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REVIEW ARTICLE

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Development of a clinical practice guideline for orthodontic retention

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Structured Abstract

Objectives: To develop a clinical practice guideline (CPG) for orthodontic retention (OR).

Materials and Methods: The CPG was developed according to the AGREE II instrument and EBRO (Dutch methodology for evidence-based guideline development). Reporting was done according the RIGHT statement. A Task Force developed clinical questions regarding OR. To answer these questions, a systematic literature search in PubMed and EMBASE was performed. Two independent researchers identified and selected studies, assessed risk of bias using Cochrane RoB tool and rated quality of evidence using GRADE. The Task Force formulated considerations and recommendations after discussing the evidence. The concept CPG was sent for commentary to all relevant stakeholders.

Result: One systematic review—with 15 studies—met the inclusion criteria. In case of low evidence and lack of outcome measures, expert-based considerations were developed. Over four meetings, the Task Force reached consensus on considerations and recommendations, after which the concept CPG was ready for the commentary phase. After processing the comments, the CPG was presented to the Dutch Association of Orthodontists, whereafter authorization followed.

Limitations: The paucity of evidence-based studies concerning OR and the reporting of measurable patient outcomes.

Conclusion: This CPG offers practitioner recommendations for best practice regarding OR, may reduce variation between practices and assists with patient aftercare. A carefully chosen retention procedure for individual patients, combined with clear information and communication between orthodontist, dentist and patient will contribute to long-term maintenance of orthodontic treatment results.

KEYWORDS
clinical practice guideline, orthodontic, retention

1 | INTRODUCTION

Orthodontic treatment is successful when the treatment goal is achieved, and the result remains stable. Unfortunately, teeth tend to migrate to their initial position—known as relapse.[1] Furthermore, due to post-pubertal growth and ageing, changes occur in all individuals, with and without orthodontic treatment.[2,3] To maintain treatment results and to prevent dental changes after treatment, orthodontic retention (OR) is utilized in virtually every patient.[4,5] Different retention procedures are in use; however, there is no agreement upon which retention regimen should be recommended.

Retention can be implemented with removable and fixed retainers. Differences may exist in design, material and duration. Common removable retainers are Hawley-type retainers (HRs) and vacuum-formed retainers (VFRs). Fixed retainers are usually bonded to (a) all anterior teeth, (b) only upper incisors or (c) only lower canines. Especially in the upper arch, a combination of removable and fixed retainers is often used. Consideration must be given to potential changes in tooth position, as well as the willingness and ability of the patient to cooperate with the retention procedure. The choice for a certain retention procedure appears to be mainly experience based.[6]

Various surveys carried out worldwide show some agreement in the application of retention procedures; however, large individual differences exist.[5] To diminish practice variation, it is meaningful to develop a clinical practice guideline (CPG) for OR, for which a demand has been demonstrated.[7,8]

Therefore, the aim of this study was to develop a CPG according to a strict scientific protocol, including clinical considerations and recommendations on OR. This CPG is primarily intended for clinical decision-making for orthodontists and applies to individuals of any age after orthodontic treatment. Secondly, this study is intended for dentists and orthodontic patients. The CPG does not apply to patients with cleft lip and palate or other craniofacial deformities.

2 | MATERIALS AND METHODS

2.1 | Initiative and task force

In 2015, the Dutch Association of Orthodontists (NVvO, *Nederlandse Vereniging van Orthodontisten*) initiated the development of a CPG for OR. A Task Force was convened, consisting of five members of the NVvO as representatives of the professional group—four orthodontists and one resident in orthodontics. The orthodontists were clinicians working in academia or in private practices with great interest and expertise in OR. They were all trained at different universities and geographically spread over the country. For methodological support, an expert in CPG development from the Knowledge Institute of Medical Specialists, Utrecht, The Netherlands, was involved. The patients' Federation (patients' association), although invited to participate in the Task Force as a representative of laymen, decided only to be involved in the commentary phase.

Development and writing of the CPG took place from September 2015 to July 2018.

2.2 | Guideline development

The CPG for OR was developed according to the AGREE II instrument (Appraisal of Guidelines for Research & Evaluation II) and EBRO (*Evidence-Based Richtlijnontwikkeling*, the Dutch Method for Evidence-Based Guideline Development) and the reporting follows the RIGHT statement (Reporting Items for practice Guidelines in Healthcare).[9,10] Steps for developing the CPG were preparation phase, development phase, commentary phase and authorization phase.

During the preparation phase, relevant topics were translated into clinical questions (CQs). This was achieved by consultation of the Task Force and research into OR procedures.[5] All NVvO members were given the opportunity to give feedback on the CQs before the literature search was performed.

