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A comprehensive survey of retention procedures in Australia and New Zealand

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Objectives: This survey aimed to identify consistencies in retention procedures.
Methods: Three hundred Australian orthodontists and 70 New Zealand orthodontists were randomly selected for the study. A questionnaire gathered their views regarding the most commonly used retainers, wire types and sizes of bonded retainers, factors influencing the design of retainers, duration of regular retention, definition of permanent retention, percentage of cases that needed permanent retention, factors influencing the decision to use permanent retention, changes in retention protocols over the last five years, and reasons for such changes.
Results: Upper invisible and lower canine-to-canine bonded retainers were the most commonly used retainers. Pretreatment tooth position was the major factor influencing the design of retainers, and most respondents preferred bonded retainers. The majority preferred multistrand stainless steel wire for bonded retainers. The most common wire size was 0.0175 inch. Orthodontists more commonly recommended a regular retention period of more than two years, and defined permanent retention as "life-time". Orthodontists applied permanent retention to either a very high or very low percentage of their cases. A high percentage of respondents made changes to their retention protocols over the past five years. There was no relationship between factors influencing the design of retainers and the preferred type of retainer. There was no consensus on the major factor influencing the decision to use permanent retention.
Conclusions: Retention procedures are variable and dependent largely on personal preferences. There does not seem to be any consistent pattern in the application of retention methodologies.
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Introduction

At completion of active treatment, a phase of retention is used to combat the inherent tendency of teeth to return to their original positions. This phase is one of the most difficult challenges facing orthodontists. Numerous factors affecting post-treatment stability have been reported including alteration of arch-form,[1,2] stretching of gingival tissues in rotational relapse,[3–5] influence of neuromusculature[6] and post-treatment growth changes.[7,8]

Scant attention has been paid in the literature to the methods and duration of retention. A few controlled clinical studies have investigated the failure rates of bonded retainers, the tendency of these retainers to accumulate plaque and calculus, and the development of enamel demineralisation and periodontal disease with bonded retainers.[9–19] A wide range of failure rates of bonded retainers has been reported, ranging from 4.3 per cent to 53 per cent.[9,10,13–19] Zachrisson[9] reported that despite optimal oral hygiene instructions, calculus formed to a greater extent on the lingual surfaces of the lower incisors with bonded retainers, compared with incisors without retainers, over a mean observation period of 15.7 months. Dahl and Zachrisson[15] also found more plaque and calculus around mandibular retainers compared with maxillary retainers over a five year period. On the other hand, Artun[11] and Artun *et al.*[12,17] did not find that bonded retainers made of multistrand wire accumulated more plaque and calculus than those made of plain wire. Axelsson and Zachrisson[16] reported that two of the 14 patients who had long span (three or four units) bonded labial retainers showed surface demineralisation 2.3 years after placement of the retainers. Others have reported no evidence of increased enamel demineralisation or periodontal disease due to bonded retainers.[9–12,15–18,23,24]

The methods of retention adopted by orthodontists in the United States were surveyed in 1986, 1990 and 1996.[20–22] Over this period Hawley retainers remained the most popular type despite a continuing decline in routine use. Spring retainers and invisible retainers were used more routinely in 1996 than in the earlier surveys. Use of fixed banded retainers continued to fall, but the use of fixed bonded canine-to-canine retainers continued to rise. In the 1990 study, about half of the orthodontists used a specific retention period, with a median of 24 months. Over this 10 year period the proportion of orthodontists using "lifetime" retention increased while the percentage of orthodontists using an indefinite retention period decreased.

The aim of this study was to identify consistency in retention procedures in Australia and New Zealand in order to provide guidelines and reference information for orthodontists.

Materials and methods

A survey questionnaire was sent to selected orthodontists in Australia and New Zealand. Full lists of names and addresses of orthodontists practicing in the above countries were obtained from the Australian Society of Orthodontists Inc. directory and the New Zealand Dental Council. Three hundred Australian orthodontists and 70 New Zealand orthodontists were randomly selected from these lists.

The survey form was formulated after undertaking a pilot study. The form included images of all commonly used retainer types to avoid errors of interpretation or definition. Adequate space was also provided for additions or further comment. The information provided in the returned questionnaire was statistically analysed with cross-tabulation and Chi-square analysis. The following features were investigated:

The most commonly used types of upper and lower retainers.

Factors influencing the design of the retainers, and orthodontists' preferred type of retainer.

Types and sizes of wire commonly used in bonded retainers.

Duration of regular retention, and definition of permanent retention.

Percentage of cases requiring permanent retention.

Factors influencing the decision to use permanent retention.

Changes in retention protocols over the past five years, and reasons for such changes.

