

University of Groningen

How do general dental practitioners perceive and deal with orthodontic bonded retainers?

Rafflenbeul, Frederic; Hanriat, Clemence; Lefebvre, Francois; Renkema, Anne-Marie; Bolender, Yves

Published in:
 American Journal of Orthodontics and Dentofacial Orthopedics

DOI:
[10.1016/j.ajodo.2020.12.018](https://doi.org/10.1016/j.ajodo.2020.12.018)

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version
 Publisher's PDF, also known as Version of record

Publication date:
 2021

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Rafflenbeul, F., Hanriat, C., Lefebvre, F., Renkema, A-M., & Bolender, Y. (2021). How do general dental practitioners perceive and deal with orthodontic bonded retainers? *American Journal of Orthodontics and Dentofacial Orthopedics*, 160(1), E1-E8. <https://doi.org/10.1016/j.ajodo.2020.12.018>

Copyright

Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

The publication may also be distributed here under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license. More information can be found on the University of Groningen website: <https://www.rug.nl/library/open-access/self-archiving-pure/taverne-amendment>.

Take-down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from the University of Groningen/UMCG research database (Pure): <http://www.rug.nl/research/portal>. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.

How do general dental practitioners perceive and deal with orthodontic bonded retainers?

Frédéric Rafflenbeul,^a Clémence Hanriat,^a François Lefebvre,^b Anne-Marie Renkema,^c and Yves Bolender^a
Strasbourg, France, and Groningen, The Netherlands

Introduction: Long-term follow-up and management of orthodontic bonded retainers require a strong collaboration between orthodontists and general dental practitioners (GDPs). This study aimed to evaluate if Eastern French GDPs were aware of bonded retainers' complications and side effects and if they were willing to take part in their long-term follow-up. **Methods:** Two-hundred and eighteen randomly selected GDPs were invited to answer an online questionnaire. The initial sections covered their experience and management with bonded retainers. In the final sections, GDPs were asked their opinion on the responsibility for long-term follow-up of patients wearing fixed retainers and on the mutual communication between orthodontists and GDPs. Statistical analysis involved descriptive statistics and Fisher exact tests. **Results:** Response rate was 32.6% (n = 71). The vast majority of GDPs were familiar with loose retainers, but only 45.2% were willing to repair them. Respondents offering orthodontic services on a regular basis were more likely to insert retainers and repair loose or broken retainers ($P < 0.001$). Approximately 18.6% of GDPs were aware of third-order side effects encountered with unintentionally active retainers bonded to all 6 anterior teeth. For 88.8% of GDPs, permanent retention was justified, whereas 90% of the dentists refused to be responsible for long-term supervision of fixed retainers. In addition, 67.1% were interested in further training on orthodontic retention, and 92.9% would appreciate clinical guidelines. **Conclusions:** Knowledge about the harmful side effects of bonded retainers was evaluated as insufficient among surveyed GDPs. Long-term follow-up of patients wearing bonded retainers raises issues that should be addressed globally by enhancing mutual communication, practitioners' education, and patients' involvement. (Am J Orthod Dentofacial Orthop 2021;160:e1-e8)

Bonded retainers are frequently used to prevent relapse of anterior crowding after orthodontic treatment.¹⁻⁵ They are effective in maintaining alignment of maxillary and mandibular anterior teeth.⁶⁻⁹ Two basic designs are used in the mandibular arch: either a rigid wire bonded to canines only or a retainer bonded to all anterior teeth.^{7,8} The latter is more effective in preventing incisor irregularity,^{7,8,10}

and is usually made of plain or multistrand stainless steel wires of various cross-sections.^{3,11}

Currently, 65%-92% of orthodontists in European countries or the United States do not recommend the removal of bonded retainers for long-term maintenance of treatment results.^{2-4,12} This recommendation is most likely made to keep the anterior teeth alignment,¹³ which is strongly associated with posttreatment patient satisfaction.¹⁴ However, complications such as wire fractures or bond failures occur in some instances, with failure rates reaching up to 50%.¹⁵ Moreover, bonded retainers have been reported to become unintentionally active in some patients, resulting in opposite buccolingual inclinations of adjacent teeth (X effect) or opposite canines (twist effect).^{16,17} These unexpected movements would affect 1.1%-5% of patients wearing fixed retainers.^{8,16,17} Some of these complications can be severe enough to require retreatment and might be associated with irreversible periodontal damages.^{3,16,18-20}

Regular retention check-ups are therefore necessary as long as bonded retainers remain in place. This increases the number of patients under supervision as

^aDepartment of Dento-Facial Orthopedics, Faculty of Dental Surgery, Strasbourg University, Strasbourg, France.

