

## Which Way Forward? Fixed or Removable Lower Retainers

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### ABSTRACT

**Objective:** To determine whether lower lingual, canine to canine, bonded multistrand retainers prevent relapse of lower labial segment alignment following fixed appliance therapy and to compare this with lower Hawley-type removable retainers.

**Materials and Methods:** Two groups of 29 patients were identified. Group 1 had bonded lower canine to canine multistrand retainers placed following debonding, whereas Group 2 had lower Hawley-type retainers (with acrylic labial to the incisors) fitted following debonding. Study models were taken of all patients at debonding ( $T_1$ ) and at least 1 year post debonding ( $T_2$ ). Changes in Little's index over the study period were recorded using a reflex microscope.

**Results:** Statistically significant changes in Little's index occurred in the lower labial segment of both study groups ( $P = .001$ ) over the observation period. There was no statistically significant difference in the amount of change in Little's index between the bonded and removable retainer groups ( $P = .13$ ). Bonded retainers tended to be placed in older patients ( $P = .02$ ).

**Conclusions:** Relapse can occur in the lower labial segment with both fixed and removable retainers. The amount of relapse seen with both types of retainer is not statistically significantly different.

**KEY WORDS:** Relapse; Retention; Bonded; Removable

### INTRODUCTION

Many studies have demonstrated the unpredictable nature of relapse following orthodontic treatment.<sup>1-5</sup> In particular, the long-term stability of the lower labial segment teeth and, therefore, the most suitable mode of retention remains one of the most controversial areas in orthodontics.<sup>6,7</sup> Recent work has suggested that long-term retention of the lower labial segment may be necessary in order to prevent or reduce the likelihood of unwanted posttreatment changes.<sup>8,9</sup> Lower bonded multistrand retainers have long been proposed as a method of orthodontic retention,<sup>10</sup> and a number of different designs and techniques for placement have been suggested.<sup>11,12</sup> The proposed benefit of using

such a retainer has been to allow physiologic tooth movement while maintaining tooth alignment.<sup>10</sup>

Stated advantages of lower bonded retainers include reduced patient compliance, in terms of remembering to wear the appliance, and good esthetics.<sup>12</sup> There is also evidence to suggest that prolonged use of a bonded retainer will decrease the likelihood of lower labial segment relapse.<sup>9</sup> Nevertheless, these retainers do have disadvantages. Their placement is time-consuming and technique-sensitive,<sup>10,13,14</sup> and for some individuals they can be difficult to maintain, encouraging plaque and calculus accumulation.<sup>15</sup> The evidence would, however, suggest that there are few such long-term problems.<sup>16-18</sup>

Although there are a large number of studies that report on the failure rate of bonded retainers,<sup>10,13,14,19,23</sup> relatively few have investigated the incidence of relapse within retainer types and, in particular, with bonded retainers (Table 1). Those that have, demonstrate lower labial segment relapse to some extent even with bonded retainers in situ. Of these, only one study directly compares the relapse experience of subjects with bonded retainers and those using removable retainers.<sup>18</sup> The findings suggest that clinically significant relapse occurs with the use of both retainers. However, the small numbers in the study precluded statistical evaluation.

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**Table 1.** Summary of Published Papers Reporting on the Effectiveness of Lower Bonded Retainers

Authors	Retainer Design	Study Sample	Average Length of Retention, Years	Relapse
Dahl and Zachrisson, 1991 <sup>14</sup>	3-Stranded spiral wire (0.0195-inch/0.0215-inch)	29	5.7	None <sup>a</sup>
	5-Stranded spiral wire (0.0215-inch)	17	3.2	None <sup>a</sup>
Årtun et al, 1997 <sup>18</sup>	Plain wire	11	3	Significant relapse ( $P < .01$ )
	Thick multistrand	13		
	Flexible multistrand	11		
	Removable	14		
Andrén et al, 1998 <sup>21</sup>	Multistrand variable diameter	52	6.8	23% Minor relapse
Störmann and Ehmer, 2002 <sup>23</sup>	0.0195-inch Respond (multistrand)	31	2	None <sup>a</sup>
	0.0215-inch Respond (multistrand)	38		20% <sup>a</sup>
	Plain wire (lower 3–3)	34		80% ( $P < .01$ ) <sup>a</sup>

<sup>a</sup> Method of measurement not recorded.