Comparison of differences between Australian and New Zealand respondents.

For the purpose of testing for differences between Australian and New Zealand orthodontists in the use of various retainer designs, five popular retainer types were selected. The remaining respondents, not counted as users of any of these selected types, were grouped as users under the category, "Others". A two-way cross-tabulation table was then formulated for Chi-square test purposes.

For the purpose of testing for differences between Australian and New Zealand orthodontists in the percentages using permanent retention, respondents were grouped into two groups. The first group, "More frequently using permanent retention", included those who claimed that 70 per cent or more of cases required permanent retention, and the second group, "Less frequently using permanent retention", included the remaining orthodontists. A two-way cross-tabulation table was then formulated for Chi-square test purposes.

Results

A total of 47 completed questionnaires was received from the 70 New Zealand orthodontists, representing a response rate of 67 per cent. One hundred and seventy responses were received from 300 Australian orthodontists, representing a response rate of 57 per cent. The overall response rate was 59 per cent.

The overall average percentage use of upper invisible retainers was 31.4 per cent, being the highest compared with other types, and that of upper banded retainers was 0.2 per cent, being the lowest (Table I). Australian and New Zealand orthodontists were significantly different in the use of five selected popular types of upper retainer ($p < 0.05$). The main cause of the statistical difference was that New Zealand orthodontists used "Wraparound I" (with adjustment U-loop in the canine or premolar area) in approximately 16 per cent of their cases, this being two times higher than that of Australian orthodontists. Despite the above difference, both Australian and New Zealand orthodontists most frequently used upper invisible retainers (32.8 per cent and 25.9 per cent respectively).

Table I. Average percentage use - upper retainers.

	Average per cent		
Type	Total	Australia	NZ
Hawley I #	20.22	21.79	14.11
Hawley II #	7.71	6.64	11.83
Hawley III	2.09	2.54	0.33
Wraparound I #	9.05	7.26	15.92
Wraparound II	3.10	2.63	4.90
Wraparound III	1.56	1.97	0.00
Invisible #	**31.35**	**32.75**	**25.91**
Other removable	7.80	8.49	5.15
Bonded 11-21	3.24	2.27	7.01
Bonded Padded 11-21	0.92	1.13	0.07
Bonded 12-22 #	5.21	3.64	11.27
Bonded 13-23	3.48	3.74	2.47
Bonded 13-23(Loop)	1.07	1.17	0.66
Other bonded	0.56	0.68	0.10
Banded 14-24	0.01	0.00	0.04
Banded 16-26	0.11	0.11	0.11
Other banded	0.01	0.02	0.00
Combined *	2.53	3.16	0.11

* Combined type - both removable and fixed types of retainers are used.
# Selected for Chi-square analysis of average percentage use.
Average percentage use of a retainer is defined as the average of percentages of cases using the specific retainer type reported by orthodontists.

Hawley I	Hawley upper with Adams clasps on first molar
Hawley II	Hawley upper with labial bow soldered to Adams clasps
Hawley III	Hawley upper with acrylic added to labial bow
Wraparound I	Wraparound upper with U-loop in canine or premolar area
Wraparound II	Wraparound upper with U-loop in molar area
Wraparound III	Wraparound upper without adjustment U-loop

Table II. Average percentage use - lower retainers.

	Average per cent		
Type	Total	Australia	NZ
Hawley	3.11	3.84	0.28
Wraparound I	0.77	0.85	0.49
Wraparound II	2.65	3.34	0.00
Spring retainer I #	8.11	7.97	8.63
Spring retainer II	3.18	3.77	0.93
Invisible #	22.34	**25.12**	11.56
Other removable #	10.36	11.75	5.01
Bonded 33–43 (bonded to 3's) #	**24.64**	16.80	**54.77**
Bonded 33-43 (bonded to 6 teeth) #	13.34	13.75	11.76
Other bonded	4.58	4.22	6.02
Banded 34-44	3.06	3.72	0.53
Banded 36-46	1.27	1.59	0.02
Combined *	2.59	3.27	0.00

* Combined type - both removable and fixed types of retainers are used.
# Selected for Chi-square analysis of average percentage use.
Average percentage use of a retainer is defined as the average of percentages of cases using the specific retainer type reported by orthodontists.