^bDivision of Public Health, Methodology and Biostatistics, University Hospitals of Strasbourg, Strasbourg, France.

^cDepartment of Orthodontics, University Medical Centre Groningen, University of Groningen, Groningen, The Netherlands.

Frédéric Rafflenbeul and Clémence Hanriat contributed equally to this work.

All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest, and none were reported.

Address correspondence to: Frédéric Rafflenbeul, Faculty of Dental Surgery, Department of Dento-Facial Orthopedics, 8 rue Sainte-Elisabeth, 67000 Strasbourg, France; e-mail, frederic.rafflenbeul@gmail.com.

Submitted, September 2020; revised, November 2020; accepted, December 2020.

0889-5406/\$36.00

© 2021 by the American Association of Orthodontists. All rights reserved.

<https://doi.org/10.1016/j.ajodo.2020.12.018>

well as the workload in orthodontic practices.^{2,3} The initial retention follow-up is usually performed by the orthodontist during the first 1-3 years in retention.^{2-4,12,21} However, attendance of patients at retention check-ups, decreases with time,¹⁷ and general dental practitioners (GDPs) could take over the long-term supervision and management of bonded retainers at annual appointments. This would be more convenient for the patients and would free them from attending their orthodontist's practice. Even if this procedure has been recommended in recent guidelines,^{22,23} little is known about the perception GDPs have of this transfer of responsibility or their ability to perform this long-term maintenance. Previous studies in Switzerland (2012) and the United Kingdom (2014) highlighted issues regarding communication between orthodontists and dentists and insufficient knowledge of potential side effects with bonded retainers among GDPs.^{24,25} GDPs' willingness to monitor bonded retainers was different between these nations.²⁴⁻²⁶ It is therefore timely and appropriate to conduct similar surveys in other countries to have a broader perspective on this question.

This study aimed to determine Eastern French GDPs' management of orthodontic bonded retainers, knowledge of their side effects, and to evaluate their willingness to take part in their long-term follow-up. GDPs' perceptions of permanent retention and their demand regarding specific training on fixed retainers were also assessed.

MATERIAL AND METHODS

This survey was approved by the Ethics Review Board of the Faculty of Dental Surgery and the University Hospitals of Strasbourg, France.

On the basis of sample size calculation, 218 GDPs were randomly selected among the 1433 dentists practicing in Alsace, Eastern France, to obtain a 95% confidence level with a 6% margin of error. The names of the 1433 registered dentists were collected from the French Dental Board and randomized using the RAND function in Excel (Microsoft™, Redmond Wash).

The questionnaire was adapted for French working conditions from the one used in a previous study of Swiss GDPs' management of orthodontic retainers.²⁴ The latter was already available in French. Therefore, the adapted version was prepiloted and validated by staff members not involved in the study without the need to renew a pilot study. The questionnaire was organized into 4 parts: (1) the first gathered demographic information (gender, age, working experience, and type of practice), (2) the second section dealt with dentists' clinical

management of bonded retainers, (3) the third part aimed to evaluate GDPs' knowledge of bonded retainers' side effects, and (4) the final part focused on communication between dentists and orthodontists on the retention follow-up, the responsibility of long-term supervision and the need for common guidelines.

In May 2019, the selected GDPs were contacted and asked to anonymously answer the online questionnaire. Data collection was stopped by the end of June after 2 reminders: 1 and 3 weeks after the initial e-mail. Participants could only complete the questionnaire once. All investigators were blinded to the names of the respondents.

Statistical analysis

Statistical analysis involved descriptive statistics presented as absolute values and percentages. Associations between items in the questionnaire with the working experience of the practitioner and the provision of orthodontic services were evaluated with Fisher exact tests. The level of significance was set at 5%. All statistical analyses were performed with the R Program (version 3.4.3; R Foundation for Statistical Computing, Vienna, Austria).

RESULTS

A total of 71 out of 218 GDPs completed and returned questionnaires; therefore, the response rate was 32.6%.

Approximately 57.8% of participants were male, and 63.4% had less than 20 years of working experience. Information about age, working experience, and the professional setting are summarized in [Table](#). The vast majority of respondents (90.1%, $n = 64$) were initially trained at the local university in Strasbourg, France. 14.3% of respondents ($n = 10$) reported to offer orthodontic services in their practices, ranging from 10 to 50 new cases per year. There was no association between the dentist's age and the provision of orthodontic services ($P = 0.92$).

