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Research Article

# Orthodontic retention procedures in New Zealand: A survey to benefit clinical practice guideline development

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ABSTRACT

*Background:* The aim of the current study was to survey contemporary retention procedures applied by orthodontists in New Zealand and to examine their acquaintance with unintentionally active retainers.
*Methods:* A questionnaire was sent to 92 orthodontists involved in patient treatment in New Zealand. The questionnaire consisted of questions on orthodontic retention procedures, wire material for bonded retainers, and those related to unintentionally active retainers. Statistical analyses were performed using the Statistical Package for Social Sciences (version 22.0; IBM, Armonk, NY). Tests for the relationship between two items were based on the $\chi^2$ test.
*Results:* The response rate was 88%. The most often-applied retention modality was a solitary removable retainer in the upper arch combined with a solitary bonded retainer in the lower arch. The combination of dual retention in the upper arch with a solitary bonded retainer in the lower arch was also applied frequently. Ninety percent of the orthodontists preferred permanent (life-time) retention with bonded retainers. Acquaintance of unintentionally active retainers varied. One in 8 was not familiar with this phenomenon and 1 in 5 had never observed any.
*Conclusions:* A trend toward more dual retention instead of solitary removable or solitary fixed retention, more vacuum-formed retainers instead of Hawley-type retainers and more life-long retention instead of retention for a definite period of time has been demonstrated. For all dental professionals in New Zealand and worldwide, it is necessary to be familiar with unintentionally active retainers and be able to identify them. This can prevent the worsening of inadvertent tooth movements.


## 1. Introduction

The importance of orthodontic retention was already recognized in 1860, when Angell [1] stated that retention is indispensable to stabilize the result of orthodontic treatment. Nevertheless, in 1944 Graham described retention as being the stepchild of orthodontics [2]. Meanwhile, it is known that retention is not only needed to prevent relapse as a direct result of orthodontic treatment, but also to avoid the onset of posttreatment changes caused by normal age changes [3,4]. Today, before the start of their orthodontic treatment, patients are well informed regarding the need for retention and know, at best, what their responsibilities are [5].

Starting with the reports of Gottlieb et al. [6–8] in the 1980s, and followed by several other reports [9–20], it can be stated that interest in orthodontic retention procedures has increased. These procedures appear to differ from country to country and from continent to continent. Wong and Freer [9] concluded that there does not seem to be any consistent pattern in the application of retention procedures. However, a trend toward more fixed instead of removable retention, more invisible instead of Hawley retainers, and more life-long retention instead of retention for a definite period of time has recently been demonstrated in the Netherlands [20].

Recently, several reports regarding complications after long-term use of bonded retainers have been published [21–28]. In severe situations, an “unintentionally active retainer” can almost completely move the roots of teeth out of the alveolar process [20]. Wong and Freer [9] determined accurately the retention procedures

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of orthodontists in Australia and New Zealand. Questions regarding wire material used for bonded retainers and unintentionally active retainers were not included. This is an important issue, because specific wire materials are partially responsible for posttreatment complications [26]. Therefore, the aims of the present investigation were to survey contemporary retention procedures applied by orthodontists in New Zealand and to examine their acquaintance with unintentionally active retainers.

## 2. Material and methods

This study was approved by the Department of Oral Sciences, Sir John Walsh Research Institute, Faculty of Dentistry, University of Otago, Dunedin, New Zealand (reference code D16/083).

The questionnaire designed by Padmos et al. [20] and used in the Netherlands in 2015, was translated into English by Padmos. Full lists of names and addresses of orthodontists registered in the New Zealand register of specialists in orthodontics were obtained from the New Zealand Association of Orthodontists. In April 2016, the questionnaire was sent to all orthodontists involved in patient treatment in New Zealand. One month later, a reminder was sent to the nonresponding orthodontists. If requested, another copy of the questionnaire was sent. Those who still did not reply after 2 months were contacted again by phone or e-mail. In case the questionnaire was not fully completed, the orthodontist, dental laboratory, or distributor of wire material was contacted. In June 2016, the survey was completed and the data were entered into a Filemaker database.