In view of the increasing use of these appliances, there would seem to be a need for further longer term research to be undertaken to review their effectiveness. The aims of this study were therefore:

- To assess the amount of tooth movement (relapse) which may occur when either a lower multistrand bonded retainer or a removable Hawley-type retainer is used following fixed appliance therapy.
- To compare the amount of relapse between the two types of retainer.

The null hypotheses were:

- Lower lingual canine to canine bonded multistrand retainers prevent any change in lower labial segment alignment following orthodontic treatment.
- Lower Hawley-type retainers prevent any change in lower labial segment alignment following orthodontic treatment.
- There is no difference in effectiveness of the maintenance of alignment between the two types of retainer.

**MATERIALS AND METHODS**

Subjects were identified who had completed a course of upper and lower fixed appliance orthodontic treatment. All subjects had been treated by orthodontic registrars undertaking a three-year postgraduate training program and were identified from the laboratory databases of Bristol Dental Hospital and the Royal United Hospital in Bath. Calculated estimates indicated that for a power of 90% and at a significance of .05, a sample size of 18 in each group was sufficient, taking a 0.5-mm (SD 0.5) change (relapse) as significant.

**Group 1**

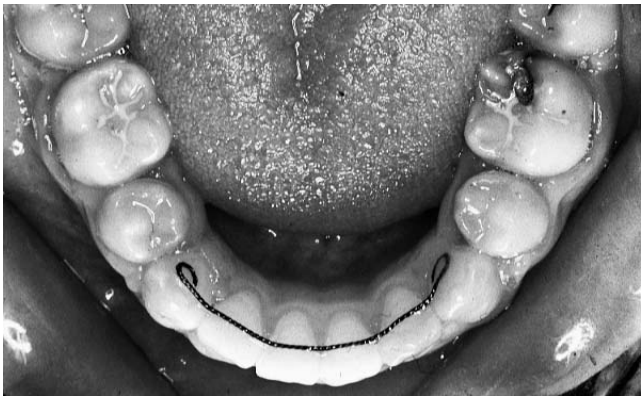
Twenty-nine subjects were initially identified who had bonded lower canine to canine multistrand retain-

ers placed at the completion of orthodontic treatment. The retainers had been in place for at least one year (Figure 1). It was felt that this number of patients would enable the study number to be attained, allowing for sample attrition where some subjects may have been unwilling to return for further models to be taken. In each patient the retainers were made from 0.0175-inch stainless steel Wildcat wire (GAC, Bohemia, NY) and bonded to each individual tooth (canine to canine) using orthodontic Concise (3M Unitek, St Paul, Minn).

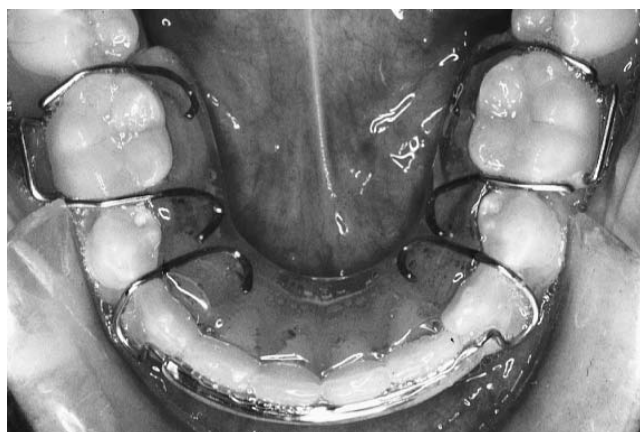
**Group 2**

Twenty-nine subjects were identified who had lower Hawley-type retainers with acrylic, labial to the incisors on the labial bow, fitted at the completion of treatment, and were at least one year post debonding (Figure 2). Subjects were instructed to wear the retainer full-time for the first three months and then to wear the retainer only at night. This would again allow for sample attrition.

The age and sex distributions of the two groups are shown in Table 2. All subjects were chosen from the same pool of patients and were selected to represent similar malocclusions, extraction frequency, and treat-



**Figure 1.** Bonded lower canine to canine twistflex retainer.



**Figure 2.** Lower removable retainer with labial acrylic on the labial bow.

ment mechanics as in Group 1 (Tables 2 and 3). All had healthy periodontal support pre- and posttreatment. The subjects were not consecutively treated cases.