Monitoring and management of bonded retainers

Most of our respondents (83.1%, $n = 59$) never inserted bonded retainers ([Fig 1](#)), but those providing orthodontic services placed fixed retainers significantly more often ($P < 0.001$). Approximately 73.2% of GDPs ($n = 52$) estimated to see between 2 and 10 patients wearing fixed retainers per week, and none saw more than 30 per week. Approximately 78.9% of GDPs reported checking the integrity of bonded retainers during appointments, and no statistical association was found in this matter with working experience nor

Table. Respondents' age, working experience, and professional setting

Variable	n	%
Age (y)		
20-29	14	19.7
30-39	24	33.8
40-49	14	19.7
50-59	15	21.2
60-69	4	5.6
Working experience (y)		
0-9	23	32.4
10-19	22	31.0
20-29	17	23.9
30-39	8	11.3
≥40	1	1.4
Professional setting		
Academic	3	4.2
Solo practice	22	31.0
Group practice	38	53.5
Multidisciplinary practice	1	1.4
Employee	13	18.3
Locum	0	0
Retired	0	0

provision of orthodontic services ($P = 0.12$ and $P = 0.71$). The main reasons mentioned by the GDPs for not checking the fixed retainers' integrity were "this is part of the orthodontist's duty" (50.0%) and "lack of knowledge about bonded retainers" (43.7%).

Almost all respondents had already detected a loose retainer (97.2%). This situation seemed to occur once or twice per month, according to 56.7% of GDPs, and 70.0% of respondents thought the mandibular arch to be the most affected. A majority of respondents (77.0%) reported detecting problematic bonding sites either easily or very easily. This was done in different ways (Fig 2). Repairing these bonding failures was a familiar procedure for 47.9% of our respondents, and practitioners offering orthodontic services were more willing to repair them ($P < 0.001$). Management of bonding failures differed if the debonded retainer was accompanied or not by tooth movement. If it was not, 45.1% of GDPs rebonded it, and 66.2% referred the patient to an orthodontist (Fig 3). In contrast, if tooth movement was associated with the debonded retainer, the vast majority of respondents referred the patient to an orthodontist (91.6%). In these matters, no statistical difference was found between dentists offering orthodontic services or practitioners who did not.

Approximately 85.9% of the respondents had already encountered a fractured retainer. In this situation, 84.3% advised their patients to contact the orthodontist, and 18.6% removed the fractured retainer without

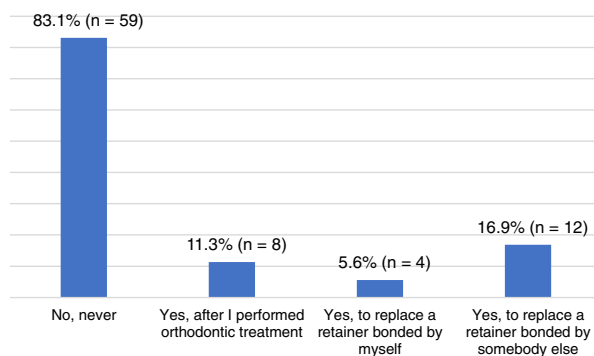


Fig 1. Placement of bonded retainers by dentists (multiple answers possible).

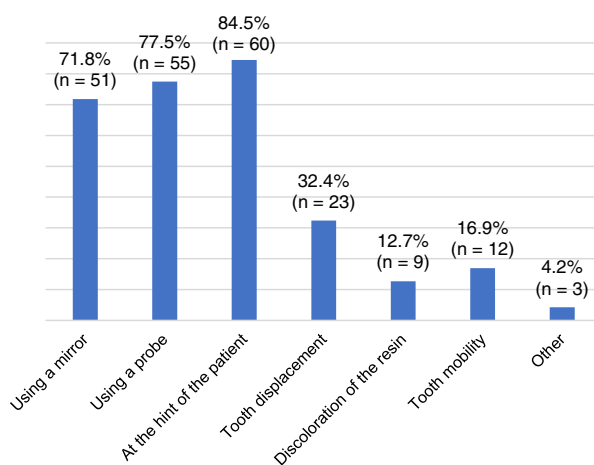


Fig 2. Detection methods for bonding failures according to GDPs (multiple answers possible).

replacement. Forty-five percent of GDPs thought fractures occurred most of the time in the mandibular arch.

For 64.8% of our respondents, 1-5 patients per year wished their bonded retainer to be removed. In general, our respondents referred the patient back to the orthodontist who initially bonded the retainer (70.4%), but 30.0% removed the retainer after providing information on unpredictable changes in tooth position. A few GDPs mentioned offering vacuum-formed retainers as an alternative. Factors determining GDPs' decision to remove a bonded retainer are listed in Figure 4.