The questionnaire consisted of four parts, mainly containing multiple-choice questions. Part 1 addressed background information on the individual orthodontist. Part 2 consisted of questions on the use of different retainer types, duration of retention with removable and bonded retainers, and number of retention checkups. In part 3, information regarding wire material and wire dimension for bonded retainers was assessed, and finally in part 4, questions were related to unintentionally active retainers. Respondents could give comments and add additional information at the end of the survey.

### 2.1. Statistical analyses

All statistical analyses were performed using the Statistical Package for Social Sciences (version 22.0; IBM, Armonk, NY). Background information on each orthodontist was described in frequencies and percentages, with the other results in percentages. Chi-square tests were used for 2-by-2 cross tables; when necessary, the Fisher exact test was applied.

## 3. Results

### 3.1. General

Questionnaires were sent to 92 orthodontists, of whom finally 81 responded. Because none of the received questionnaires had to be excluded, the response rate was 88.4%. Most orthodontists completed their specialty training in Dunedin, New Zealand (60.5%), and 39.5% were trained abroad: nine in Australia, five in the United Kingdom, three in India, two in South Africa, four in Germany, six in the United States, one in Italy, and two in the Netherlands.

Table 1 gives an overview of sample size, age, professional experience, days per week involved in patient treatment, and professional setting. Mean days of patient treatment for the whole sample was 3.71 (SD 1.13, 1.0–4.5). The male-female ratio for working as a solo practice owner was 16:9, and the male-female ratio for all participants was approximately 12:9. No significant differences in distribution of professional setting were found between genders.

**Table 1**
Overview of sample size, age, experience as an orthodontist in years, days per week involved in patient treatment, and professional setting of the orthodontists by gender

| Study sample N = 81 | Male n = 46 (56.8%) | | | | Female n = 35 (43.2%) | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean | SD | Min | Max | Mean | SD | Min | Max |
| Age (years)[a] | 53.3 | 11.9 | 31.3 | 75.5 | 45.4 | 10.8 | 30.9 | 68.1 |
| Experience (years)[a] | 21.9 | 12.2 | 1.0 | 47.0 | 15.8 | 12.0 | 1.0 | 47.0 |
| Patient Tx (days per week)[a] | 4.1 | 1.2 | 1.0 | 5.5 | 3.3 | 0.9 | 1.5 | 5.0 |
| **Professional setting** | **Male n (%)** | | | | **Female n (%)** | | | |
| Private practice | | | | | | | | |
| Solo owner[b] | 23 (50.0) | | | | 13 (37.1) | | | |
| Co-op full owner[b] | 7 (15.2) | | | | 6 (17.1) | | | |
| Co-op partial owner[b] | 8 (17.4) | | | | 7 (20.0) | | | |
| Associated[b] | 6 (13.0) | | | | 6 (17.1) | | | |
| Staff member[b] | 3 (6.5) | | | | 2 (5.7) | | | |
| Locum[b] | 3 (6.5) | | | | 2 (5.7) | | | |
| Academic[b] | 3 (6.5) | | | | 4 (11.4) | | | |
| Hospital | 2 (4.3) | | | | 1 (2.9) | | | |
| North Island | 31 (67.4) | | | | 24 (68.6) | | | |
| South Island | 15 (32.6) | | | | 11 (31.4) | | | |

[a] Mean, SD, minimum, and maximum.
[b] Total number is higher because of combinations.

Male orthodontists were significantly older (7.93 years, $P = 0.003$), had significantly more experience (6.19 years, $P = 0.026$) and spent significantly more days per week in patient treatment (0.80 days, $P = 0.001$). Orthodontists working as a locum had less experience than the other orthodontists (7.75 years); this difference was not statistically significant. The most often combined professional setting was working in private practice and at the university (n = 4; 4.9%). The ratio for working on the North and South Island was approximately 2:1, whereas the ratio for inhabitants of the North and South Island was 3:1 [29].

### 3.2. Choice of retention modality

In the upper arch, solitary removable retainers were used most often (48.4%) (Table 2). The second most often-applied retention modality in the upper arch was the combination of removable and bonded retainers (45.5%). In the lower arch, mainly bonded retainers without removable retainers were applied (61.7%). Twenty-four orthodontists (29.6%) indicated using nothing but bonded retainers in the lower arch.

