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The reliability of bonded lingual retainers

Robert Cerny

Specialist practice, Newcastle, New South Wales, Australia

Background: Bonded lingual retainers have become increasingly popular, but there is little information on their long-term reliability.

Objectives: The aims of this retrospective study were to investigate the reliability of bonded upper and lower lingual retainers and the factors contributing to their failure.

Methods: The study group were 149 patients who returned between 2002 and 2005 with failed upper and/or lower fixed lingual retainers. Approximately 230 patients were debonded each year and approximately 1150 patients were covered annually by a 5-year guarantee of replacement or repair of failed retainers. The retainers were made from 0.018 inch round stainless steel heat-treated orthodontic wire. The upper retainers had loops opposite the embrasures and the lower retainers had loops between the lateral incisors and canines. The following details were recorded: teeth involved, patient gender, the likely cause of any damage and the time taken for each repair.

Results: Between 35 and 40 patients required repair/replacement of their retainers each year. Multiple bond failures occurred in approximately 9 per cent of these patients. Male patients had twice the fracture rate of female patients. Extra-oral trauma was the most frequent cause of failure followed by intra-oral trauma, operator error and wire fracture. The central incisors in both arches were the most frequent sites of failure. Single tooth repairs required approximately 12 minutes of the orthodontist's chair-side time.

Conclusions: Bonded lingual retainers are a reliable form of retention after orthodontic treatment.

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Introduction

Two of the main objectives of orthodontic treatment are the correction of irregularity and malocclusion of the teeth. Following treatment, some conditions such as imbricated, rotated, spaced and flared teeth show a strong tendency to return to the original condition following removal of the appliances. This process is termed relapse or 'physiological recovery'.[1] Preventing relapse can be a long-term and difficult process because many orthodontic results are potentially unstable.[2–5] While the profession may acknowledge that some relapse is inevitable, patients are understandably disappointed if some of the original condition returns after treatment.[2] The desire to retain the results of treatment has lead to the development of long-term or so-called 'permanent' retainers, and procedures that appear to reduce the tendency of some conditions to relapse.[6–7] Fixed retainers are preferable to removable retainers because patients' compliance with wearing removable retainers is usually unreliable.[8]

Long-term retention is more commonly employed in the anterior region, and it is usually achieved by bonding a fine wire to the lingual/palatal surfaces of the anterior teeth. Bonded lingual or palatal retainers were promoted as 'invisible' retainers in the late 1970s.[9] They have steadily gained in popularity because they are effective at preventing relapse of the anterior teeth and patient involvement is minimal.[10] Because of the convenience of this form of retention, they are preferred by many patients and parents. However, there is little information on how reliable these retainers are and how effective they are at preventing relapse.[11] The aims of this retrospective study were to investigate the reliability of fixed lingual retainers made from looped round wires, and the factors that may have contributed to their failure.