For patients with retainer failures, 54.9% of GDPs felt sufficiently competent to rebond the retainer and 25.4% to replace it. In contrast, 39.4% of respondents indicated that they did not feel able to repair nor to replace a bonded retainer. In addition, 67.1% were interested in a continuing education seminar about orthodontic

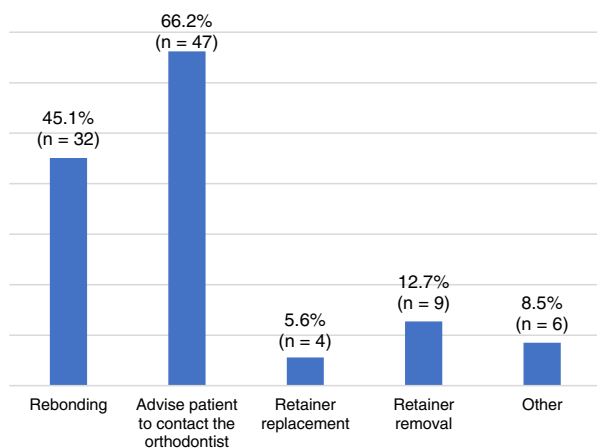


Fig 3. Dentists' interventions after detection of bonding failures (multiple answers possible).

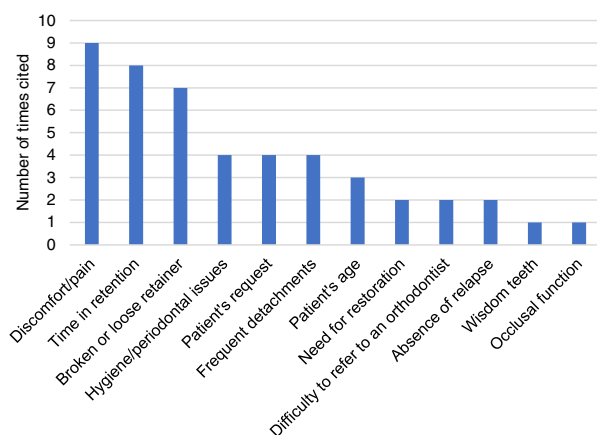


Fig 4. Factors influencing the decision to remove a bonded retainer.

retention, and 92.9% would appreciate clinical guidelines on long-term follow-up of bonded retainers.

Side effects of bonded retainers

GDPs agreed that retainers bonded to all anterior teeth are efficient in maintaining anterior alignment (94.3%). Retainers bonded only to canines were considered less effective. Few respondents thought that retainers impede professional dental cleaning. Furthermore, 52.9% and 28.6% of GDPs thought that 3-2-1-1-2-3 or 3-3 retainers represent obstacles to restore teeth. Most practitioners agreed that retainers promote plaque and calculus accumulation (Fig 5).

The vast majority of respondents (81.4%, n = 57) was unaware of possible third-order movements

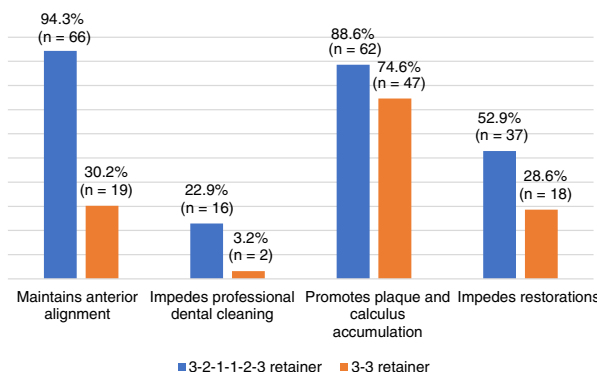


Fig 5. The proportion of respondents who agreed with statements regarding the 2 retainer designs.

(X effect or twist effect) observed when retainers bonded to all anterior teeth become unintentionally active. Dentists providing orthodontic services were not better informed nor more confronted with this type of unintentional movement than other GDPs ($P = 0.29$ and $P = 0.24$). If such an unwanted tooth displacement was observed, 90% of our respondents stated that they would refer the patient to an orthodontist, with no statistical difference between dentists offering orthodontic services or not ($P = 0.44$).

Communication and responsibility

Most practitioners (78.3%) wished to be informed on the completion of their patients' active orthodontic treatment. This information was provided by the orthodontists in 58% of their orthodontically treated patients, with high variability among our respondents. Approximately 36.2% were informed of treatment completion for 80%-100% of their patients, whereas 24.2% obtained this information for less than 30% of their patients. In addition, 74.6% of GDPs would appreciate more precise information regarding the type of retainer used and how to supervise it; 11.6% did receive this information.