Hawley	Hawley lower with labial bow and rests on molars
Wraparound I lower	Wraparound lower with labial bow soldered to Adams cribs
Wraparound II lower	Wraparound lower with acrylic added to labial wire
Spring retainer I	Spring retainer
Spring retainer II	Spring retainer with acrylic flanges extending lingually to the 1st molars
Bonded 33-43(3's)	Bonded 33-43 lower (bonded to 3's only)
Bonded 33-43(6)	Bonded 33-43 lower (bonded all 6 teeth)

The overall average percentage use of the more commonly used lower canine-to-canine bonded retainer (bonded to canines only) was 24.6 per cent. Lower invisible retainers were also popular, with the overall average percentage use being 22.3 per cent, the second highest (Table II). The overall average percentage use of a combination of lower removable and fixed retainers was minimal (2.6 per cent). Australian orthodontists more commonly used lower invisible retainers (25.1 per cent) and New Zealand respondents commonly used lower canine-to-canine bonded retainers (54.8 per cent). Australian and New Zealand orthodontists were statistically significantly different in use of five selected popular types of lower retainer ($p < 0.05$). The main cause of the statistical difference was that New Zealand orthodontists used

Table III. Duration of regular retention.

	Total		Australia		NZ	
Duration	N	Per cent	N	Per cent	N	Per cent
6-12 months	19	8.8	16	9.4	3	6.4
1-2 years	38	17.6	25	14.8	13	27.6
2 years/more*	71	32.9	63	37.3	8	17.0
Lifetime	46	21.3	40	23.7	6	12.8
Other	42	19.4	25	14.8	17	36.2
Total	216	100.0	169	100.0	47	100.0

* "2 years/more" refers to more than 2 years, but shorter than lifetime.

Table IV. Definition of permanent retention.

	Number of orthodontists					
	Total		Australia		NZ	
Definition of permanent retention	N	Per cent	N	Per cent	N	Per cent
More than 5 years	50	23.6	43	26.1	7	14.9
Lifetime	**148**	**69.8**	**109**	**66.0**	**39**	**83.0**
Others	14	6.6	13	7.9	1	2.1
Total	212	100.0	165	100.0	47	100.0

lower bonded canine-to-canine retainers (bonded to canines only) in over 50 per cent of their cases. This was in contrast to Australian respondents who used this type in less than 17 per cent of cases.

Most orthodontists considered pretreatment tooth position in combination with age and/or presence of third molars as the influencing factor(s) when designing retainers. The presence of third molars was the least frequently cited factor. There was no significant relationship between the factors influencing the design of retainers and the preferred retainers ($p > 0.05$).

The majority of orthodontists more commonly used multistrand stainless steel wire (51.3 per cent) in their bonded retainers. Single strand stainless steel wire was their second preference. Orthodontists gave diverse responses regarding wire sizes for such retainers while some did not specify the sizes in their returns. Of those who did respond 0.0175 inch multistrand wire was the most widely used.

Most orthodontists recommended a regular retention period of more than two years (Table III). However, some cited their own regular retention periods that were not detailed in the questionnaire, and these were grouped under the category of "Other" for the purpose of analysis. Most Australian orthodontists recommended a regular retention period of more than two years. New Zealand orthodontists were diverse in their views and many preferred other durations of regular retention (not detailed in the questionnaire). Among these "Other" durations, Australian orthodontists more commonly recommended full-time retention followed by part-time retention. New Zealand orthodontists more commonly recommended a specific retention period for upper retainers. Australian and New Zealand orthodontists were significantly different in the durations of regular retention ($p < 0.05$). There were also significant differences between the two countries in the "Other" retention periods ($p < 0.05$). None of the New Zealand respondents chose full-time retention followed by part-time retention for lower retainers. This was in contrast with some respondents from Australia who recommended full-time retention followed by part-time retention for both upper and lower retainers.

The majority of orthodontists surveyed defined permanent retention as lifetime retention (69.8 per cent). Australian and New Zealand orthodontists showed similar patterns and there was no significant difference between them (Table IV). Orthodontists tended to use permanent retention in either a very high percentage (90–100 per cent) or a very low percentage (less than 10 per cent) of cases indicating a significant difference in their views of the benefits of permanent retention (Table V).

Most orthodontists who used permanent retention cited potential relapse of individual teeth as the major factor influencing their decisions. However, other reasons were also specified by some, such as clinical experience and patient consideration. There was no consistency amongst the 93 orthodontists listed under "Others" (Table VI).

Of the 217 respondents 120 (55.3 per cent) stated that they had made changes in their retention protocols over the past five years (Table VII). The majority

Table V. Percentage of cases using permanent retention.