**Table 2**
Average percentages of different retention modalities used in general

| Retention modality | Upper arch | | | Lower arch | | |
|---|---|---|---|---|---|---|
| | Mean % | SD | n (%) | Mean % | SD | n (%) |
| Hawley-type retainer | 21.4 | 33.4 | 39 (48.1) | 3.1 | 12.2 | 10 (12.3) |
| VFR | 28.6 | 32.3 | 57 (70.3) | 5.8 | 17.3 | 28 (34.6) |
| Bonded retainer $I_2$–$I_1$–$I_1$–$I_2$ | 1.2 | 4.3 | 10 (12.3) | - | - | - |
| Bonded retainer C–$I_2$–$I_1$–$I_1$–$I_2$–C | 0.4 | 2.1 | 4 (4.9) | 26.0 | 37.3 | 39 (48.1) |
| Bonded C–C (canines only) | - | - | - | 35.7 | 42.0 | 38 (46.9) |
| Hawley-type + bonded $I_2$–$I_1$–$I_1$–$I_2$ | 7.0 | 17.4 | 30 (37.0) | - | - | - |
| Hawley-type + bonded C–$I_2$–$I_1$–$I_1$–$I_2$–C | 0.8 | 4.7 | 5 (6.2) | 0.1 | 0.6 | 1 (1.2) |
| Hawley-type + bonded C–C (canines only) | - | - | - | - | - | - |
| VFR + bonded $I_2$–$I_1$–$I_1$–$I_2$ | 32.8 | 38.2 | 52 (64.2) | - | - | - |
| VFR + bonded C–$I_2$–$I_1$–$I_1$–$I_2$–C | 4.8 | 16.7 | 14 (17.3) | 12.0 | 30.2 | 22 (27.2) |
| VFR and bonded C–C (canines only) | - | - | - | 15.8 | 33.8 | 21 (25.9) |
| Other | 4.3 | 16.9 | 9 (11.1) | 1.5 | 10.2 | 5 (6.2) |
| Total | 100% | | | 100% | | |

$I_2$, Lateral incisor; $I_1$, central incisor; C, canine; VFR, vacuum formed retainer.

**Table 3**
Initial wearing time of removable retainers

| Initial wearing time per day | Duration initial phase of removable retention in years | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Upper arch (n = 81) | | | | Lower arch (n = 55) | | | |
| | N | Mean (SD) | Min | Max | N | Mean (SD) | Min | Max |
| Day and night | 43 | 0.56 (0.42) | 0.04 | 2.00 | 21 | 0.63 (0.45) | 0.13 | 2.00 |
| After school, evening and night | 3 | 0.29 (0.19) | 0.13 | 0.50 | 3 | 0.38 (0.22) | 0.13 | 0.50 |
| Evening and night | 9 | 1.06 (0.67) | 0.08 | 2.00 | 4 | 1.12 (0.63) | 0.50 | 2.00 |
| Night time only | 26 | 0.98 (0.37) | 0.08 | 2.00 | 27 | 1.03 (0.47) | 0.25 | 2.00 |

Mean, initial phase in years; n, orthodontists.

More than 20% of the orthodontists (n = 17) applied the combination of a solitary removable retainer in the upper arch with a solitary bonded retainer in the lower arch in 80% or more of their patients; a few of them (n = 2) did so in all of their patients. Eleven orthodontists (13.6%) combined a removable and bonded retainer in the upper arch with a bonded retainer in the lower arch in 80% or more of their patients; two of them did so in all of their patients. More than 11% of the orthodontists (n = 10) always applied bonded and removable retainers in both the upper and lower arch; another 5% (n = 4) did so in 90% to 99% of their patients. One orthodontist placed nothing but vacuum-formed retainers (VFRs) in the upper and lower arch. Some others (n = 2) did so in 80% to 95% of their patients. None of the orthodontists indicated using only bonded retainers in both arches.