2.3 | Literature search

In the development phase, a systematic literature search—based on the CQs—was performed in cooperation with a senior librarian specialized in health sciences (Supporting information). PubMed and EMBASE were searched until 26 January 2016. Two members of the Task Force (AMR and CW) assessed the literature search twice and independently, following predetermined inclusion and exclusion criteria (Table 1). The analysis was limited to randomized controlled trials (RCTs), and systematic reviews (SRs) were written in English and Dutch.

Initial screening for eligibility was based on title and abstract and was done separately for all CQs. The selected articles were screened based on full text. Differences between observers were discussed and solved by consensus. Articles that complied with the inclusion and exclusion criteria were then used to answer the CQs.

Study characteristics of the selected articles were clearly presented in evidence tables. If possible, a meta-analysis was performed

TABLE 1 Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
• Different types of retainers	• Bonding procedures
• Papers concerning efficacy	• Prosthetic retainers
• Papers concerning safety	• Retention combined with fiberotomy
• Complications	• Retention after removable orthodontic treatment
• Patient perception of retainers	• Surgical interventions
	• Cleft lip and palate, craniofacial anomalies

by pooling data across studies. Additionally, a hand search was performed on all relevant studies of the search.

2.4 | Assessment of quality of evidence

Two independent researchers (AMR and CW) assessed risk of bias using the Cochrane RoB tool and rated the quality of evidence using GRADE (Grading Recommendations Assessment, Development and Evaluation). Limitations in study design, inconsistency, indirectness, imprecision and publication bias were examined. Quality of evidence was rated—high, moderate, low and very low—for each outcome measure and reflects the degree of certainty that exists over the literature results.[11]

2.5 | Recommendations

During the Task Force meetings, evidence was discussed, and considerations were drafted to enable the development of recommendations. Other factors including patients' preferences, values and compliance, risks, side effects and organizational matters were also considered. Therefore, recommendations were based on available evidence combined with considerations based on additional literature and expert opinion.

The strength—strong, weak—of recommendations was dependent on the quality of evidence, the consensus considerations and the importance the Task Force assigned to the various aspects and arguments. According to the GRADE methodology, it is possible to draw strong recommendations with low levels of evidence, and vice versa. Based on the recommendations, an implementation plan was written.

2.6 | Commentary phase, authorization phase and implementation

A draft version of the CPG was sent to all members of the NVvO and other relevant stakeholders (Supporting information) for an external review, giving them the opportunity to comment within 7 weeks. After comments were considered and processed, an implementation plan was drafted, and the final CPG was approved by the NVvO and published on their website (www.orthodontist.nl). Moving through all phases of guideline development took 3 years.

3 | RESULTS

3.1 | Literature search

Based on the initial consultation of the Task Force and research into OR procedures, three CQs were formulated by the Task Force. They considered stability, failure, adverse effects and patient satisfaction as critical outcome measures for decision-making (Table 2). The search strategy for CQ1 yielded 723 studies in MEDLINE and 592 in EMBASE (Supporting information), of which 464 were duplicates. After screening according to title and abstract, 536 studies were excluded because they did not meet the inclusion criteria (no RCTs or SRs). Full-text screening of the remaining 315 eligible studies identified four SRs, of which one with 15 studies met the inclusion criteria (Figure 1).[12]

Regarding CQ1 comparison *a*, no studies were found suitable for analysis. Regarding CQ1 comparison *b*, *c* and *d*, the included RCTs are listed in Table 3. To answer CQ2 and CQ3, a hand search was performed on all relevant studies of the search.

3.2 | Literature analysis and quality of evidence

Risk of Bias tables for the included SR are found in Supporting information. If possible, each outcome of a CQ comparison was rated according to GRADE before literature conclusions and recommendations were drafted.

Reported evidence in the literature and the quality of evidence for the clinical questions are described in Table 3. In this table, the evidence for each specific outcome is enumerated and the GRADE level (*"Quality of evidence"*) indicated. In general, the quality of the available evidence was rated as low or very low and patient-reported

TABLE 2 Clinical questions

CQ 1	Which retainer is best for retaining the upper and lower arch after orthodontic treatment? • Fixed versus removable retainers upper arch *(a)* • Fixed versus removable retainers lower arch *(b)* • Design and wire material upper fixed retainers *(c)* • Design and wire material lower fixed retainers *(d)* • Removable retainers for upper and lower arch *(e)* Outcome measures Stability: Little's Irregularity Index, settling of the occlusion, intercuspid distance and molar distance, overjet and overbite Failure probability: bond failure, broken or lost retainers Adverse effects: periodontal bleeding, pockets and caries Survival time Patient's satisfaction
CQ 2	Which frequency of retention check-ups is advisable for different forms of retention?
CQ 3	What are the responsibilities of the orthodontist, dentist and patient to provide successful OR?

