 2. The incidence of retainer failure, calculus accumulation and discoloration within groups and differences between groups at the 2-year follow-up

Group	Retainer Failure, %	Calculus Accumulation, %	Discoloration, %
Resin (n = 25)	4	4	0
Nonresin (n = 26)	27	31	69
P value	.049*	.003†	<.001†

* Calculated with Fisher's exact test. Significant differences ($P < .05$).

† Calculated with chi-square test. Significant differences ($P < .05$).

RESULTS

All but one of the 52 patients was followed for 2 years (Figure 1). The two study groups were quite homogeneous with regard to age, gender, and the age of the retainers in situ at the 2-year follow-up (Table 1). No significant differences in any variables used in this study were found between the genders.

In the resin group, the incidence of retainer failure after 2 years in situ occurred once in one patient (4%) and at the composite-wire interface. In the nonresin group, the incidence of retainer failure occurred once in seven different patients (27%), from one or several teeth, and all at the enamel-composite interface. The difference between the groups was statistically significant ($P = .049$). The incidence of calculus accumulation and discoloration adjacent to the composite pads was significantly higher in the nonresin group (Table 2).

DISCUSSION

From a clinical point of view, the need for secure retention after orthodontic treatment is unquestioned. One of the most popular methods for retaining the lower anterior segment is a bonded lingual retainer. Such a retainer can be fabricated from different wires by the orthodontist or a dental technician and bonded using different techniques or materials.

Caries prevention of the etched enamel on smooth surfaces was suggested as an indication for the use of resin sealant.[1] Excluding liquid resin from orthodontic bracket bonding was, however, shown to work equally well compared with the conventional bonding technique under the influence of optimally fluoridated drinking water[5]; however, the authors pointed out the need for prospective randomized clinical trails to assess further the success of the liquid resin-free bonding technique.

Our data show better retainer retention with the use of liquid resin, with a significantly lower failure incidence in the resin group. The breakage of the

retainer in the resin group, which occurred at the composite-wire interface in only one patient, could depend on an inadequate bulk of composite covering the wire. At the same time, this breakage indicates an adequate bonding strength between the composite and the enamel surface, most likely due to the better retention properties advocated by the liquid resin. On the other hand, all the retainer failures in the nonresin group occurred at the enamel-composite interface, which implies a weaker retention of the composite to the enamel surface.

These findings are not in accordance with the results of Tang et al.[5] regarding bonding of orthodontic brackets with elimination of liquid resin. Differences between the results in the current study and the study conducted by Tang et al. could depend on two factors. In the retrospective study by Tang et al., the orthodontist who bonded the brackets without using liquid resin etched the enamel surfaces for 60 seconds followed by applying 70% alcohol twice on the air-dried and etched enamel to desiccate the enamel surface further. In our study, the enamel surfaces were etched for only 30 seconds as recommended by the manufacturer, and no further desiccation was carried out by applying alcohol on the enamel surfaces. However, an unpublished study with a cross-mouth design conducted in Orebro County Council indicated the insignificance of dehydration using 70% alcohol in orthodontic bonding. The other factor that differed between the studies involves the composite used; in the study done by Tang et al., Phase II (Reliance III), which is a two-paste composite, was used for bonding brackets. In our study, the composite used was Tetric EvoFlow, which is a low-viscosity composite. The difference in shear bond strength between these two composites could possibly contribute to the differences between the studies.

In addition, the nonresin group showed significantly higher incidences of calculus accumulation and discolorations adjacent to the composite pads. This could be due to an effect of the etching, which roughens the enamel surface and gives rise to better mechanical retention for dental plaque and calculus accumulation. The discoloration around the composite pads also could be a result of microleakage around the composite pads. Whether these areas of discoloration are demineralization sites or just show a pattern of discoloration is hard to establish without a histological examination.

The study design of this prospective trial was a randomized clinical trial. The randomization process, in which the patients are randomly assigned in advance, results in a similar distribution of confounding variables between the groups. This reduces the selection bias. Moreover, to reduce the risk of bias, the patient records were blinded; the coauthor was unaware of the patients' groups when reviewing the records. All of the retainers were bonded by the same operator and with the same procedure to eliminate interoperator discrepancies. The other major source of bias in prospective clinical studies comes from dropouts. An important aspect of any prospective study is keeping track of all the patients once they have been assigned to a treatment regimen.[7] In this study, one patient in the resin group moved from the county shortly after finishing the treatment and could not be reached despite many attempts to get in contact with the patient. The authors were unable to find any publications regarding retainer breakage and failure in association with elimination of liquid resin; therefore, a calculation of sample size was difficult.

Because of the close significant level in this study ($P = .049$), one should be cautious not to draw firm conclusions regarding the significant differences between the higher failure incidence of lingual retainers in the nonresin group and the resin group. Larger study groups would have been desirable. On the contrary, the significantly higher calculus accumulation and discoloration rate in the nonresin group is not influenced by the one dropout in this study.

Considering pros and cons of eliminating liquid resin, at least with regard to lingual retainers, it seems to be more favorable not to eliminate the liquid resin, primarily to optimize the bonding strength of the composite pads to the tooth surface but also to minimize the calculus accumulation and maybe even the microleakage around the composite pads in the long term.

CONCLUSION

- Application of resin in bonding of lingual retainers appears to reduce the incidence of retainer failure as well as the incidence of calculus accumulation and discoloration adjacent to the composite pads.

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