In the upper arch, significantly more retainers were bonded only to the incisors (41.1%, SD 37.2%) instead of bonded to all upper anterior teeth (5.8%, SD 17.9%; $P < 0.001$). In the lower arch, more retainers were bonded only to the canines (51.5%, SD 44.2%) instead of bonded to all lower anterior teeth (38.1%, SD 42.5%); however, this difference was not statistically significant ($P = 0.153$).

Male orthodontists applied significantly fewer Hawley-type retentions than female orthodontists: 12.6% versus 30.7%, respectively ($P = 0.016$). Male orthodontists applied significantly more bonded C-C retention combined with VFR than female orthodontists: 23.8% versus 5.2%, respectively ($P = 0.007$). No correlations were found between retention modality and orthodontic experience and training location.

Respondents mentioned among “other” retention modalities: retainers only bonded to central incisors, retainers bonded from premolar to premolar, cuspid-and-cuspid retainers also bonded on one or two previously rotated incisor(s) and positioners.

Mentioned reasons for using removable retainers were retention of arch width, extraction sites, aligned crowding of posterior teeth, and for cases with persisting parafunctional habits. Mentioned reasons for using bonded retainers were pretreatment diastema in the anterior region and root resorption of anterior teeth.

### 3.3. Retention period

Prescribed initial duration of removable retention is presented in Table 3. Statistically significant positive correlations ($P < 0.001$) were found between the amount of daily wear and the duration of the initial phase of removable retention, $R = 0.501$ in the upper and $R = 0.485$ in the lower arch. When more hours of removable retainer wear per day were prescribed, respondents indicated a shorter duration of the initial phase and vice versa. Orthodontists who prescribed 24 hours of initial retainer wear per day in the upper arch had a mean initial phase of almost 6 months (SD 0.42), whereas those who prescribed 8 hours of initial retainer wear per day had a mean initial phase of almost 1 year (SD 0.37).

Total duration of removable and bonded retention is described in Table 4. In case of individually determined retention with removable retainers, more than half of the respondents used the Hawley-method, which means temporarily, gradually diminishing retention, and the patient has to check now and then if the appliance still fits.

Respectively, 82.0% and 88.8% of the respondents recommended lifetime retention with bonded retainers in the upper and lower arch. Reasons for temporarily and individually determined duration of retention with bonded retainers were: until facial growth has ceased, and depending on the oral health status and eruption of third molars.

### 3.4. Retention checkups

Number of checkups (Table 5) showed a positive correlation with the total period that orthodontists check their patients' retainers (removable retainer, 0.60, $P < 0.001$; bonded retainer, 0.64, $P < 0.001$). Some orthodontists reported that the time between the successive retention checkups was getting longer over time, that is, 3 months after debond, 6 months thereafter, then yearly until after growth, extending 2 to 3 yearly, as long as the patient wishes to come back.

### 3.5. Wire material for bonded retainers

Wire material used for bonded retainers in both arches is shown in Figure 1. The total number does not equal 162 because some

**Table 4**
Total duration of removable and bonded retention

| | Total duration of removable retention | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Upper arch (n = 81) | | | | Lower arch (n = 55) | | | |
| | n | % | Mean (SD) | Min–Max | n | % | Mean (SD) | Min–Max |
| Temporarily | 11 | 13.6 | 1.8 (0.4) | 1.0–5.0 | 6 | 10.9 | 1.92 (0.2) | 1.5–2.0 |
| Permanently (lifetime) | 36 | 44.4 | - | - | 30 | 54.5 | - | - |
| Individually determined | 34 | 42.0 | - | - | 19 | 34.5 | - | - |
| Not applied in upper/lower | 0 | - | - | - | 26 | - | - | - |
| | Total duration of bonded retention | | | | | | | |
| | Upper arch (n = 75) | | | | Lower arch (n = 80) | | | |
| | n | % | Mean (SD) | Min–Max | n | % | Mean (SD) | Min–Max |
| Temporarily | 9 | 12.0 | 5.2 (3.0) | 2–10 | 6 | 7.5 | 3.6 (3.5) | 1–10 |
| Permanently (lifetime) | 62 | 82.7 | - | - | 71 | 88.8 | - | - |
| Individual determined | 4 | 5.3 | - | - | 3 | 3.8 | - | - |
| Not applied in upper/lower | 6 | - | - | - | 1 | - | - | - |

Mean, time in years; Max, maximum; Min, minimum; N, orthodontists.