Approximately 10% of participating GDPs were willing to accept the transfer of responsibility for long-term retainer supervision after initial follow-up by the orthodontist. A shared responsibility between dentists and orthodontists would be appreciated by 41% of our respondents, whereas the remaining 49% thought it to remain the orthodontist's sole responsibility. For 23.2% of the dentists, long-term supervision could be transferred to them after a minimum of 5 years of retention maintenance by the orthodontist. The reasons to decline long-term follow-up of bonded retainers were related to lack of knowledge on this topic (72.9%), financial issues (61.0%), and insufficient chair time

(30.5%). If they repaired a bonded retainer, 76.5% of our respondents felt that they would, in case of complications, share the responsibility with the orthodontist who inserted the retainer.

The vast majority of GDPs (88.8%) agreed with the concept of permanent retention; however, half considered it as problematic. Compared with older or more experienced practitioners, younger dentists tended to agree to a greater extent with permanent retention ($P = 0.01$).

DISCUSSION

This survey aimed to obtain contemporary data on the management of patients wearing bonded retainers by a representative sample of Eastern French GDPs. This aspect becomes more and more relevant for all orthodontists and dentists, as the number of patients wearing fixed retainers for permanent retention is increasing steadily around the world.¹⁻³ For now, our knowledge base is limited to the perception of Swiss and British GDPs.²⁴⁻²⁶

To be appropriate for the French health care system and GDPs' working conditions, questions of the original Swiss questionnaire in French²⁴ had to be amended. For instance, dental hygienists are not recognized in France, and dentists cannot delegate procedures such as dental cleaning or retainer check-ups to their assistants. Moreover, the duration of the retention phase in France is mostly limited to 1 year, but an additional second year of insurance coverage can be obtained. French dentists are not involved in this initial 1-2-year follow-up performed by orthodontists because fees for the initial retention phase are paid annually to the orthodontist by the patient. They include all follow-up visits and material costs. Therefore, this study's results reflect the practices and views of GDPs under a specific health care system in a given country. Regional and national factors, such as the number and density of dentists and orthodontists, practice workload, type of insurance coverage, or patient demographics, certainly have an influence on GDPs' willingness to take part in the long-term follow-up of bonded retainers. Our findings might not be directly comparable to other countries or working environments.

Sample size calculation and randomization were carried out to ensure sufficient power and prevent selection bias. A total of 218 GDPs were contacted, but despite the 2 reminders, the anonymity of the survey, and the convenience of an online questionnaire, our response rate was only 32.6% ($n = 71$). This response rate could be evidence of a lack of commitment among Eastern French GDPs in regard to orthodontic retention. Our response

rate was lower than those obtained in similar studies conducted among dentists in Switzerland and the United Kingdom, with rates of 61.2%, 73.2%, and 48% ($n = 123-562$).^{24,25,27} Surveys on retention procedures among orthodontists yielded higher response rates in European countries (65%-98%, $n = 145-300$),^{2,3,5} but similar or lower response rates (32.9% and 18%, respectively; $n = 658$ and $n = 1632$) in the United States.^{4,28} Thus, a response bias could have been introduced in our study, and generalizability may be limited. We do not know if the respondents were different from the nonrespondents, but it can be expected that the former were more involved in the subject and therefore produced more optimistic results. Finally, Web-based surveys have been shown to present lower response rates than postal questionnaire surveys among patients aged between 50 and 75 years.²⁹ By this online modality, we might have favored younger respondents.

GDPs' clinical management of bonded retainers

Most French GDPs were aware of the possibility of posttreatment incisor irregularity with a retainer bonded only to canines. Compared with their Swiss colleagues (54.1%),²⁴ only 30.2% of respondents found this type of retainer to be effective in maintaining anterior alignment in the mandibular arch. This result supports the findings by Arnold et al,²⁷ who showed that non-Swiss dentists and orthodontists tend to bond mandibular incisors to the retainer more frequently. However, French and Swiss dentists both agreed that fixed retention promotes plaque and calculus accumulation. It has been observed around bonded retainers in the long-term,^{6,30,31} but does not necessarily translate into severe detrimental effects on periodontal health.³² Surprisingly, French GDPs considered retainers as obstacles to professional cleaning or tooth restorations to a lesser extent than their colleagues in Switzerland.²⁴