Subjects in each group had their retainer fitted within one week of having their lower fixed appliance removed. Each retainer was constructed in the laboratory on a working model by a qualified dental technician.

All subjects had study models taken at the beginning ( $T_0$ ) and end of active treatment ( $T_1$ ) and were recalled for study models to be taken at least one year after completion of active treatment ( $T_2$ ). All the patients initially identified as fulfilling the study criteria were willing to return for further records. A total of 58 patients, 29 in each group, took part in the study.

In each case the clinicians and supervisors names were recorded as well as any supplemental retainers used in the bonded retainer group (Group 1) patients.

One investigator measured the contact point displacements of the lower labial segment (between the mesial canine contact points) at  $T_0$ ,  $T_1$ , and  $T_2$  from the study models using a reflex microscope. A computer program was developed which permitted data entry to an Excel spreadsheet for later analysis. From these measurements, Little's index,<sup>24</sup> ie, the summed contact point displacement in the lower labial segment, was calculated for each model.

Twelve models from the original sample were ran-

domly selected six weeks after the original measurements were recorded in order to assess the repeatability and method error for the measurement.

## RESULTS

The Shapiro-Francia test was used to test for normality, and it indicated that the data were not normally distributed. Therefore, nonparametric tests were used with a predetermined significance of  $\alpha = .05$ . The summary data are shown in Table 2. The Lin's concordance correlation coefficient was used to assess the method error. Reproducibility of measurement was found to be excellent as shown by the line of concordance (Figure 3).

### Comparison of the Two Sample Groups

The groups were similarly matched for malocclusions, extraction frequency, and treatment mechanics (Tables 3 and 4). There appeared to be no consistent pattern in operator or supervisor preference for the type of retainer selected. The small numbers involved precluded further investigation of retainer preference.

The Mann-Whitney  $U$ -test demonstrated no statistically significant difference between the two groups with respect to the amount of initial crowding present in the lower labial segment ( $T_0$ ) ( $P = .65$ ). There was also no statistically significant difference ( $P = .12$ ) in the time between  $T_1$  and  $T_2$  (ie, length of monitored retention) which was found to be 17.4 months  $\pm$  4.3 months (Group 1) and 15.7 months  $\pm$  4.9 months (Group 2).

The mean age of the subjects at the end of active treatment was 18 years 6 months  $\pm$  6 years 8 months (Group 1) and 15 years 4 months  $\pm$  3 years 3 months (Group 2). The mean age at both the start and end of treatment was higher in the bonded retainer group ( $P = .02$ ).

### Comparison of the Effectiveness of Retainers

Summary data for Little's index for each group at  $T_1$  and  $T_2$  are shown in Table 2 and in the boxplots in Figure 4. The Mann-Whitney  $U$ -test indicated that there was a small but significant difference between the groups at  $T_1$  ( $P = .003$ ), suggesting that the tooth

**Table 2.** Summary Table of Results of Little's Index for Both Groups at  $T_1$  and  $T_2$ <sup>a</sup>

Retainer Group and Time	Mean, mm	Median, mm	Interquartile Range, mm	Minimum, mm	Maximum, mm	Shapiro-Francia
Bonded $T_1$	0.37	0.26	0.00 to 0.71	0.00	1.15	0.251
Bonded $T_2$	1.02	0.98	0.54 to 1.45	0.27	2.96	0.024
Removable $T_1$	0.73	0.62	0.47 to 0.95	0.00	1.91	0.379
Removable $T_2$	1.79	1.60	1.17 to 1.92	0.00	5.50	0.001

<sup>a</sup> Number of subjects was 29 in each instance.

**Table 3.** Summary of Age, Sex, and Extraction Distribution of the Two Study Groups

Group	Male N	Female N	Age at start Years/Months	Extraction N	Nonextraction N
Bonded retainer Group1	15	19	16/8 (± 7/2)	22	12
Removable retainer Group2	9	25	13/3 (± 3/4)	25	9

alignment was different between the two groups at the end of active treatment. Therefore, instead of analyzing the difference between the two groups at  $T_2$ , the changes in Little’s index within each of the two groups from  $T_1$  to  $T_2$  were compared. In this case no significant difference was found between the two groups ( $P = .13$ , Table 5), although the range of change within the removable retainer group was much larger than in the bonded retainer group.