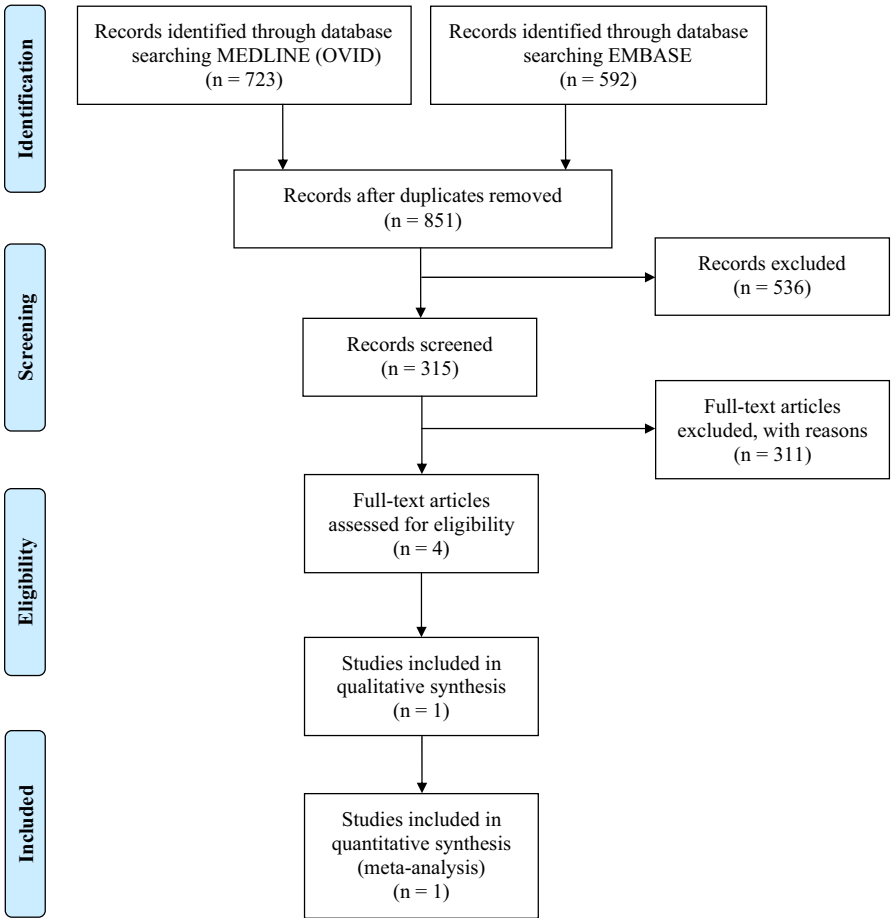

FIGURE 1 PRISMA flow chart [Colour figure can be viewed at wileyonlinelibrary.com]

outcome measures were virtually lacking. In case of low evidence and lack of outcome measures, the Task Force developed considerations and recommendations based on their interpretation of the literature, clinical experience and discussions held during the consensus meetings.

3.3 | Final recommendations

Recommendations were drafted for each CQ, based on the literature conclusions, expert considerations, clinical experience and discussions held during the consensus meetings. In four meetings, the Task Force reached consensus on the final recommendations, after which the conceptualized CPG was ready for the commentary phase.

3.4 | Commentary phase, authorization phase and Implementation

The Task Force received 125 comments of six stakeholders. The comments were reviewed and processed during a meeting of the Task Force. In July 2018, the final guideline was presented to the NVvO, whereafter formal authorization followed in September 2018. The implementation plan states that strong recommendations should be implemented within 1 year after publication of the CPG and others within 3 years after authorization. The CPG will be re-evaluated within 5 years and—if indicated—updated every 5 years.

4 | DISCUSSION

The aim of this CPG was to develop evidence-based, and if necessary, consensus-based, recommendations for OR. The discussion includes the considerations of the Task Force on available evidence, using relevant studies found during the hand search. The discussion is subdivided based on the clinical questions. Final recommendations follow after the discussion and are developed using both evidence and considerations.

During a Task Force meeting, it was considered that prior to orthodontic treatment, the retention modality for the upper and lower arch—with advantages and disadvantages—must be discussed with the patient and caretaker.

4.1 | CQ1*a* Which retainer is best for retaining the upper arch?