**Table 5**
Number of checkups after placement of a removable or bonded retainer

| Number of checkups | Removable retainer (n and % of orthodontists) | | Bonded retainer (n and % of orthodontists) | |
|---|---|---|---|---|
| | n (%) | Mean period y (SD) | n (%) | Mean period y (SD) |
| 1 | 1 (1.2) | 1.0 (0.0) | - | - |
| 2 | 3 (3.7) | 1.6 (0.5) | 4 (5.0) | 1.0 (0.0) |
| 3 | 13 (16.0) | 1.9 (0.5) | 14 (17.5) | 1.5 (0.5) |
| 4 | 43 (53.1) | 1.9 (0.5) | 41 (51.3) | 1.9 (0.6) |
| >4 | 21 (25.9) | 5.1 (2.8) | 21 (26.3) | 4.1 (5.1) |

%, percentage of orthodontists; Mean period y, mean period of time in years that orthodontists checked their patients' retainer; N, number of orthodontists.

orthodontists did not apply bonded retention in the upper arch and lower arch; respectively n = 6 and n = 1. An overview of all applied wires with their cross sections is given in Table 6.

### 3.6. Acquaintance with unintentionally active retainers

Acquaintance with unintentionally active retainers varied. One in eight (n = 10) was not familiar with this phenomenon, and one in five (n = 16) had, although familiar with unintentionally active retainers, never observed any; 55 were familiar with the phenomenon and had observed it (Table 7). Number of years in practice showed a negative correlation with number of observed unintentionally active retainers (−0.30, $P < 0.05$).

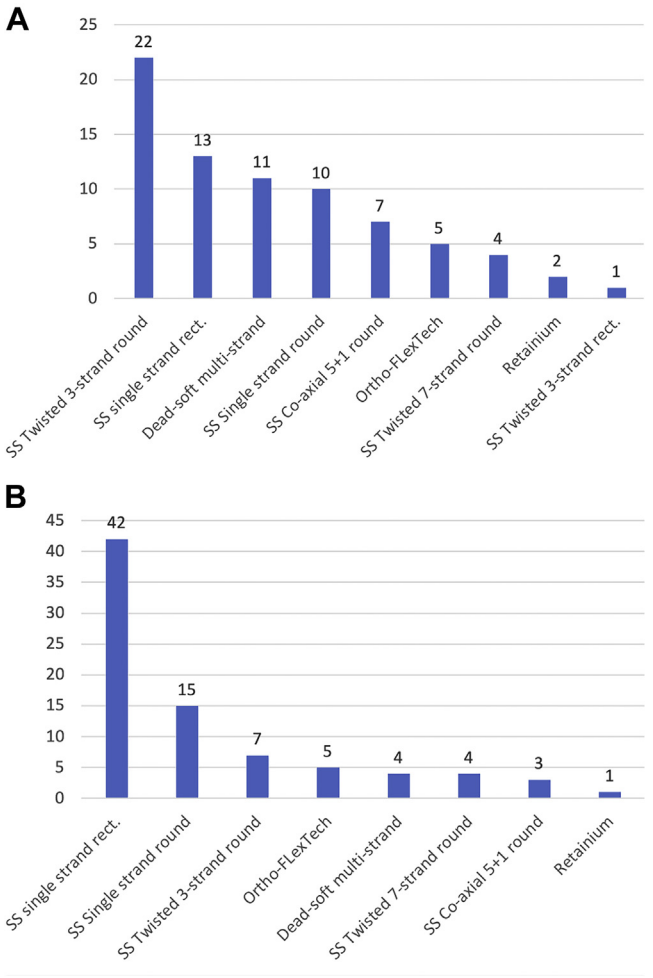


**Fig. 1.** (A) Overview of wire materials applied in the maxillary arch (total N = 75). (B) overview of wire materials applied in the mandibular arch (total N = 80). SS, Stainless steel.