Once again, using the Mann-Whitney  $U$ -test, within each of the two retainer groups a statistically significant difference in Little’s index (relapse) occurred between  $T_1$  and  $T_2$  for both retainers ( $P = .001$ ).

**DISCUSSION**

**Study Sample**

There appeared to be no consistent pattern in the choice of retainer used by either operator or supervisor. Reasons such as initial spacing, severe rotations, periodontal involvement, or the inclination of the lower labial segment have been proposed as influencing the choice of retainer.<sup>11,13,25</sup> In this study there was no difference in the periodontal health or the amount of initial crowding in both groups. The higher average age at both the start and end of active treatment in the bonded retainer group might suggest that clinicians are more likely to place bonded retainers in adults, a view supported by others.<sup>21,25</sup> Possibly, there is a

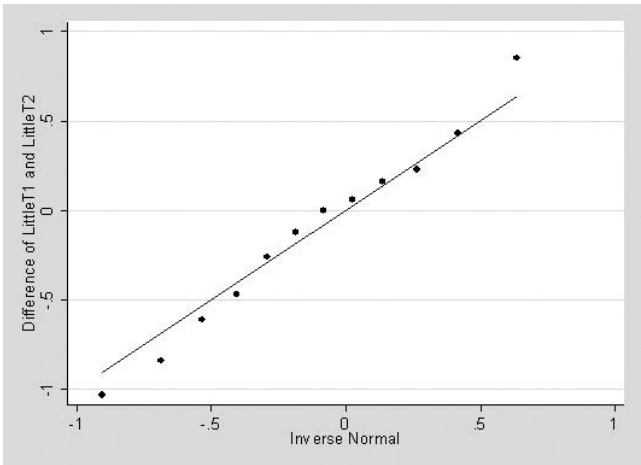
greater perceived patient convenience and improved compliance with this type of retainer in adult patients.

In the present study, the irregularity in the lower labial segment at the time of fixed appliance removal ( $T_1$ ) was greater in the removable retainer group than in the bonded retainer group, suggesting a different level of finishing for the two groups of patients. It is possible that the level of finishing may have influenced the type of retainer chosen for patients in this study. However, the limited evidence available in this area suggests it is the initial malalignment that has the greater influence on clinicians’ choice of retainer.<sup>26</sup>

**Relapse Experience**

The findings of this investigation support those of most previous studies, which demonstrate that relapse in the lower labial segment occurs even with a fixed retainer in place (Table 1). Dahl and Zachrisson<sup>14</sup> commented that in some subjects spaces opened within the lower labial segment with the bonded retainer in situ. Although their cases experienced “no” relapse, no details were given on the method of measurement. In the present study contact point displacement was recorded and all subjects demonstrated some change in Little’s index, ie, a 100% incidence of relapse. Interestingly, some “relapse” improved the alignment.

Comparison with other studies is problematic, with some reporting incidence of relapse, although quoting a percentage relapse, and then failing to include method of measurement or error of the method.<sup>21,23</sup> Årtun et al<sup>18</sup> found a highly significant change in alignment during retention, measured with a digital caliper, but they did not state the number of cases in which the relapse occurred. They reported 0.3 mm of relapse within a bonded retainer and 0.66 mm of relapse within a removable retainer over a 3-year period. This compares with a median change of 0.72 mm in the bonded retainer group and 0.98 mm in the removable retainer

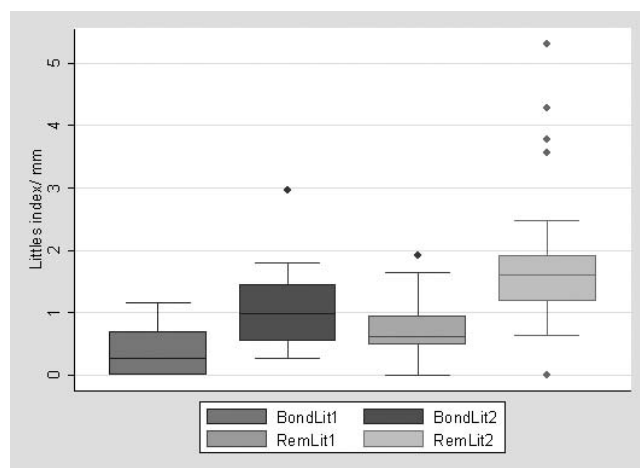


**Figure 3.** Graph indicating Lin’s concordance correlation illustrating method error.

**Table 4.** Summary of the Malocclusions Treated in Each Group

Malocclusion	Bonded Retainers (Group 1)	Removable Retainers (Group 2)
Class 1	8	9
Class 2 division 1	19	18
Class 2 division 2	4	2
Class 3	3	5





