Journal of Dentistry 66 (2017) 8–17

Contents lists available at ScienceDirect

Journal of Dentistry

journal homepage: www.elsevier.com/locate/jdent

Review article

Performance of pit and fissure sealants according to tooth characteristics: A systematic review and meta-analysis

Spyridon N. Papageorgiou[a,*], Dionysia Dimitraki[b], Nikolaos Kotsanos[b], Katrin Bekes[c], Hubertus van Waes[a]

[a] Clinic of Orthodontics and Pediatric Dentistry, Center of Dental Medicine, University of Zurich, Zurich 8032, Switzerland
[b] Department of Paediatric Dentistry, Aristotle University of Thessaloniki, Thessaloniki 54124, Greece
[c] Department of Paediatric Dentistry, Medical University Vienna, School of Dentistry, Vienna 1090, Austria

ARTICLE INFO

Keywords:
Dental sealants
Caries
Treatment effectiveness
Randomized clinical trial
Systematic review
Meta-analysis

ABSTRACT

Objective: Aim of this systematic review was to assess the clinical performance of sealants on various teeth in an evidence-based manner.
Sources: Five databases were searched from inception to February 2017.
Data: Randomized clinical studies on humans.
Methods: After duplicate study selection, data extraction, and risk of bias assessment according to the Cochrane guidelines, Paule-Mandel random-effects meta-analyses of Relative Risks (RRs) and their 95% confidence intervals (CIs) were calculated.
Results: A total of 16 randomized clinical trials with 2778 patients (male/female 49.1%/50.9%) and an average age of 8.4 years were included. No significant difference in either caries incidence of sealed teeth or sealant retention could be found according to (i) mouth side (right versus left), (ii) jaw (upper versus lower), (iii) and tooth type (1st permanent molar versus 2nd permanent molar/1st permanent molar versus 2nd deciduous molar/1st deciduous molar versus 2nd deciduous molar), based on evidence of very low to low quality. On the other side, compared to 1st permanent molars, sealed premolars were significantly less likely to develop caries (3 trials; RR = 0.12; 95% CI = 0.03 to 0.44; P = 0.001) and less likely to experience loss of the sealant (5 trials; RR = 0.33; 95% CI = 0.20 to 0.54; P = 0.001), both based on low to moderate quality evidence.
Conclusions: The performance of pit and fissure sealants does not seem to be negatively affected by mouth side, jaw, and tooth type, apart from the exception of a favorable retention on premolars.
Clinical significance: Based on existing evidence, pit and fissure sealants can be effectively applied on any deciduous or permanent posterior teeth without adverse effects on their clinical performance.

1. Introduction

1.1. Background

Dental caries remains the most common chronic disease amongst all oral conditions [1] with prevalence of untreated caries or caries experience ranging between 21% (children 6–11 years old), 58% (adolescents 12–19 years old), and 91% (adults older than 20 years old) [2,3], and differences according to geographic region [4] and family income [5].

Dental caries manifests itself as a continuous range of disease with increasing severity and tooth destruction, varying from subclinical changes to lesions with dentinal involvement [7,8]. Although the initial caries stages lack clear symptoms, this is not the case when lesions progress into dentine [9]. Dental caries can result in aesthetic, functional, or psychosocial complaints in a child's daily routine that ultimately affect their quality of life, including chewing and speech impairment, school absenteeism, decline in school performance, trouble sleeping, irritability, and refraining from smiling or speaking [10–13], while it is the primary cause of oral pain and tooth loss [9].

Overall, about half of all carious lesions are found in the pits and fissures of permanent posterior teeth [6], although caries is not confined solely to permanent teeth. This has to do with the direct influence of internal morphology of the interlobal groove-fossa system and caries progression [14], due to the easier bacterial accumulation, qualitative differences of pit-and-fissure plaque with smooth-surface plaque, and difficulty of plaque removal from the occlusal surfaces [8,15]. Additionally, fluoride is less effective at preventing caries in these

* Corresponding author at: Clinic of Orthodontics and Pediatric Dentistry, Center of Dental Medicine, University of Zurich, Plattenstrasse 11, Zurich 8032, Switzerland.
E-mail address: snpapage@gmail.com (S.N. Papageorgiou).

http://dx.doi.org/10.1016/j.jdent.2017.08.004
Received 3 May 2017; Received in revised form 30 July 2017; Accepted 5 August 2017

secluded tooth surfaces than at smooth surfaces [16], due to the anatomical particularities of the former.