Based on Littlewood et al. (2016), no clear evidence exists which retention modality is preferred for the upper arch.[12] A recent publication provides an answer to the question, but the results must be interpreted with caution; according to Forde et al. (2018), upper arch alignment remains equally stable with removable and fixed retainers.[13]

For retention of the upper arch, Dutch orthodontists apply a combination of (a) a fixed and removable retainer, (b) a solitary fixed

TABLE 3 Literature conclusions and quality of evidence

Outcome	Literature conclusion	Quality of evidence GRADE	References first author year
CQ1*b*			
Stability	Orthodontic treatment results in the lower arch are best retained with fixed retainers.	Low	Millet (2007)[76]
Survival	Conflicting results are reported regarding failure rates among lower fixed and removable retainers.	Very low	Artun (1997)[78] Millett (2007)[75]
Adverse effects	More gingivitis and periodontal pockets are found with the use of fixed mandibular retainers, than with removable retainers.	Low	Millett (2007)[77]
Patient satisfaction	Patients accept removable vacuum-formed retainers better than fixed retainers.	Low	Millett (2007)[75]
	Patient satisfaction is similar for fixed and removable retainers.	Low	Millett (2007)[75]
CQ1*c*			
Survival	On the long-term base, no differences are found between the number of bond failures of glass fibre reinforced fixed retainers and multi-strand fixed retainers.	Low	Bolla (2012)[79], Salehi (2013)[22]
CQ1*d*			
Survival	Retainers made of thick, twisted multi-strand wires or single-strand wires—only bonded to the canines—and retainers made of thin multi-strand wires—bonded to all anterior teeth—do have a similar failure rate.	Low	Artun (1997)[78]
	Glass fibre reinforced fixed retainers and thin multi-strand fixed retainers do have a comparable failure rate.	Low	Bolla (2012)[79], Rose (2002)[80], Salehi (2013)[22]
CQ1*e*			
Stability	Little's Irregularity Index		
	Six months post-treatment, Little's Irregularity Index is equal after full-time and part-time wear of thermoplastic retainers.	Low	Gill (2007)[56]
	Derotated teeth are better retained with thermoplastic retainers (9-month part-time) than with Hawley retainers (3-month full-time, 6-month part-time).	Moderate	Rohaya (2006)[81]
	Three-month full-time wear of Hawley retainers, followed by 3-month part-time wear is superior to full-time wear of thermoplastic retainers for 1 week followed by part-time wear for 6 months.	Low	Rowland (2007)[47]
	One year post-treatment, Little's Irregularity Index is equal after full-time and part-time wear of Hawley retainers.	Low	Shawesh (2010)[57]
	Settling of the occlusion		
	Six months post-treatment, the number of occlusal contacts is equal after full-time wear of modified thermoplastic retainers and full-coverage thermoplastic retainers.	Very low	Aslan (2013)[65]
	An extra three-month part-time wear of modified thermoplastic retainers and full-coverage thermoplastic retainers, results in more posterior occlusal contacts with modified thermoplastic retainers.	Very low	Aslan (2013)[65]
	Intermolar and intercuspid distance		
	Six months post-treatment, intermolar and intercanine distances are equal after full-time and part-time wear of thermoplastic retainers.	Low	Gill (2007)[56]
	Intermolar distances are, after a 3-month full-time wear of Hawley retainers followed by a 3-month part-time wear, comparable with intermolar distances after 1-week full-time wear of thermoplastic retainers followed by 6-month part-time wear.	Low	Rowland (2007)[47]
	Overjet and overbite		
	Six months post-treatment, overjet and overbite are comparable after full-time and part-time wear of thermoplastic retainers.	Low	Gill (2007)[56]

(Continues)

TABLE 3 (Continued)

Outcome	Literature conclusion	Quality of evidence GRADE	References first author year
Survival	Six months post-treatment, the failure rate is higher for Hawley retainers than for thermoplastic retainers.	Moderate	Rowland (2007)[47]
	One year post-treatment, the failure rate for Hawley- and thermoplastic retainers is equal.	Low	Sun (2011)[82]
Patient satisfaction	Six months after treatment, compliance and acceptance (aesthetics and comfort) of thermoplastic retainers is better than compliance and acceptance of Hawley retainers.	Low	Rowland (2007)[47]

retainer or (c) a solitary removable retainer in respectively 54%, 34% and 1% of their cases.[5] Dual upper retention—a fixed retainer combined with a removable retainer worn nightly—is recommended in high-risk cases.[14,15] It prevents dental changes in case of bond failures and gives the patient extra time for repair. It also prevents tooth movement, deleterious effects on the periodontium caused by unintentionally active retainers and holds the transverse dimension if needed.[16]

