Original Contributions

Systematic Review

Enamel remineralization therapies for treating postorthodontic white-spot lesions

A systematic review

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Supplemental material is available online.

ABSTRACT

Background. One of the adverse effects of orthodontic treatment is the appearance of white-spot lesions (WSLs) resulting from enamel demineralization. The objective of this systematic review was to investigate the effectiveness of remineralization therapies on WSLs after orthodontic treatment.

Types of Studies Reviewed. In this systematic review, the authors identified relevant articles listed in 5 databases—PubMed, the Cochrane Library, Scopus, Embase, and Web of Science—by using a combination of search terms referring to orthodontics, demineralization, and treatment. Ten articles on the efficacy of WSL remineralization therapies met the inclusion criteria.

Results. Among the studies of remineralizing therapy, neither fluoride mouthrinses nor phosphopeptide toothpastes with or without fluoride had any positive effect in addition to oral hygiene maintenance with fluoride toothpaste. A 5% sodium fluoride varnish was the only therapy to show a statistically significant improvement compared with results in the control group. The authors found large variations in results among the studies reviewed because of the different methods used.

Conclusions and Practical Implications. None of the treatments was capable of remineralizing WSLs. A 5% sodium fluoride varnish could improve remineralization of WSLs.

Key Words. White-spot lesion; enamel demineralization; remineralization; fluoride.

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The aims of orthodontic treatment are to improve both dental function and esthetics. One of the adverse effects of treatment is the accumulation of plaque around the orthodontic brackets resulting from poor hygiene maintenance.[1] The production of organic acids by acidogenic bacteria lowers pH levels and dissolves the mineral content of dental enamel,[2,3] leading to the appearance of white-spot lesions (WSLs), a manifestation of early and reversible caries.[4-8] WSLs are characterized by an opaque white color derived from porosities created in the enamel subsurface. These often appear at the edges of the brackets and below badly fitting orthodontic bands.[9,10]

WSLs are prevalent, so they require special attention in terms of prevention.[2,11] However, despite the dentist's preventive measures and efforts to motivate the patient in oral hygiene practices, WSLs continue to be a problem because of a lack of patient cooperation.[12,13]

When clinicians have debonded brackets, the area returns to a favorable condition as hygiene improves.[1] Reestablishing pH levels helps small and superficial WSLs regress[13] because of the ions in saliva.[14] However, in most cases, the natural arrest of WSLs is insufficient and affects only the surface, so the white color persists.[2,15,16]

Enamel remineralizing treatments consist of agents such as fluoride or toothpastes containing casein phosphopeptide—amorphous calcium phosphate (CPP-ACP),[17] which are applied to WSLs. Nonremineralizing enamel treatments can resolve the problem more quickly by eliminating the appearance of WSLs. The most novel method, to our knowledge, consists of low-viscosity resin

infiltration, which fills the porosities to equalize the refraction index between healthy enamel (refraction index = 1.65) and the infiltrate (refraction index = 1.52).[15,18,19] Other techniques clinicians can use are microabrasion[10] and external bleaching.[20]

Clinicians can assess the size, severity, color changes, and progress of WSLs visually by various means, such as the International Caries Detection and Assessment System (ICDAS) II system,[6] image analysis software,[13,21] or by spectrophotometry (CIELAB color space).[18,20] The fluorescent imaging systems include the DIAGNOdent (KaVo Dental) caries detection aid[22,23] and the quantitative light-induced fluorescence (QLF) oral health assessment.[14]

Given the treatments available and the diversity of results deriving from their use, Huang and colleagues[21] noted that no systemic reviews had addressed specifically the remineralization of WSLs after orthodontic treatment and that a review on this topic could help assess the strengths and limitations of the published studies. Most of the literature focuses on the prevention of WSLs and has shown little evidence that the introduction of fluoride during orthodontic treatment reduces the severity of demineralization.[3] In this context, we aimed in this review to investigate the effectiveness of remineralization therapies on WSLs resulting from orthodontic treatment.

METHODS

Inclusion and exclusion criteria

We reported this systematic literature review according to the Preferred Reporting Items for Systematic Reviews and Meta-analyses criteria.[24] The research question was as follows: Is enamel remineralization therapy effective in treating WSLs after orthodontic treatment? The review included randomized controlled clinical in vivo studies in humans of all ages and both sexes who had completed orthodontic treatment and had at least 1 WSL after bracket debonding. Exclusion criteria were any other type of article, studies with a split-mouth design in which the investigators were studying remineralizing therapy (because there is always the risk that the agent can migrate through saliva and contaminate the control side), treatment of WSLs not stated to be the outcome of orthodontic treatment, or studies in patients still wearing brackets during the trial. We registered the review in the PROSPERO International Prospective Register of Systematic Reviews (registration CRD42017054109).

Search strategy

We conducted the search in 5 databases: PubMed, Embase, Scopus, the Cochrane Library, and Web of Science. In addition, we conducted an electronic literature search for gray literature in the New York Academy of Medicine Grey Literature Report. We applied the after filters to all databases: publication date within the past 15 years and studies of humans. We then searched the references cited in all the articles located to identify any additional articles. For the search, we used a combination of Medical Subject Headings and non–Medical Subject Headings terms together with Boolean operators (AND and OR) related to demineralization (*tooth demineralization*, *white spot lesion*, *early/incipient caries lesion*, *non-cavitated enamel lesion*, and *decalcification*), orthodontics (*orthodontic appliances*, *braces*, and *multibracket appliances*), treatment (*tooth remineralization*, *cariostatic agents*, *fluorides*, *fluoridation*, *caseins*, *CPP-ACP*, *CPP-ACFP* [casein phosphopeptide–amorphous calcium fluoride phosphate], *remineralizing agents*, *remineralization techniques*, and *minimally invasive treatment*), and participants (*human* and *in vivo*). The search covered the period up to and including March 2018.

Data extraction

Two researchers (L.F-.F., V.P-.G.) conducted the same search independently, and in cases of discrepancies in the results, they consulted a third reviewer (J.M.M-.C.). We extracted the following data from all the studies included for analysis to facilitate comparison among the articles: number of participants per group, age and sex, statistical unit (WSLs per tooth per patient), time since bracket debonding, duration of orthodontic treatment, type of intervention, follow-up time, diagnostic method used, and conclusions. Furthermore, we also extracted the quantitative progress values of the WSLs some study investigators measured by using DIAGNOdent and QLF.

ABBREVIATION KEY

- **C:** Control group.
- **CPP-ACFP:** Casein phosphopeptide–amorphous calcium fluoride phosphate.
- **CPP-ACP:** Casein phosphopeptide–amorphous calcium phosphate.
- **DD:** DIAGNOdent.
- **E:** Experimental group.
- **FT:** Fluoride toothpaste.
- **ICDAS:** International Caries Detection and Assessment System.
- **NA:** Not applicable.
- **QLF:** Quantitative light-induced fluorescence.
- **WSL:** White-spot lesion.