The procedure of 'sealing' the pits and fissures of teeth was introduced in the 1960s to protect the tooth from caries and includes the placement of a liquid material onto the occlusal surface (i.e. pits and fissures) of posterior teeth, thereby forming a layer that is bonded micromechanically and acts mainly as a barrier against acids and the subsequent mineral loss from within the tooth [17]. Pit-and-fissure sealants can be placed on either caries-free posterior teeth to prevent pit-and-fissure caries or on teeth with incipient caries lesions to prevent their progression to definitive caries [17]. There is a vast wealth of available clinical evidence about the effects of dental sealants. Recent systematic reviews and meta-analyses of randomized clinical trials concluded that pit and fissure sealants are effective and safe to prevent or arrest the progression of non-cavitated carious lesions compared with a control without sealants [19,20] and have a caries-preventive effect equal [21] or better [20,22] than fluoride varnishes. Additionally, the use of adhesive systems beneath pit-and-fissure sealants has been reported to increase the sealant's retention, with conventional etch-and-rinse systems being preferable to self-etching systems [18]. Finally, further uses of dental sealants include sealing palatal surfaces of anterior teeth to protect against erosive tooth wear [23], sealing anomalous dental morphologies like talon cusps or hypomineralizations [24,25], or sealing smooth enamel surfaces to protect against caries during orthodontic treatment [26], but these fall out of the scope of the present review.

1.2. Rationale

Although the overall efficacy of dental sealants has long been documented in randomized clinical trials and systematic reviews thereof [19,20,22], it remains unclear whether the clinical performance of sealants is affected by the various tooth types. The most recent evidence-based clinical practice guideline for the use of pit-and-fissure sealants published by the American Dental Association and the American Academy of Pediatric Dentistry in 2016 [27] recommended the use of sealants compared with nonuse in primary and permanent molars with both sound occlusal surfaces and non-cavitated occlusal carious lesions in children and adolescents. However, no distinction was made between 1st and 2nd molars, and premolars were not mentioned at all. Additionally, the guideline authors highlighted the need for additional studies assessing the effect of sealants in the primary dentition. This information could have direct implications on the clinical decision of which teeth should be sealed by the dentist. Therefore, the aim of the present systematic review was to answer the clinical question: "Is the clinical performance of dental sealants affected by tooth characteristics (like tooth type, jaw, or side, etc.)"?

2. Materials and methods

2.1. Protocol and registration

The review's protocol was made a priori following the PRISMA-P statement [28], registered in PROSPERO (CRD42017058510), and all post hoc changes were appropriately noted. This systematic review was conducted and reported according to Cochrane Handbook [29] and PRISMA statement [30], respectively.

2.2. Eligibility criteria

According to the Participants-Intervention-Comparison-Outcome-Study design schema (PICOS), we included randomized clinical trials on human patients including at least one trial arm comparing the clinical performance of pit and fissure sealants with any other active, control, or placebo modality. We subsequently selected trials that compared any two or more different groups in terms of tooth characteristics (tooth type, jaw, or side). Excluded were non-clinical or non-randomized studies, case reports, animal studies, and studies that did not directly compare between different teeth.

2.3. Information sources and literature search

Five electronic databases were systematically searched by one author (SNP) without any limitations from inception up to February 23, 2017 (Appendix A in Supplementary material). Additionally, five sources (Google Scholar, International Standard Registered Clinical/soCial sTudy Number registry, Directory of Open Access Journals, Digital Dissertations, and metaRegister of Controlled Trials) and the reference/citation lists of included trials were manually searched for any additional trials. Authors of included trials were contacted for additional missed or ongoing trials. No limitations concerning publication language, publication year, or publication status were applied.

2.4. Study selection

The eligibility of identified studies was checked sequentially from their title, abstract, and full-text against the eligibility criteria by one author (SNP) and were subsequently checked independently by a second one (DD), with conflicts resolved by a third author (NK).

2.5. Data collection and data items

Study characteristics and numerical data were extracted from included trials independently by two authors (SNP, DD) using pre-defined and piloted extraction forms including: (i) study characteristics (design, clinical setting, country), (ii) patient characteristics (age, sex, status of sealed teeth), (iii) interventions used, (iv) follow-up, and (v) study outcome measures. The primary outcome of this systematic review was dental caries of the sealed tooth, while the secondary outcomes included combined (total or partial) loss of the sealant, total loss of the sealant, need for re-sealing, and replacement of the initial sealant by a restoration. Piloting of the forms was performed during the protocol stage until over 90% agreement was reached. Missing or unclear information was requested by the trials' authors and re-analyzed firsthand, when possible.

2.6. Risk of bias in individual trials

The risk of bias of included RCTs was assessed in duplicate by the same two authors (SNP, DD) using Cochrane's risk of bias tool [29]. A main risk of bias assessment was included in the systematic review pertaining to each trial's primary outcome.

2.7. Data synthesis

Meta-analysis was performed if similar interventions and control groups were compared and similar outcomes were measured. As the clinical performance of dental sealant might be affected by treatment-related characteristics (clinical setting, operator's experience, technique adequacy, materials used) or patient-related characteristics (age, sex, dietary or oral hygiene habits), a random-effects model was judged as clinically and statistically appropriate [31]. The novel random-effects model proposed by Paule and Mandel was preferred a priori over the more widely known DerSimonian and Laird method to estimate all pooled data, as it outperforms the latter [32]. Relative Risks (RR) and their corresponding 95% Confidence Intervals (CI) were calculated. Statistically significant results of binary meta-analyses were translated clinically using the Number Needed to Treat (NNT). If included trials had clustered data and raw data were acquired, we re-analyzed the trial's results ourselves with generalized linear regression accounting for clustering with robust standard errors. Comparisons among the various tooth categories were performed taking the 1st permanent