The choice for the upper retention modality is determined by several factors: initial malocclusion, treatment result, treatment modality, oral hygiene, patients' compliance, personal preferences and practitioners' experience.[6,7]

Advantages and disadvantages of removable and fixed retainers can also determine the choice. Removable retainers are easy to clean, but compliance is difficult, even when the retainer only has to be worn at night.[13,17,18] If not worn as prescribed, relapse may occur.[19] Oral hygiene with fixed retainers needs to be perfect, while patients find them difficult to clean.[13,16,20] The use of upper removable retainers is preferred in cases with a low risk of relapse, poor oral hygiene, and after extractions and expansion.[6–8] However, since VFRs are contraindicated in patients with high plaque levels, HRs are indicated in those cases.[4]

Oral habits, including chewing on pens, nail biting and the opening of sports bottles, may compromise the enamel-composite interface, wire-composite interface or the retainer wire, resulting in breakage, bond failures and unintentionally active retainers causing unwanted tooth movements.[5,21,22]

4.2 | CQ1*b* Which retainer is best for retaining the lower arch?

Based on Littlewood et al. (2016), no clear evidence exists concerning which retention modality is preferable for the lower arch.[12] The more recent publications of Westerlund et al. (2015), O'Rourke et al. (2016) and Forde et al. (2018) conclude that lower arch alignment is more effectively retained with fixed rather than with removable retainers.[13,23,24] The increase in Little's Irregularity Index with removable retainers is most likely to be the result of poor compliance. Therefore, the Task Force recommended retention with fixed retainers in the lower arch.

In comparison with removable retainers, lower fixed retainers lead to more gingival bleeding, pockets and recessions.[20,25] The use of lower removable retainers is preferable in cases with poor oral hygiene.[7] However, since VFRs are contraindicated in patients with poor oral hygiene, HRs are indicated in these cases.[4] An alternative choice is a retainer only bonded to the lower canines.[7] For the patient and dental professional, the cleaning of this retainer type is easier.[26] Patients should, however, be informed about the risk of changes in alignment when retainers are only bonded to the lower canines. When oral hygiene is sufficient, lower fixed retention should be the first choice.[27] Dual lower retention—a fixed retainer combined with a removable retainer worn nightly—is recommended for high-risk cases, as is previously mentioned for the upper arch.[15]

4.3 | CQ1*c* Which design and wire material are best for upper fixed retainers?

Based on Littlewood et al. (2016), no clear evidence exists in determining which fixed retainer design and material is preferable for retention of the upper arch.[12]

Upper fixed retainers usually include either all six anterior teeth or only all four incisors.[5] When all anterior teeth are bonded, more failures/fractures are observed, probably due to contact of the lower canines with the wire.[28] According to Steinnes et al. (2017), alignment is eight years post-treatment stable when the retainer wire is only bonded to the upper incisors.[29]

Not only the design but also the material for bonded retainers is important. Overall, stainless-steel (SS) wires, either multistrand or single strand, and reinforced glass fibres are used in modern clinical practice. Our literature results regarding glass fibre reinforced fixed retainers contradict findings in more recent studies.[30,31] Although aesthetic in appearance, compared with SS wires, they are susceptible to a higher risk of failure. This is because they break easily and have higher failure rates due to contamination during bonding.[31]

The mobility of teeth connected to a retainer wire is dependent on wire material and its cross section.[32] Application of single-strand SS wires will result in lower tooth mobility compared to the use of multi-strand SS wires with identical design and cross section,

resulting in a higher risk of bond failures. Torque resistance of single-strand 0.016 × 0.016-inch SS wires and multi-strand 0.016 × 0.022-inch SS is much higher than torque resistance of round 6-stranded co-axial SS and 3-stranded twisted SS wires. Therefore, the former wires are preferred for retention of the upper arch.[33]

Stiffness of dead-soft—annealed—wires is reduced, resulting in an increased yield strength.[33] The advantage of dead-soft wires is their ease to adjust and insert. The disadvantage of dead-soft wires is their high risk of fracture and decreased retention capacity.[34–36]

Bonded retainers can become unintentionally active due to the properties of the wire material, elastic deflection during insertion and repair, mechanical deflection caused by chewing forces and parafunctions.[33,35,37–42] Although the incidence of this phenomenon is low, it is highly problematic, since the consequences can be dramatic if unnoticed.[39–41] The use of rectangular and square wires will decrease the incidence of unintentionally active retainers.[5,33]

4.4 | CQ1*d* Which design and wire material are best for lower fixed retainers?