**Figure 4.** Boxplots of Little's index at  $T_1$  and  $T_2$  for both study groups. Key: Bonded retainer at  $T_1$ —BondLit1; Bonded retainer at  $T_2$ —BondLit2; Removable retainer at  $T_1$ —RemLit1; Removable retainer at  $T_2$ —RemLit2.

group in the present study. This difference might be explained by the two different methods of measurement used. The present research utilized a reflex microscope, which provides greater accuracy over the small distances being measured.

Nevertheless, the results demonstrated that the relapse experienced by both groups with the retainers in situ was highly statistically significant. It was felt that comparing the differences in Little's index at  $T_2$ , to see if one retainer is more effective than the other, was not valid due to the statistically significant differences in Little's index at  $T_1$ . Instead, the change in Little's index was compared between the two groups, and in this case there was no statistically significant difference in this change from  $T_1$  to  $T_2$ . Therefore, the results of this study would suggest there is no statistically significant difference in the measured relapse between bonded and removable retainers.

The question is whether the relapse observed in each case can be considered clinically significant. The median relapse was less than or equal to 1.6 mm for both groups within the study, although the range, particularly in the removable retainer group, was much greater (Table 2). What Little's index does not do is discriminate as to where the relapse occurs within the labial segment. For example, has it occurred to a large degree at one contact point or to a lesser degree over

several contact points? While 1.6 mm distributed over several contact points may not be clinically significant, 1.6 mm at one contact point is likely to be clinically significant. Therefore, location and degree will influence the clinical decision on the level of significance.

The range of relapse for individuals within this study was large, particularly in the removable retainer group, with a number of significant outliers. A possible explanation is that being removable, patient cooperation is a greater factor in the success of these appliances, which is less of an issue with bonded retainers. Direct assessment of compliance with instructions in the removable group was not possible; however, the greater range of relapse in this group might suggest less wear and, hence, greater risk of tooth movement. A lost removable retainer is likely to permit greater relapse across the labial segment than a partial debonding or fracture of a bonded retainer.

This study demonstrated once again, that even with bonded retainers in place, relapse still occurs; the study results support the finding of previous studies (Table 1). This suggests that either deformation of the stainless steel multistrand wire allows some tooth movement or that the wire was not passive when placed. The thickness of the bonded retainer wire may have influenced relapse. A review of the literature by Bearn<sup>11</sup> recommended the use of 0.0215-inch multistrand wire instead of the 0.0175-inch wire used in this study. More rigid, larger diameter wires will increase the force required for permanent deformation and hence possibly reduce relapse, although this is not always supported by the evidence.<sup>23</sup>

Backup removable retainers were issued for 12 of the 29 subjects in the bonded retainer group. No standard instructions were given on when the retainers should be worn. It was, therefore, not possible to determine whether the use of these retainers influenced the amount of relapse experienced, although it still does not alter the finding that relapse occurred with the bonded retainers, and the degree of relapse was not significantly different between the two groups, bonded or removable.

Many factors are taken into account when choosing the best method of retention for a patient. On the evidence presented here, there appears to be no clear indication as to the most appropriate method when trying to prevent relapse. Although the median change in

**Table 5.** Mann-Whitney *U*-Test Demonstrating No Statistically Significant Difference Between the Fixed and Removable Retainers in the Amount of Change in Little's Index from  $T_1$  to  $T_2$

Retainer Group and Time	Number	Rank Sum	Expected	p/z
Change in Little's index with the fixed retainer from $T_1$ to $T_2$	29	758	855.5	0.13
Change in Little's index with the removable retainer from $T_1$ to $T_2$	29	953	855.5	0.13
Combined	58	1711	1711	

Little's index was less in the bonded retainer group, this was not statistically and probably not clinically significant. Further prospective research on this subject is required.

## CONCLUSIONS

- Relapse as measured by Little's index can occur in the lower labial segment with both bonded and modified Hawley retainers.
- There is no statistically significant difference in the relapse seen in the lower labial segment teeth with either bonded or modified Hawley removable appliances.

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