Almost all GDPs in our study had experienced loose and fractured retainers. In comparison with Swiss dentists, our respondents were less likely to rebond them (45.1% vs 63.4%), and they referred their patients more frequently to the orthodontist, regardless of associated tooth displacement.²⁴ GDPs offering orthodontic services repaired significantly more often failed bonded retainers ($P < 0.001$), as was observed in Switzerland.²⁴

Unwanted third-order movements (X effect or twist effect) in which apparently intact retainers bonded to all anterior teeth become unintentionally active were first described in 2007.¹⁶ In 2018, the majority of French orthodontists were aware of these, and 88% had already experienced them.¹² Only 18.6% of our respondents were familiar with these unintentional complications,

whereas 40%–65.3% of their Swiss colleagues had heard about or noticed them.^{24,27} Early detection of this phenomenon requires a well-trained practitioner and is an absolute requirement to prevent further periodontal damage.^{3,16,18–20} In Switzerland, Arnold et al²⁷ found that orthodontic specialists detected these side effects almost 8 times more often than GDPs and that years in practice also had a positive influence. Nevertheless, neither provision of orthodontic services nor experience were associated with a better knowledge of these unwanted movements among GDPs in our study, highlighting insufficient orthodontic expertise in this group.

Need for training in orthodontic retention

Overall, like their British colleagues, serious gaps in knowledge on fixed retention were identified among Eastern French dentists. Under these circumstances, GDPs are not perfectly suited to take over the long-term follow-up of orthodontic retainers. In France and the United Kingdom, more than two thirds of respondents requested further training on bonded retainers and associated complications.²⁵ Moreover, it has been shown that specialist status has a significant influence on procedures in fixed retention.²⁷ Arnold et al²⁷ and Kotecha et al²⁵ already suggested addressing this lack of knowledge by specific courses on orthodontic retention and bonded retainer management at the undergraduate level and by continuing education seminars for dentists. Undergraduate education in orthodontics often concentrates on diagnosis, treatment timing, or referral to specialists,^{25,33,34} and guidelines on competencies for graduating dentists fail to specifically address orthodontic retention.^{35,36} In Switzerland, specific training dedicated to detection and problem management in orthodontics is required in dentists' core education. This approach could be 1 reason explaining why 74.1% and 54.9% of Swiss GDPs felt confident enough to repair or replace a fixed retainer, respectively.²⁴

Long-term follow-up and responsibility for bonded retainers

Lifelong orthodontic retention is recommended by most orthodontists.^{2–4,12} However, only a minority of specialists handle the long-term follow-up of bonded retainers,^{3,27} putting increasing demand on GDPs to be involved in the supervision of patients wearing these retainers.^{22,23} As such, it raises issues regarding communication between orthodontists and dentists, responsibility for long-term supervision, and remuneration for this service.

Among our respondents, only 10% indicated accepting the responsibility of long-term retainer monitoring,

whereas 88.8% were in favor of permanent retention. More experienced practitioners were less in agreement with this concept, as has already been shown by Arnold et al²⁷ among Swiss dentists. Overall, our respondents expressed the same difficulties as their British and Swiss colleagues: lack of communication between orthodontists and dentists on the applied retention protocol and insufficient instructions on long-term retainer care and supervision.^{24–26} Discrepancies between orthodontists and dentists in the perceived quality of mutual communication on the retention phase are evident; most orthodontists report providing enough instructions, but only a minority of dentists believe they are sufficiently informed.^{2,24,26,37} In 2019, clinical practice guidelines on orthodontic retention were established to address these global problems.²³ They should now be widely promoted as they have been requested by most specialists and dentists.^{2,5,24,25,27} Their impact on GDP's attitudes and successful management of lifetime retention could be evaluated in future studies across the world.

Furthermore, as was indicated by United Kingdom-based GDPs working in the National Health Service,^{25,26} financial limitations were important reasons reported by French dentists to decline responsibility for long-term follow-up of bonded retainers. Specific codifications for further monitoring and potential fixed retainer repairs or replacements after initial follow-up do not exist in France. These indirect costs cannot be prevented and are most of the time not covered by public insurance systems,^{25,26,37} and only on rare occasions by private insurance. It might explain this reluctance among French and British dentists to charge for them, and as a consequence, to perform long-term supervision of retainers. This feature could be less relevant to countries where dentistry and orthodontic care are essentially privately funded or public and/or private insurances cover the postorthodontic retention phase. Nonetheless, the financial aspect of long-term retention should be discussed honestly with the patient, ideally before starting orthodontic treatment,^{26,37} irrespective of Lasance et al³⁸ findings that 72.9% of prospective orthodontic patients were willing to pay for recall visits linked to permanent retention.