Based on Littlewood et al. (2016), no clear evidence exists concerning which fixed retainer design and wire material is preferable for retention of the lower arch.[12] The choice of a fixed retainer design and wire material for retention of the lower arch is determined by the same factors as those for fixed retainers in the upper arch (see CQ1*c*).

Lower fixed retainers usually include either all six anterior teeth or are fixed to the canines only.[5] Our literature results regarding stability and failure rates with both retainer designs contradict with findings from more recent studies. When all anterior teeth are bonded, the lower front region is better stabilized; however, more failures are observed.[38,43]

From clinical experience, it is known that today's patients are more demanding, and their dental awareness has increased. Even small positional changes are no longer accepted. This has led to an increase in the use of lower retainers bonded to all anterior teeth instead of lower retainers only bonded to the canines.[5]

Although the failure rate of lower retainers bonded to all anterior teeth is higher than of retainers only bonded to the canines, preference is given to the retainer that seems to provide better stability.[38] In high-risk patients with extreme rotations and spacing in the anterior region prior to orthodontic treatment, the first choice in retainer should be a retainer bonded to all lower anterior teeth.

However, in cases of poor oral hygiene the use of a wire only bonded to the canines should be considered.[7] In comparison with a wire bonded to all lower front teeth, a wire only bonded to the canines is easier to clean for both the patient and the dental professional.[26]

When the wire is only bonded to the canines, rather than using a tick twisted multi-strand SS wire, a thick single-strand SS wire should be used. This is because a thick single-strand wire is more comfortable for the tongue and less plaque sensitive.[44,45]

4.5 | CQ1*e* Which type of removable retainer is best for retaining the upper and lower arch?

Based on Littlewood et al. (2016), no clear evidence exists to determine which removable retainer is best for retaining the upper and lower arch.[12] In general, HRs and VFRs are used and the stability of these appears to be comparable. If irregularities arise, they are usually not clinically relevant.[46–51] These findings suggest that factors other than stability are important in the choice of removable retainers.

Patients prefer VFRs over HRs because they are more comfortable.[52,53] According to Wan et al. (2016), this is due to the negative impact of HRs on speech.[54]

Results of studies into failure rates of HRs and VFRs show conflicting results. According to our results, HRs fail more often than VFRs. Pratt et al. (2011) compared both retainers one year post-treatment and found that VFRs fail more often.[55] Their explanation was that functional and parafunctional activities can lead to breakage. This phenomenon is particularly observed in grinders.

To date, research into the cost-effectiveness of various retention procedures and in patient satisfaction has received little attention. VFRs are more cost effective than HRs.[52,53] These factors should be further investigated.

According to our results, the full-time or part-time wearing of removable retainers is comparable in stability. This finding is supported in other studies.[56–59] However, during the first weeks directly after active treatment teeth are more prone to relapse.[60,61] When removable retainers are worn part time during this period, teeth will experience jiggling which is unpleasant for the patient.[62–64] Therefore, the wearing of removable retainers full time for a short period of time could be recommended, especially in patients with a high risk of relapse.[4] When removable retainers are combined with fixed retainers, less jiggling will be experienced and part-time wear of a removable retainer will be sufficient from the very beginning.

When comparing the different retention procedures with removable retainers, all seemed to be equally effective in stabilizing the treatment result on a short-term basis. However, strong evidence, regarding differences in stability between part-time retention with HRs and VFRs, was lacking.

The advantage of HRs is that teeth have the ability to settle, leading to more occlusal contacts and a better interdigitation. This is difficult to achieve with a full-coverage VFR.[65]

4.6 | CQ2 Which frequency of retention check-ups is advisable for different forms of retention?

Despite the use of retention, dental changes can occur after treatment. The periodontal fibres reorganize, forces act on the dentition due to orofacial muscles and occlusal contacts, post-pubertal craniofacial growth occurs, as does ageing.[2,3,66] Additionally, the compliance of the patient in wearing removable retainers and the side effects of fixed retainers make it necessary to plan check-ups after

treatment. The included systematic review did not pay attention to the frequency of retention check-ups.[12] An alternative literature search showed a lack of available literature on this topic. The number of retention check-ups varies a lot in number and duration.[5–8,55,67,68] Schneider et al. (2011) and others showed that failure of fixed retainers is highest directly after the debonding of orthodontics appliances.[28,69,70] The combination of increased mobility together with increased failure risk within the first month after debonding indicates the first retention check-up should occur within the first three months post-treatment. Additionally, the wearing of removable retainers can also be checked. When retention check-ups are frequently performed, the compliance of the patient can be positively influenced.[46,71] When no problems exist during the first retention check-up, a longer period until the next check-up can be advised. Two to three retention check-ups should be planned within the first year after treatment. Following this, an annual retention check-up is advised.[5,55] However, the increase in the number of patients together with the tendency towards permanent retention leads to an increase in work load.[5,8] Therefore, the Task Force considered to refer patients to their dentist for further retention check-ups which can be performed simultaneously with the annual dental check-up.