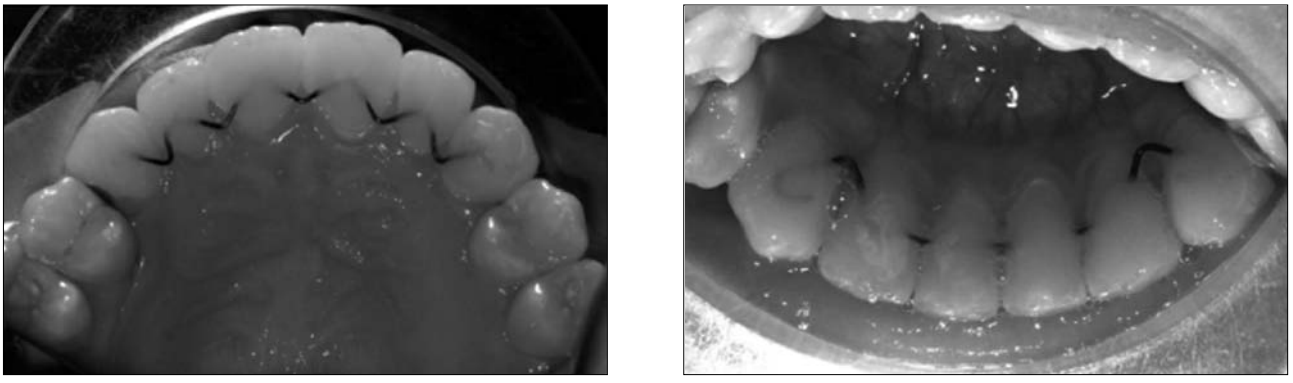

Figure 1. Lingual retainers bonded to the anterior teeth in the upper (left) and lower (right) arches.

Materials and methods

The subjects were 149 patients who returned with failed upper and/or lower fixed retainers over a four year period between 1 January 2002 and 31 December 2005. Of the 149 patients who returned for repairs and/or replacement of a retainer(s), 76 were male patients and 73 were female patients.

All patients were treated and reviewed by the same orthodontist working in the same specialist practice. At the conclusion of their active treatment with fixed appliances, all patients were fitted with fixed looped wire retainers bonded to the lingual surfaces of the upper and lower anterior teeth. Actual figures for the number of patients debonded were not available and have been conservatively estimated from the approximate number of patients debonded each working week. This estimate was based on the orthodontist working 46 weeks each year and debonding five patients, that is, 10 dental arches each week. The annual number of patients debonded was approximately 230. Since 1990 each patient has been given a written guarantee by the orthodontist that he would undertake replacement or repair without cost to the patient if a retainer was dislodged or fractured within five years of the initial fitting of the retainers. Patients also agreed to wear a mouthguard during contact sports, not to use their teeth 'recklessly' or inappropriately and to attend all orthodontic and dental appointments. In each year of the study 1150 patients were covered for repairs. Approximately twice as many female to male patients were treated in this practice. During the study no patient or parent requested the removal of a fixed retainer.

The designs of the retainers used in this study are shown in Figure 1. All retainers were made from 0.018 inch round single strand orthodontic wire (Regular Plus, AJ Wilcock, Whittlesea, Victoria, Australia) and bonded to the lingual or palatal surfaces of the anterior teeth with composite resin. A direct bonding technique was used in all cases. The same bonding primer (OrthoSolo universal bonding primer, SDS Ormco, Glendora, Calif., USA) and composite resin (Z100, 3M ESPE St. Paul, Minn., USA) were used on all patients. The upper retainers had loops opposite the embrasures to provide stress breaking and flexibility and to allow access to the interproximal areas for brushing, flossing and placement of dental restorations. All lower retainers had loops between the lateral incisors and canines for the same reasons. Loops were not placed between the lower incisors because they are uncomfortable in these sites and make tooth cleaning difficult. Wherever possible, the wire was covered by at least one millimetre of composite, as recommended by Bearn et al.[12]

The following data were recorded for the patients who attended for repairs/replacement of their retainers: personal details, the retainer (upper/lower) involved, teeth involved, nature of the damage (e.g. fractured composite, delamination, wire fracture), the gender of the patient, the likely cause of any damage, and the time taken for each repair.

Results

The results are given in Tables I–III. In the first year of the study 35 patients (21 male, 14 female) attended for repairs or replacement and 13 of these

Table I. The number of patients experiencing breakages.

Year		2002		2003		2004		2005		Mean	
		Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
		35	3.00	38	3.00	36	3.10	40	3.50	37	3.20
Repairs	Male	21	1.80	16	1.40	17	1.47	22	1.90	19	1.60
	Female	14	1.20	22	1.60	19	1.65	18	1.80	18	1.60
Total number of unit bond and wire breakages		52	0.38	50	0.36	56	0.40	53	0.38	53	0.38
Number of patients with multiple bond breakages		13	1.10	10	0.87	14	1.20	10	0.87	12	1.00
Multiple	Male	9	0.78	3	0.26	6	0.50	4	0.35	6	0.50
repairs	Female	4	0.35	7	0.00	8	0.70	6	0.52	6	0.50