	Number of orthodontists					
	Total		Australia		NZ	
Per cent of cases	N	Per cent	N	Per cent	N	Per cent
0–10	**79**	**36.6**	**66**	**39.3**	**13**	**27.1**
10–20	30	13.9	20	11.9	10	20.7
20–30	19	8.8	15	8.9	4	8.3
30–40	5	2.3	5	2.9	0	0.0
40–50	3	1.4	2	1.2	1	2.1
50–60	6	2.8	4	2.4	2	4.2
60–70	5	2.3	3	1.8	2	4.2
70–80	5	2.3	3	1.8	2	4.2
80–90	3	1.4	2	1.2	1	2.1
90–100	**61**	**28.2**	**48**	**28.6**	**13**	**27.1**
Total	216	100.0	168	100.0	48	100.0

Table VI. Factors influencing the decision to use permanent retention.

	Number of orthodontists		
Factor	Total	Australia	NZ
Age	9	9	0
Prone to relapse	86	66	20
Non-extraction	11	9	2
Others	**93**	**68**	**25**

Note: The "Others" group included those not specified in the questionnaire, and also combinations of those specified factors and non-specified factors.

cited "Post-treatment stability" (43.3 per cent) as the major reason for changing their retention protocol (Table VIII). While there was no significant difference between the two countries in their changes in retention protocol, they differed in their reasons for changes. Most Australian orthodontists considered post-treatment stability as the major reason for change while New Zealand orthodontists gave diverse reasons for changing.

Discussion

The overall response rate was reasonable at 59 per cent. We found that orthodontists practising in Australia and New Zealand more commonly used

Table VII. Number of orthodontists making changes in retention protocol over the past five years.

	Number of orthodontists		
Change in retention protocol	Total	Australia	NZ
Type of retainer	**67**	**51**	**16**
Period of retention	32	22	10
Design of retainer	8	5	3
Stripping and other procedures	13	11	2

Table VIII. Reasons for making changes in retention protocol over the past five years.

	Number of orthodontists		
Reason for change	Total	Australia	NZ
Post-treatment stability	**52**	**50**	8
Compliance and/or comfort	28	33	**11**
Literature reports	18	31	5
Miscellaneous	22	28	10

upper invisible retainers and lower canine-to-canine bonded retainers, and the second most popular lower retainer was the invisible retainer. In contrast, Gottlieb *et al.*[22] reported that the Hawley retainer was the most commonly used retainer up to 1996 (they did not classify these as upper and/or lower retainers). This could be because Hawley retainers have been with the profession since 1919,[25] while Sheridan and coworkers[26] introduced invisible retainers in 1993. Hawley retainers also have some advantages over invisible retainers. Adjustment of the labial bow of a Hawley retainer can provide minor tooth movement – for example, minor rotation or closure of small anterior spaces. The latter feature was particularly useful in the days when fully banded fixed appliances were used. Hawley retainers also allow more post-treatment occlusal settling than invisible retainers. However, we found that orthodontists prefer to use invisible upper retainers over Hawley retainers. This could be due to the low manufacturing cost, ease of fabrication, less interference with speech when the

retainers are initially worn, and superior aesthetics of invisible retainers. The more commonly used lower bonded canine-to-canine retainer, identified in our survey, is in agreement with the findings of Gottlieb and coworkers. The reasons given for favouring lower canine-to-canine bonded retainers included: patients' preference, aesthetics, comfort and elimination of compliance problems. It is also easier to leave bonded retainers *in situ* to prevent late mandibular incisor crowding and/or until wisdom teeth concerns are resolved.

However, bonded canine-to-canine retainers are rarely used in the upper arch despite their advantages over removable retainers (for example, aesthetics, comfort, and elimination of compliance problems). This is probably due to concern for higher breakage rates from masticatory forces. We found remarkably few upper banded retainers were used, which confirmed the findings of Gottlieb *et al.*[22] that the use of banded retainers continues to fall. The minimal use of banded retainers could be due to concerns over the effects of bands on the periodontal health and higher aesthetic expectations of patients.

There was a statistically significant difference between Australian and New Zealand orthodontists in the use of five selected popular types of upper and lower retainers. Since 66.0 per cent of New Zealand respondents and 21.8 per cent of Australian respondents were not trained in Australia, the difference between Australian and New Zealand orthodontists in the choice of upper and lower retainers could be a result of different retention philosophies taught in universities in Australia and other countries.