4.7 | CQ3 What are the responsibilities of the orthodontist, dentist and patient to provide successful OR?

Most orthodontists use permanent retention, and therefore, it is crucial to check retainers on a regular basis to examine their function and the health of surrounding tissues.[8,37,42]

Clear communication between the orthodontist and dentist about all aspects of OR is necessary in order to transfer the responsibility to the dentist.[26] It is not only important to request the dentist take over aftercare, but also necessary for agreements to be made between the orthodontist and dentist about repair and replacement of retainers. The dentist should be aware that despite the presence of retainers, changes in the position of the teeth and unwanted side effects may occur.[4] The role of the dentist in OR is of great importance in terms of (a) motivating patients to take care of their retainers and be compliant, (b) assessing whether the treatment result is stable, oral hygiene is appropriate and retainers are intact, (c) repairing or replacing retainers if necessary and (d) consulting the orthodontist if necessary.[14]

The orthodontist must provide patients with clear explanations of all aspects of OR. The responsibilities of the patient in the retention phase should be explained and patients must agree. This information should be in written form.[72] It is of great importance to inform the patient of the risk of undesirable changes in the position of the teeth.[15,73] To minimize this risk, regular retention check-ups, initially by the orthodontist and later by the dentist, are necessary. Patient satisfaction with the treatment result is strongly related to the patient's sense of responsibility for the retention phase.[53]

It is the responsibility of the orthodontist to provide clear information on OR, the patient has to accept this information and act accordingly, and the dentist has to deal with information provided by the orthodontist in a professional manner. Responsibility for the retention phase lies within the combination of orthodontist-patient-dentist. A joint responsibility for the retention phase can only be achieved with clear information.[72]

5 | KEY RECOMMENDATIONS

5.1 | CQ1*a* Retention in the upper arch

- Apply removable upper retainers in patients with a low risk of relapse.
- Apply fixed upper retainers in patients with a moderate risk of relapse.
- Apply dual upper retention in patients with a high risk of relapse.
- Consider the use of upper HRs in patients with poor oral hygiene.

5.2 | CQ1*b* Retention in the lower arch

- Apply fixed retainers for lower arch retention.
- Apply dual lower retention in patients with high risk of relapse.
- Consider the use of lower HRs in patients with poor oral hygiene.

5.3 | CQ1*c* Design and wire material for upper fixed retainers

- Bond all upper six anterior teeth in case of initial rotations.
- Use square or rectangular SS wire material for upper fixed retainers.
- Consider the use of lateral-to-lateral fixed upper retainers in case of dual retention.

5.4 | CQ1*d* Design and wire material for lower fixed retainers

- Bond retainers to all lower six anterior teeth in patients with a high risk of relapse.
- Use square or rectangular SS wire material for lower fixed retainers.
- Consider the use of retainers only bonded to the lower canines in patients with a low risk of relapse.
- Consider the use of thick single-strand SS retainers only bonded to the lower canines in patients with poor oral hygiene.
- Inform patients about the risk of changes in alignment when retainers are only bonded to the lower canines.

5.5 | CQ1*e* Removable retainers

- Choose, based on own experience and patients' preferences for a HR retainer or VFR
- Select, when anchorage for a HR is inadequate, a VFR
- Consider, in case of solitary removable retention and depending on the initial situation and treatment modality, short-term full-time wearing of removable retainers.

5.6 | CQ2 Frequency of retention check-ups

- Schedule the first retention check-up preferably within three months after insertion of the retainers.
- Schedule 2-4 retention check-ups in a period of 1-2 years after insertion of the retainers, depending on the timing of transferring the patient to the dentist.
- Communicate with the dentist regarding retention check-ups to guarantee effective retention aftercare.