Note. In each year 1150 patients were covered by the 5-year guarantee

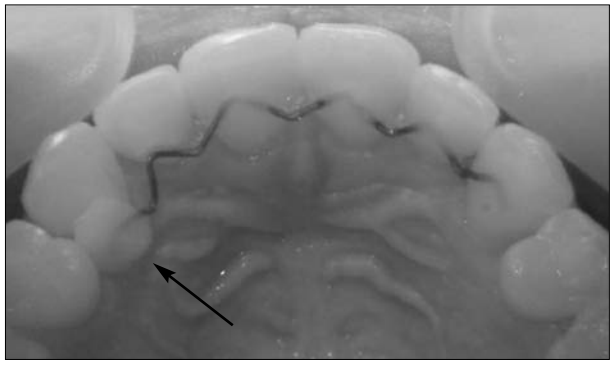

Figure 2. Failure due to fracture at the enamel – composite interface.

patients (9 males, 4 females) attended more than once for repair/replacement of a retainer. The total number of bonds and/or wire breakages in 2002 was 52. The figures in the following years were remarkably similar with small fluctuations in the number of males and females and number of patients with multiple breakages (Table I). On average, seven retainers each year had fractured wires. As twice the number of females to males were treated each year male patients damaged/dislodged their fixed retainers twice as often as female patients.

Over the four year period covered by the study the fracture/dislodgments were attributed to extra-oral trauma (43 per cent), intra-oral trauma (26 per cent), operator error (18 per cent) and wire fracture (13 per cent). A blow to the face playing sport, as a result of fighting or an accident was considered extra-oral trauma. Intra-oral trauma was loss or failure of a retainer during biting or using the teeth for a task other than eating or speaking (Table II). Bond failure at the composite – enamel interface was considered to be due to contamination during bonding and has been called operator error (Figure 2).

The most common sites of fracture were the lower central incisors (29 per cent), upper central incisors (26 per cent) and upper lateral incisors (21 per cent) (Table III). Repairs to upper retainers were twice as common as repairs to lower retainers. The average clinical time taken to repair a single unit bond failure was 12 minutes.

The retainers were effective at maintaining anterior alignment providing they remained attached. When breakages occurred, it was not uncommon to see displacement of the tooth detached from the retainer within a few days. Patients without exception remarked that their retainers were comfortable within one to two weeks of placement, and were rarely

Table II. The causes of failure and/or breakage.

Cause of fracture(s)	2002		2003		2004		2005		Mean	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
a. Trauma – extra-oral	33	63	20	40	14	25	23	43	23	43
b. Trauma – intra-oral	9	17	18	37	18	32	11	20	14	26
c. Operator fitting	9	18	8	16	11	20	9	18	9	18
d. Wire fracture	1	2	4	7	13	23	10	20	7	13
Totals	52	100	50	100	56	100	53	100	53	100

Table III. The sites of failure and/or fracture.

		2002		2003		2004		2005		Mean	
		Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Maxillary anterior teeth	1	7	13	18	36	13	23	12	23	14	26
	2	15	28	9	18	15	26	8	14	11	21
	3	6	12	7	14	10	18	6	12	8	14
Mandibular anterior teeth	1	18	35	10	20	13	23	21	39	15	29
	2	2	4	2	4	1	2	4	8	2	4
	3	4	8	4	8	4	7	2	4	3	6

Note. In each year 1150 patients were covered by the 5-year guarantee

difficult to clean. Over the period covered by this study there were no cases of caries or periodontal disease due to the presence of the retainers. In some patients, there was a noticeable increase in supragingival calculus around lower retainers.