**Table 6**
Overview of all wires used in both arches with their respective cross sections

| Wire material used in upper arch | n (%) | Cross section(s) in inch |
|---|---|---|
| SS Single strand rectangular | 55 (35.5) | .016 × .016–**.016 × .022** –.017 × .025–.018 × .025 –.019 × .025 |
| SS Twisted 3-strand round | 29 (18.7) | **.0175**–.0195 – .0215–.032 |
| SS Single strand round | 25 (16.1) | **.014**–.016 – .018–.020 – .022 –.024 – .026 –. 028–.030 – .032 |
| Bond-a-braid (Reliance) | 15 (9.7) | .010 × .026 |
| SS Co-axial 5 + 1 round | 10 (6.5) | .0175–.0195 |
| Ortho FlexTech (SS and Gold) | 10 (6.5) | .016 × .038 |
| SS Twisted 7-strand round | 8 (5.2) | .0175–**.0195** – .0215 |
| Retainium single strand | 2 (1.3) | .012 × .027 |
| SS Twisted 3-strand rectangular | 1 (0.6) | .016 × .022 |
| Total wires | 155 (100) | |

Most often used dimensions are given in bold.

Strategies to manage observed unintentionally active retainers varied; 39 (60.0%) explained the problem to the patient, 50 (76.9%) removed the retainer wire, 44 (80%) started retreatment if necessary, and 15 respondents (27.2%) waited some months for spontaneous correction. After re-treatment, most orthodontists (85.5%) placed a new bonded retainer or a removable retainer (14.5%). A quarter inserted an extra removable retainer. Two other mentioned options were to discuss the future retention plan with the patient after retreatment, and no intervention was needed because changes were very mild.

After having observed unintentionally active retainers, a third of the orthodontists (n = 18) reported that they changed from a round multistranded wire to another wire material. Respondents were also asked to give a possible explanation for the unintentionally active retainers. All orthodontists mentioned one or more explanation. The following were the most commonly mentioned factors: deflection of the wire during placement or repairs (n = 52, 92.7%), deformation of the wire by masticatory forces (n = 49, 89.1%), material property of the wire (n = 36, 65.5%), and parafunctional habits (n = 19, 34.5%). One respondent mentioned bond-failure of the wire-composite interface (pivot effect) [20,22,24].

## 4. Discussion

### 4.1. General

A high percentage, 88.4%, of the orthodontists working in New Zealand participated in this survey. The response rate of previous studies varied from 2% to 98% [20]. Compared with the survey conducted in New Zealand [9] in 2004, the response rate to this

**Table 7**
Acquaintance with and frequency of observed active retainers

| Frequency of observed active retainers | Placed in own practice | | Placed in other practice | | Total 100%, n (%) |
|---|---|---|---|---|---|
| | n | Percentage | n | Percentage | |
| Not familiar | - | - | - | - | 10 (12.3) |
| Familiar, never observed | - | - | - | - | 16 (19.6) |
| Familiar, observed 1–5 times | 14 | 17.3 | 20 | 24.7 | 34 (42) |
| Familiar, observed 5–10 times | 9 | 11.1 | 4 | 4.9 | 13 (16) |
| Familiar, observed 11–15 times | 4 | 4.9 | 1 | 1.2 | 5 (6.2) |
| Familiar, observed > 15 times | 3 | 3.7 | - | - | 3 (3.7) |

N and %, Number and percentage of orthodontists reporting respective frequency of observed active retainers.

survey was excellent. It can be assumed that the nonresponder bias will be low. Almost 40% of the participants were trained abroad, which may be because New Zealand was known as an immigration country.

### 4.2. Choice of retention modality

It is difficult, if not impossible, to compare the current results with all previous studies. However, our questionnaire was comparable with the one of Padmos et al. [20]. The differences between the applied retention modalities in both countries are remarkable. The same applies to the comparison of our results with the study in New Zealand in 2004.

Application of lower canine-and-canine retainers (only bonded to the 33 and 43) was more or less comparable with the results of Wong and Freer [9], currently 51.5%, and 55% in 2004. This is surprising because the effectiveness of these retainers is inferior to retainers bonded to all mandibular anterior teeth [30,31].