5.7 | CQ3 Responsibilities orthodontist, dentist, patient

- Provide patients with all necessary information regarding their OR
- Provide dentists with all necessary information regarding the OR of their patients
- Refer the patient for aftercare to the dentist in a systematic and responsible manner

6 | LIMITATIONS OF THE CPG AND SUGGESTIONS FOR FURTHER RESEARCH

OR is of great importance for maintaining the result of active orthodontic treatment. In order to succeed, the orthodontist must offer the most appropriate retention modality and aftercare for the individual patient, the patient must comply with the rules, and the dentist must provide appropriate aftercare as part of regular dental check-ups, and if necessary, refer the patient back to the orthodontist. Undoubtedly, the success of OR is dependent on the orthodontist, patient and dentist working together and on the way in which each fulfils their duties. "When one of the three drops a stitch, the house of cards collapses."

Significant worldwide documented variability exists in OR procedures following active orthodontic treatment, underlining the need for and purpose of the development of a CPG for OR.[5,7,8] During the development of the CPG for OR, it became apparent high-quality evidence relating to the effectiveness, side effects and cost-effectiveness of different retainers and retention modalities together with patients' preference and satisfaction was lacking in the literature. This was especially evident in the reporting of patient outcomes. As a result, the strength of the recommendations is predominantly weak. The development of the CPG for OR is based on studies included in the systematic review undertaken by Littlewood et al. (2016) and a comprehensive review of additional literature.[12] From reviewing, analysing and evaluating the literature, it was possible to formally develop consensus among the Task Force in terms of substantiating the considerations and recommendations. With regard to CQ2 [Which frequency of retention check-ups is recommended?] and CQ3 [What are the responsibilities for the orthodontist, patient and dentist to provide successful orthodontic retention?], few studies were found in the literature. Therefore, the recommendations made in answering these CQs are predominately consensus-based.

A limitation of the development of a CPG is the time period needed to work through all phases—in accordance with the AGREE II instrument, EBRO and the RIGHT statement. The development of the CPG for OR took 3 years. It might be contended the guideline risks being out of date. However, it is impossible to carry out a new systematic search during the process. Therefore, in accordance with the AGREE II instrument, the board of the NVvO—as initiator of the development of a CPG for OR—will regularly review the guideline, by 2022 at the latest. Should new developments arise that challenge the validity of the guideline, the review process will commence sooner. For the updating procedure, clinical and methodological experts will be involved again.

Another limitation is the absence of input from laymen during the initial process of the guideline development. Their input would perhaps have provided a more patient-focused guideline. The patients' Federation was only involved in the commentary phase and had no comments.

Evidence-based recommendations in a CPG for OR are internationally relevant and therefore directly generalizable to other countries. However, differences in, for example, health insurance systems, legal obligations as well as cultural differences, may justify alternative recommendations within a CPG in different countries.[74] As an example, health insurance conditions in the UK (National Health Service) differ from those in the Netherlands. Consequently, recommendations on OR in the UK may differ from those in the Netherlands.

Littlewood et al. (2016) concluded there is insufficient evidence to make recommendations on orthodontic retention procedures after orthodontic treatment and advised further high-quality RCTs are needed.[12] However, we have shown that it is feasible to develop a CPG for retention according to an established scientific methodology, since a CPG is not just based on evidence, but also on experience and consensus. With the results of future well-designed RCTs, it must be possible to enhance the present CPG for retention. Appropriate outcome measures to further investigate include (long-term) stability, length of retention, survival, cost-effectiveness and adverse effects of retainers, and patient preference and satisfaction over the long term.[12] Also transversal, vertical and sagittal components of malocclusion should then be taken into account. Another important issue, because of the current propensity for the use of permanent fixed retainers, is to describe and investigate the onset of unintentionally active retainers, for the purpose of increasing retainer effectiveness, reducing failure rate, increasing patient compliance and limiting the incidence of unintentional active retainers.[5] The ultimate goal being to offer the best retention modality and aftercare for the individual patient.

7 | CONCLUSION

The paucity of evidence-based studies concerning OR leads to a CPG development mainly based on expert opinion and clinical evidence.

Nevertheless, this CPG provides practitioners with recommendations for best practice procedures in OR, may reduce variation between practices and assist with patients' aftercare. A carefully chosen retention procedure for the individual patient combined with clear information and communication between orthodontist, dentist and patient will contribute to the long-term maintenance of orthodontic treatment results.

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CONFLICT OF INTEREST

According to the "Code for the prevention of improper influence due to conflicts of interest" (http://www.haring.nl/download/tools/en/Code_for_the_prevention_of_improper_ influence_due_to_conflicts_of_interest.pdf) drawn up by a number of Dutch health authorities, all members of the Task Force were required to disclose potential conflicts of interest of the last three years regarding financial (relationship to commercial companies, personal financial interests, research funding) and indirect interests (personal relations, reputation management, knowledge valorization). None of the members of the Task Force declared any conflicts that would influence the development of the CPG for orthodontic retention.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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