Discussion

In this study, the reliability of fixed lingual retainers made from looped round wires and the factors that contributed to their failure were investigated. Out of an annual total of approximately 1150 patients with 2300 upper and lower retainers covered by a guarantee, approximately 40 patients returned annually for repairs or replacements to one or both retainers. Of these patients 9 per cent returned for repairs on more than one occasion each year. As twice the number of female patients to male patients were treated male patients had twice the fracture rate of the female patients. Extra-oral trauma was the most common reason for failure, and failures most frequently occurred at the central incisor regions in both dental arches.

The number of patients who required repairs was static each year and kept pace with the running sum of retainers in place and under guarantee. In each year of the study less than 4 per cent of the 1150 patients covered by the guarantee returned for repair or replacement of a retainer(s). This group of patients had a combined total of 13800 unit bonds (1150 patients x 2 fixed retainers each x 6 unit bonds per retainer) in place. The number of unit bonds that needed to be repaired each year over the first 5 years after their placement was 0.43 per cent of all unit bonds involved.

This finding compares well with other dental treatments involving restorative materials and appliances. Hickel and Manhart[13] found dental restorations in posterior teeth had an annual failure rate of up to 7 per cent for amalgams, 9 per cent for direct composites, 11.8 per cent for composite inlays and 5.9 per

cent for cast gold inlays and onlays. A 1990 study of survival rates of implants by Adell et al. reported a failure rate of approximately 5.5 per cent over 5 years and 10.2 per cent over 10 years.[14] Bonded brackets had a failure rate of around 5 per cent per annum between 1986 and 2002.[15]

The 0.018 inch round stainless steel Regular Plus wire used in the retainers was adapted to the anterior teeth and interproximal loops were used in the upper arch in between the lower lateral incisors and canines. Of the approximately 460 retainers placed each year the wire frames in seven retainers fractured giving an annual wire fracture rate of less than 2 per cent. Dahl and Zachrisson who used five-strand 0.0215 inch Twistiflex wire reported an annual failure rate of 1.1 per cent in their study of 2.5 years.[16] Rogers and Andrews, who used round 0.025 inch stainless steel wire bonded to the lower canines only, had an annual bond fracture rate of 0.014 per cent per annum over three years.[17] As more than 30 per cent of the wire fractures and/or bond failures occurred in the lower incisor region in the present study, the reliability of the lower retainers would have been improved markedly if the lower incisors had not been bonded. However, if these teeth are not bonded any relapse is visible and distressing to the patient. Rose et al. who used polyethylene ribbon-reinforced resin composite fixed retainers had a failure rate of 50 per cent over 24 months.[18]

The 3M–Z100 Universal Composite paste was chosen because it is claimed to have favourable strength, attrition resistance, durable smoothness, ease of handling and universal colour matching.[19] Wherever possible, the wire was covered by at least one millimetre of composite for optimum strength and patient comfort as recommended by Bearn et al.[12] In the present study, the fracture rate of this material was 0.26 per cent per annum. The composite and bonding agent combine to produce a fracture rate of 46 per annum from 13800 unit bonds which is 0.33 per cent per annum over the first five years of fitting the fixed lingual retainers. The fixed lingual retainers in the present study were effective at maintaining the alignment of the teeth they were attached to. When a wire fractured or a bond failed the patients usually became aware of this by movement of the teeth involved. Repairs of fractures were generally straight-forward and required, on average, 12 minutes per tooth bonded. This amounted to 15 minutes each week of the orthodontist's clinical time.

Conclusions

1. Bonded lingual retainers are a reliable form of retention after orthodontic treatment.

2. Male patients were more likely to have breakages than female patients.

3. Measures to protect the teeth from trauma, both extra-oral and intra-oral, may prevent some retainers from becoming dislodged or fractured.

4. Fewer breakages may be experienced if the incisors are not bonded, but it is not always possible to omit the incisors from the retainer.

5. Repairs to fractured retainers required approximately 15 minutes of chairside time per week.

Corresponding author

Dr Robert Cerny
1st Floor
139 Scott Street
Newcastle NSW 2300
Australia
Tel: (+61 2) 4929 5885
Fax: (+61 2) 4926 4221
Email: rcerny@bigpond.net.au

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