Use of removable retainers has increased significantly over the past decade, probably due to an increase in dual retention. The increase in dual retention from 0.1% to 45.5% in the upper arch and from 0% to 37.9% in the lower arch is enormous [9]. The extra removable retainer prevents dental changes in case of bond failures and gives the patient some extra time for repair. It also prevents tooth movement and deleterious effects on the periodontium caused by unintentionally active retainers [32].

Confidence of orthodontists in New Zealand in their patients' cooperation seems to be very high, given the widespread use of solitary upper removable retainers. The use of solitary removable retainers is comparable with Norway [16].

Although evidence of superior effectiveness of VFRs versus Hawley retainers is weak [33], VFRs are used more often, and Hawley-type retainers less frequently than in the first decade of the 21st century [10,13,14]. The transition to VFRs might be related to better patient compliance, probably due to less embarrassment, with VFRs than with Hawley-type retainers [33,34].

Wong and Freer [9] concluded that retention procedures depend largely on personal preferences. Vandevska et al. [16] found that the main reason for Norwegian orthodontists choosing their retention modality was based on clinical experience and specialty training. The current results and those from previous surveys indicate that the preference for a particular retention modality varies from country to country and continent to continent.

### 4.3. Retention period

More than half of New Zealand orthodontists applied a full-time initial wearing of removable retainers. The rationale behind this is questionable, because the authors of a well-conducted study found no difference in stability between full-time and part-time wear of VFRs [33,34] (moderate quality of evidence [35]).

A 1:1 comparison between the current responses and those published in 2004 is not possible, because in the former study, retention duration was not listed separately for removable and bonded retainers [9]. Orthodontists applying solitary removable retention in the upper arch used significantly more permanent retention in the lower arch than orthodontists using solitary fixed retention or dual retention in the upper arch.

Most orthodontists in New Zealand recommended permanent (lifetime) retention with bonded retainers (83% for the maxillary arch and 91% for the mandibular arch). Wong and Freer [9] reported that only 13% of the orthodontists applied lifetime retention, whereas 83% defined this as permanent retention. For that reason, we defined in advance lifetime as permanent retention. It can be stated that the proportion of clinicians favoring permanent bonded retention has greatly increased and is higher than in Australia, Norway, Ireland, and the United States. The use of long-term