Finally, involving patients in the retention phase is of paramount importance,^{22,23} as oftentimes they are unaware of the need for orthodontic retention nor their active part in its success.^{14,38,39} Therefore, the campaign *Hold that smile* was launched in November 2017 by the British Orthodontic Society, with videos being also shared by the American Association of Orthodontists in the United States. Its purposes were to motivate patients to wear and take care of their retainers and strengthen

collaboration between dentists and orthodontists on long-term retainer supervision. Despite its positive impact on patients, issues were raised by British GDPs, again highlighting the complexity of this topic.^{26,37,40}

CONCLUSIONS

With the preference for permanent retention, GDPs will be more and more involved in long-term bonded retainer supervision. However, it appears that Eastern French GDPs' knowledge and training on detection and management of side effects, especially unintentional third-order movements with apparently intact bonded retainers, is inadequate. Only a minority of dentists was willing to provide long-term follow-up of patients wearing fixed retainers. In this sense, this study highlights the same difficulties that have already been reported by dentists in other countries. Therefore, these important issues should be addressed globally by enhancing mutual communication, training of future and graduated practitioners, and involvement of patients.

ACKNOWLEDGMENTS

The authors would like to warmly thank Dr Renkema and Dr Habegger, who have allowed us to reproduce their study in France, as well as all French dentists who answered the questionnaire.

REFERENCES

- Keim RG, Gottlieb EL, Vogels DS 3rd, Vogels PB. 2014 JCO study of orthodontic diagnosis and treatment procedures, part 1: results and trends. *J Clin Orthod* 2014;48:607-30.
- Lai CS, Grossen JM, Renkema AM, Bronkhorst E, Fudalej PS, Katsaros C. Orthodontic retention procedures in Switzerland. *Swiss Dent J* 2014;124:655-61.
- Padmos JAD, Fudalej PS, Renkema AM. Epidemiologic study of orthodontic retention procedures. *Am J Orthod Dentofacial Orthop* 2018;153:496-504.
- Pratt MC, Kluemper GT, Hartsfield JK Jr, Fardo D, Nash DA. Evaluation of retention protocols among members of the American Association of Orthodontists in the United States. *Am J Orthod Dentofacial Orthop* 2011;140:520-6.
- Renkema AM, Sips ETH, Bronkhorst E, Kuijpers-Jagtman AM. A survey on orthodontic retention procedures in The Netherlands. *Eur J Orthod* 2009;31:432-7.
- Booth FA, Edelman JM, Proffit WR. Twenty-year follow-up of patients with permanently bonded mandibular canine-to-canine retainers. *Am J Orthod Dentofacial Orthop* 2008;133:70-6.
- Renkema AM, Al-Assad S, Bronkhorst E, Weindel S, Katsaros C, Lisson JA. Effectiveness of lingual retainers bonded to the canines in preventing mandibular incisor relapse. *Am J Orthod Dentofacial Orthop* 2008;134:179e1-8.
- Renkema AM, Renkema A, Bronkhorst E, Katsaros C. Long-term effectiveness of canine-to-canine bonded flexible spiral wire lingual retainers. *Am J Orthod Dentofacial Orthop* 2011;139:614-21.
- Steinnes J, Johnsen G, Kerosuo H. Stability of orthodontic treatment outcome in relation to retention status: an 8-year follow-up. *Am J Orthod Dentofacial Orthop* 2017;151:1027-33.
- Störmann I, Ehmer U. A prospective randomized study of different retainer types. *J Orofac Orthop* 2002;63:42-50.
- Arnold DT, Dalstra M, Verna C. Torque resistance of different stainless steel wires commonly used for fixed retainers in orthodontics. *J Orthod* 2016;43:121-9.
- Delavierre A, Siebert T, Lefebvre F, Bolender Y. Pratiques des orthodontistes en matière de contention en France. Proceedings of the 21èmes Journées de l'Orthodontie. Paris, France: French; 2018.
- Little RM. Stability and relapse of mandibular anterior alignment: University of Washington Studies. *Semin Orthod* 1999;5:191-204.
- Mollov ND, Lindauer SJ, Best AM, Shroff B, Tufekci E. Patient attitudes toward retention and perceptions of treatment success. *Angle Orthod* 2010;80:468-73.
- Iliadi A, Kloukos D, Gkantidis N, Katsaros C, Pandis N. Failure of fixed orthodontic retainers: a systematic review. *J Dent* 2015;43:876-96.
- Katsaros C, Livas C, Renkema AM. Unexpected complications of bonded mandibular lingual retainers. *Am J Orthod Dentofacial Orthop* 2007;132:838-41.
- Kučera J, Marek I. Unexpected complications associated with mandibular fixed retainers: a retrospective study. *Am J Orthod Dentofacial Orthop* 2016;149:202-11.
- Farret MM, Farret MMB, da Luz Vieira G, Assaf JH, de Lima EMS. Orthodontic treatment of a mandibular incisor fenestration resulting from a broken retainer. *Am J Orthod Dentofacial Orthop* 2015;148:332-7.
- Pazera P, Fudalej P, Katsaros C. Severe complication of a bonded mandibular lingual retainer. *Am J Orthod Dentofacial Orthop* 2012;142:406-9.
- Shaughnessy TG, Proffit WR, Samara SA. Inadvertent tooth movement with fixed lingual retainers. *Am J Orthod Dentofacial Orthop* 2016;149:277-86.
- Bibona K, Shroff B, Best AM, Lindauer SJ. Factors affecting orthodontists' management of the retention phase. *Angle Orthod* 2014;84:225-30.
- Littlewood S. Responsibilities and retention. *APOS Trends Orthod* 2017;7:211-4.
- Wouters C, Lamberts TA, Kuijpers-Jagtman AM, Renkema AM. Development of a clinical practice guideline for orthodontic retention. *Orthod Craniofac Res* 2019;22:69-80.
- Habegger M, Renkema AM, Bronkhorst E, Fudalej PS, Katsaros C. A survey of general dentists regarding orthodontic retention procedures. *Eur J Orthod* 2017;39:69-75.
- Kotecha S, Gale S, Khamashta-Ledezma L, Scott J, Seedat M, Storey M, et al. A multicentre audit of GDPs knowledge of orthodontic retention. *Br Dent J* 2015;218:649-53.
- Mc Crory PV. British Orthodontic Society's initiative on orthodontic retention, a GDP's perspective. *Br Dent J* 2018;224:481-6.
- Arnold SN, Pandis N, Patcas R. Factors influencing fixed retention practices in German-speaking Switzerland: a survey. *J Orofac Orthop* 2014;75:446-58.
- Valiathan M, Hughes E. Results of a survey-based study to identify common retention practices in the United States. *Am J Orthod Dentofacial Orthop* 2010;137:170-7.
- Bech M, Kristensen MB. Differential response rates in postal and Web-based surveys in older respondents. *Surv Res Methods* 2009;3:1-6.