Previous research findings[10,27,28] suggested the selection of the type of retainer depends on different factors. Proffit[27] suggested the retainer type depends on anteroposterior (Class II) and vertical (deep bite or anterior open bite) discrepancies of the malocclusion. Both Lee[10] and Zachrisson[28] recommended the use of bonded retainers, though they differed in the specific design of the retainers. They did not share the same view with regard to the major factors influencing the selection of the type of retainer. Lee considered the alteration of the anteroposterior or lateral position of the lower labial segment during treatment as an indication for the need for lower bonded retainers whereas Zachrisson claimed bonded retainers were preferable when individual tooth movements were prone to relapse. In a sense, their findings were inconsistent, implying a lack of relationship between factors determining the design of retainers and the preferred type of retainer. This study again showed no direct relationship between a single factor and a preferred retainer. This was because several factors were equally important in the selection of retainers. However, our results did show that there was consensus among the respondents from both countries on the major factor influencing the selection of retainers, that is, pretreatment tooth position. This agrees with Zachrisson's findings. Most respondents also preferred the use of bonded retainers, which is in agreement with Lee and Zachrisson. It appears most orthodontists regard bonded retainers as an effective means of achieving retention.

This survey found that the majority of orthodontists used multistrand stainless steel wire in bonded retainers. This is in agreement with previous research findings.[9,28] The popularity of multistrand wire was probably due to the perception of increased mechanical retention to the composite and the flexibility of the wire allowing physiologic tooth movement even when several adjacent teeth are bonded.[28] Furthermore, it is less costly than low modulus wires such as nickel titanium or beta titanium alloy. A variety of wire sizes was used in bonded retainers. Unfortunately, in this survey, some respondents did not specify their wire size of choice. Therefore, it was difficult to determine if there was any consistency among the orthodontists surveyed regarding the use of wire sizes. However, on the basis of the available information, 0.0175 inch wire was more commonly used than others.

Our results revealed that most orthodontists preferred a regular retention period of more than two years. This disagrees with Gottlieb *et al.*,[22] who reported that about half of the surveyed orthodontists used a specific retention period, with a median of two years. The longer regular retention period might be an indicator of increasing relapse problems or patients becoming more intolerant of minor relapses. However, this needs further investigation. There was a statistically significant difference between Australian and New Zealand orthodontists in the recommendation of regular retention periods. Most Australian orthodontists recommended a regular retention period of more than two years, while New Zealand orthodontists were diverse in their views and many used retention periods not listed in the

questionnaire. This difference could again be related to different training philosophies.

There seems to be an increasing trend to use permanent retention. This could be attributed to the increasing expectation of patients to have perfectly straight teeth. As suggested by Cerny[18] permanent retention with bonded retainers is an effective and attractive method of preventing relapse. It does not cause increased risk of enamel demineralization or periodontal disease, and is well tolerated by patients. Possibly due to the increasing expectations of patients to have perfectly straight teeth, the majority of orthodontists surveyed defined permanent retention as lifetime retention. Australian and New Zealand orthodontists showed similar patterns, and there was no significant difference between them. Orthodontists tended to use permanent retention in either a very high percentage or a very low percentage of cases. Most orthodontists who used permanent retention cited potential relapse of individual teeth as the major factor influencing their decisions. However, other reasons were also specified by some, such as clinical experience and patient consideration. There was no consensus on the major factor influencing the decision to use permanent retention.

Gottlieb *et al.*[22] reported that from 1986 to 1996, there was a change in the routine use of different types of retainers. Our survey result confirms these earlier findings. Overall, the majority of respondents had changed their preferred types of retainer over the past five years (1998 to 2002). The second most common change was the period of retention. These changes might be the result of orthodontists' concerns over post-treatment stability, arch expansion, compliance and satisfaction.

Since there is increasing use of bonded retainers and an increasing trend to use permanent retention, further research might address these two topics. With regard to bonded retainers, upper and lower retainers should be investigated separately. Design of bonded retainers, the wire type, and the wire size used are relevant. Reasons for using permanent retention should also be explored in more detail.

Conclusions

In general, orthodontists more commonly used upper invisible retainers and lower canine-to-canine bonded retainers. Invisible lower retainers were also a popular choice. The use of banded upper retainers was minimal.

Most orthodontists preferred multistrand wire for bonded retainers. The next most popular wire type was plain stainless steel. Although more orthodontists preferred 0.0175 inch, there was no consensus among orthodontists on preferred wire size.

There was consensus among orthodontists that pretreatment tooth position was the major factor influencing the design of retainers. There was no statistically significant relationship between the design factor and the preferred retainer.

Orthodontists more commonly recommended a regular retention period of more than two years. However, there was no consensus between Australian and New Zealand orthodontists on this issue.

Most orthodontists defined permanent retention as "lifetime" retention. Most orthodontists applied permanent retention to either a very high or a very low percentage of their cases. There was no consensus on the major factor influencing the decision to use permanent retention.

Many orthodontists had changed their preferred type of retainers over the past five years. The common reasons for change were post-treatment stability, compliance and comfort. However, there was no consensus among orthodontists on the main reason for change.

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A copy of the survey form may be obtained from the corresponding author.

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