Compliance with removable orthodontic appliances and adjuncts: A systematic review and meta-analysis

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Introduction: The primary aims of this systematic review were to assess objective levels of wear of removable orthodontic appliances and components vs both stipulated and self-reported levels. We also aimed to consider patient experiences and the effectiveness of interventions geared at enhancing compliance. **Methods:** Electronic databases and reference lists of relevant studies were searched with no language restriction (PROSPERO: CRD42016036059). Randomized and nonrandomized controlled trials, prospective cohort studies, case series, qualitative and mixed-methods studies objectively assessing compliance levels were identified. The quality of the studies was assessed using the Cochrane Collaboration's risk of bias tool, risk of bias in non-randomized studies of interventions (ROBINS-I), or mixed-methods appraisal tool based on their design. **Results:** Of 4269 records, 80 full texts were obtained, with 24 studies meeting the selection criteria. Of these, 11 were included in the quantitative synthesis. A weighted estimate of objectively assessed compliance levels in relation to stipulated wear time was calculated with the discrepancy highest in the headgear group (5.81 hours per day, 95% confidence interval, 4.98, 6.64) based on 6 studies. The mean discrepancy between self-reported and objectively assessed headgear wear was 5.02 hours per day (95% confidence interval, 3.64, 6.40). Compliance level was not directly related to appliance type ($P = 0.211$). Thematic synthesis was not undertaken because of the limited number of qualitative studies. **Conclusions:** Compliance with removable orthodontic appliances and adjuncts is suboptimal, and patients routinely overestimate duration of wear. Techniques for improving compliance have promise but require further evaluation in high-level research. (Am J Orthod Dentofacial Orthop 2017;152:17-32)

Compliance with removable orthodontic components can have a telling bearing on the efficiency and success or failure of orthodontics in the short and long term. Removable appliances continue to be popular despite the availability of compliance-free alternatives including fixed functional appliances, implant-supported devices, and fixed retainers. The continued use of removable components can be attributed to the relative simplicity of fabrication and adjustment, low cost, and reduced chair-side time. Moreover, fixed appliances place a higher premium on optimal oral hygiene and, although breakages of both removable[1] and fixed orthodontic appliances are frequent, fractures of fixed appliances are considerably more common at least in the short term.[2-4]

In terms of clinical effectiveness and associated harms, a lack of high-quality evidence to differentiate fixed and removable adjuncts including functional appliances and retainers has been demonstrated.[5-7] Notwithstanding this, it is accepted that achievement of optimal outcomes with removable appliances hinges on good compliance. A wealth of research has pointed to suboptimal compliance levels among orthodontic patients; moreover, candid patient reports of wear duration are typically not forthcoming.[8] Consequently, indwelling microelectronic timers have gained traction, primarily as a research tool, to corroborate reported

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estimates of appliance wear.[8] Depending on the timing and extent of poor compliance and overreporting of wear, these issues risk stagnation of treatment, unnecessary changes in treatment plans, compromised treatment outcomes, and orthodontic relapse after treatment.[9]

The problem of suboptimal compliance with removable appliances and adjuncts has been exposed in numerous contexts; however, relatively few interventions aiming to optimize appliance wear time have been studied. Furthermore, there is a lack of consensus regarding the anticipated wear levels associated with removable adjuncts and how this relates to reported wear durations. The primary aim of this review was therefore to assess levels of compliance with various removable orthodontic appliances and adjuncts. Secondary aims were to assess the effectiveness of interventions used to improve compliance levels, to explore patient experiences and interventions to enhance compliance with removable adjuncts, and to identify factors affecting cooperation.

MATERIAL AND METHODS

Protocol and registration

The protocol for this systematic review was prospectively registered on PROSPERO (www.crd.york.ac.uk/PROSPERO; CRD42016036059).

Eligibility criteria

The following inclusion and exclusion criteria were applied.

1. Study design. Quantitative studies including randomized, nonrandomized controlled clinical trials, prospective cohort studies, and case series (minimum sample size, 20 patients) incorporating objective data on compliance levels were eligible. Qualitative studies exploring patients' views and experiences of removable orthodontic appliances or adjuncts and the interventions used to improve compliance levels (including barriers and facilitators affecting wear of the appliance) were included. Mixed-methods studies in which quantitative or qualitative components met the above criteria were also included.
2. Participants. Patients of any age treated with headgear, protraction facemask, chincup, removable appliances, removable retainers, or fixed appliances with intraoral elastics as adjuncts were eligible.
3. Interventions and comparators. Orthodontic interventions including headgear, protraction facemask, chincup, removable appliances, removable retainers, or fixed appliances with intraoral elastics as adjuncts were included. The use of means of improving compliance was also to be assessed.
4. Outcome measures. Primary outcomes included compliance levels with orthodontic regimens (hours per day of wear or percentage of compliance) in relation to both stipulated and patient-reported levels of wear. Secondary outcomes were the impact of the interventions used to improve compliance levels and delineation of patient experiences and factors influencing compliance levels with wear regimens.

Information sources, search strategy, and study selection

The following electronic databases were searched from inception to May 2016 without language restrictions: MEDLINE via OVID using specific search terms (Appendix 1), PubMed, the Cochrane Central Register of Controlled Trials, Web of Science Core Collection, and LILACS and BBO databases. Unpublished clinical trials were accessed electronically using the following online portals: ClinicalTrials.gov (www.clinicaltrials.gov), the National Research Register (www.controlled-trials.com), and ProQuest Dissertation and Thesis database (http://pqdtopen.proquest.com). Citation tracking and searching of reference lists of the included studies was performed to identify relevant research. The authors of the included studies were contacted via e-mail if additional information was required.

Risk of bias and quality assessment in individual studies

After identification and retrieval of relevant abstracts, 2 authors (D.A., P.S.F.) independently identified studies that met the inclusion and exclusion criteria and assessed their quality. Reconciliation of disagreement followed discussion. The quality of randomized controlled trials was assessed using the Cochrane Collaboration's risk of bias tool with only studies at low or unclear risk of bias included in the meta-analysis.[10] The following domains were considered: sequence generation, allocation concealment, blinding of outcome assessors, incomplete outcome data, selective reporting, and other biases. The quality of nonrandomized clinical trials was assessed using the risk of bias in non-randomized studies of interventions (ROBINS-I), with studies of low or unclear risk of bias included in the meta-analyses.[11] The following domains were assessed: bias due to confounding, selection bias, bias in classification of intervention, bias due to missing data, bias in measurement of the outcomes, and selective reporting. The quality of mixed-methods studies was assessed using the mixed-methods appraisal tool, with a threshold score of 50% for inclusion assessing qualitative and quantitative aspects, as well as mixed-methods.[12] The quality of the included studies was