30. Artun J. Caries and periodontal reactions associated with long-term use of different types of bonded lingual retainers. *Am J Orthod* 1984;86:112-8.
31. Dietrich P, Patcas R, Pandis N, Eliades T. Long-term follow-up of maxillary fixed retention: survival rate and periodontal health. *Eur J Orthod* 2015;37:37-42.
32. Am ML, Dritsas K, Pandis N, Kloukos D. The effects of fixed orthodontic retainers on periodontal health: a systematic review. *Am J Orthod Dentofacial Orthop* 2020;157:156-64.e17.
33. Harzer W, Oliver R, Chadwick B, Paganelli C. Undergraduate orthodontic & paediatric dentistry education in Europe—the DentEd project. *J Orthod* 2001;28:97-102.
34. Derringer KA. Undergraduate orthodontic teaching in UK dental schools. *Br Dent J* 2005;199:224-32.
35. Field JC, Kavarella A, Szep S, Davies JR, DeLap E, Manzanares Cespedes MC. The graduating European dentist-domain III: patient-centred care. *Eur J Dent Educ* 2017;21(Suppl 1):18-24.
36. Kwo F, Orellana M. The current state of predoctoral orthodontic education in the United States. *J Dent Educ* 2011;75:518-26.
37. Littlewood SJ, British Orthodontic Society. BOS response to article on 'Hold that smile' campaign. *Br Dent J* 2018;224:925-6.
38. Lasance SJ, Papageorgiou SN, Eliades T, Patcas R. Post-orthodontic retention: how much do people deciding on a future orthodontic treatment know and what do they expect? A questionnaire-based survey. *Eur J Orthod* 2020;42:86-92.
39. Geoghegan F, Birjandi AA, Machado Xavier G, DiBiase AT. Motivation, expectations and understanding of patients and their parents seeking orthodontic treatment in specialist practice. *J Orthod* 2019;46:46-50.
40. Valiji Bharmal R, Parker K, Caldwell S, Chia M, Gillgrass T, Jones G, et al. A multicentre audit to assess the effectiveness of the British Orthodontic Society 'Hold that Smile' retainer videos. *J Orthod* 2020;47:72-7.