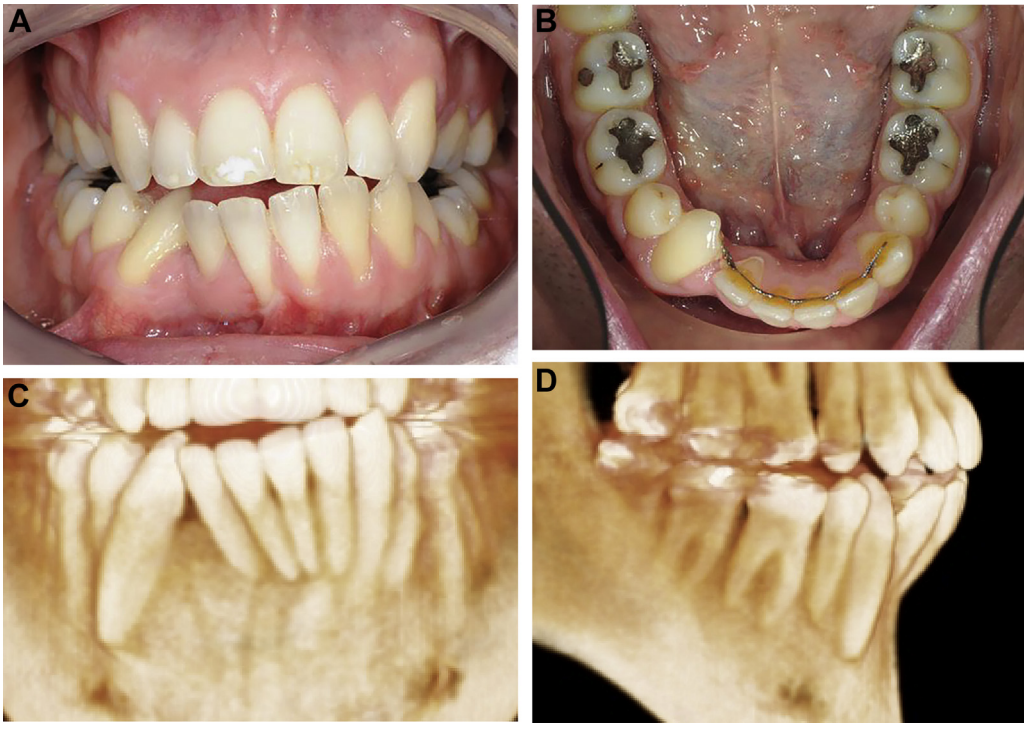


**Fig. 2.** (A) Frontal view of dentition of a patient referred by his dentist because of the onset of an open bite. (B) Occlusal view with unintentionally active retainer (coaxial wire 15 y in situ). (C, D) Cone-beam computed tomography scan clarifies the situation: the root of the 43 was moved almost completely out of the alveolar process by the unintentionally active retainer.

retention may be the best approach to reduce posttreatment changes [3].

### 4.4. Retention checkups

It is crucial, especially when permanent retention is applied, to check retainers on a regular basis to examine their function and the health of the surrounding tissues [17,21]. When retention checkups are frequently performed, the compliance of the patient can be positively influenced [14]. It is not important how often or for how long retention checkups are performed by the orthodontist, but it is crucial to ask the dentist to take over retention checkups, and it is also necessary to make agreements about repair and replacement of retainers. The orthodontist and dentist should be aware that despite the presence of bonded retainers, changes in the position of the teeth and unwanted side effects may occur [3,21–28,31].

### 4.5. Wire material for bonded retainers

The variety in applied wire materials was less high, as reported by Padmos et al. [20]. Literature regarding the reliability is available for a greater part of the applied wires. Gunay and Oz [36] reported that patients with a 0.0195-inch Respond dead-soft stainless steel coaxial retainer wire (Ormco, Brea, CA, USA) showed significantly more irregularity than patients with a 0.0175-inch TruForce stainless steel coaxial wire, and concluded that fabrication of a lingual retainer could be more safely accomplished with the TruForce stainless steel coaxial wire (Ortho Technology, Lutz, FL, USA). However, Arnold et al. [27] concluded that clinicians must select wires for fixed retainers with a high torque control. This can be achieved with plain 0.016 × 0.016-inch and eight-stranded braided 0.016 × 0.022-inch stainless steel wires and not with thin round coaxial wires, round twisted wires, and rectangular chains (Ortho-FlexTech, Reliance Orthodontic Products, Itasca, IL, USA) [27]. A large part of the wires placed in the upper arch and a small part of the wires placed in the lower arch did not meet this requirement.

### 4.6. Acquaintance of unintentionally active retainers

Although bonded retainers are effective in preventing relapse, sometimes their inadvertent activity causes distortion of the dental arch [3,21–27,31]. The mechanism of this phenomenon is largely unclear. Etiologic factors mentioned include 1) forces generated by untwisting of single strands of round flexible spiral wires, 2) mechanical deformation of the wire caused by masticatory forces, and 3) elastic deflection caused by failing to ensure that the wire is completely passive before or during bonding [27]. If unnoticed by the patient or clinician, the wire may cause devastating complications (Fig. 2A–D). Our survey showed that almost one-third of New Zealand orthodontists were neither acquainted with unintentionally active retainers (12%) nor had ever observed any (20%). This might be related to 1) few years in practice, 2) minimal use of bonded retainer, 3) use of retainer wires with a high torque control, and 4) use of dual retention. After having observed unintentionally active retainers, a third of the orthodontists (n = 18) reported that they changed from a round multistranded wire to another wire material which might, depending on the properties of the newly selected wire material, be positive.

## 5. Conclusion

A trend toward more dual retention instead of solitary removable or solitary fixed retention, more VFRs instead of Hawley-type retainers and more lifelong retention instead of retention for a definite period of time has been demonstrated. With these data, well-designed prospective randomized clinical trials can be carried out to provide evidence for a clinical practice guideline for orthodontic retention.

For all dental professionals in New Zealand and worldwide, it is necessary to be familiar with unintentionally active retainers and to be able to identify them. This can prevent the worsening of inadvertent tooth movements.

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