

The Effectiveness of the Partial Caries Removal as a Treatment Option in Deep Carious Lesion Management- Review

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ABSTRACT

Background: Dental caries is a widely prevalent disease, burdening billions of individuals and causing significant healthcare costs. The treatment of deep carious lesions approaching a healthy pulp presents a significant challenge to the practitioner. The traditional management of carious lesions indicates the removal of all infected and affected dentin providing intact tissues for the restoration that carried risks exposing or even breaching the pulp, to minimize that risk alternative concepts of caries removal provided such Stepwise technique and Partial caries excavation technique.

Objectives: To evaluate the effectiveness of the partial caries removal technique by analyzing previous literatures discussing the management of deep carious lesions in permanent and primary teeth. The data were collected from five randomized control trails, four systematic reviews, one critical review and two retrospective studies that comparing between partial caries removal and other techniques in deep carious lesions management and the clinical and radiographical outcome of this technique and also the survival of restorations and the risk factors associated with the partial caries removal.

Results: Partial caries removal is preferable to complete caries removal in the deep lesion to reduce the risk of carious exposure. There is no need to reopen a cavity and perform a second excavation for pulp vitality to be preserved. There was no adverse events relating to soft demineralized dentin left on the pulpal wall of the cavity were observed, making partial caries removal advantageous, particularly in the treatment of caries in proximity to the pulp. Partial caries removal restorations showed high rates of clinical and radiographical and the failure due to patient related factors such as high caries rate.

Conclusion: With the limitation of the study, the partial caries removal technique show high success rate both clinical and radiographical. It's reduced the incidence of pulp exposure and preserves tooth vitality. Partial caries removal can be considered as a treatment option in deep carious lesion management in primary and permanent teeth.

Keywords

Dental caries, Enamel, Infected dentin, Cavity.

Introduction

Dental caries is a widely prevalent disease, burdening billions

of individuals and causing significant healthcare costs [1-3]. The carious process begins in the enamel, with demineralization caused by bacterial acids that come from dental biofilm. Usually, enamel lesions can be arrested via control of dental biofilm, dietary changes and the adequate use of fluoride [4,5]. When the carious

lesion is not controlled, the dental-enamel junction will be affected and the lesion will progress towards the dentinal tubules, triggering progressive changes in the dentin's hardness [4]. As a result of these changes, the dentin may be divided into two layers, which are distinct from the morphological, biochemical, bacteriological and physiological points of view. The external layer of carious dentin is made up of a superficial necrotic softened tissue, irreversibly denatured and without possibility of remineralization and filled with bacteria is called infected dentin. The underlying layer is partially demineralized, the tissue harder than the infected dentin and may be remineralized, being defined as affected dentin [4,6,7].

The treatment of deep carious lesions approaching a healthy pulp presents a significant challenge to the practitioner. The traditional management of carious lesions of any kind dictates the removal of all infected and affected dentin to prevent further cariogenic activity and provide a well-mineralized base of dentin for restoration [8]. The conventional treatment paradigm has a long history. G.V. Black, in his classic 1908 text, asserted that "it is better to expose the pulp of a tooth than to leave it covered only with softened dentine" [8,9]. However the conventional treatment procedure risks exposing or even breaching the pulp, the course of treatment becomes less predictable and may require such measures as direct pulp capping (typically using a protective material such as a calcium hydroxide-based preparation), pulpotomy or, in the most extreme cases, pulpectomy [8].

For asymptomatic and vital teeth, conservative strategies have clinical advantages over the complete removal of decayed tissue as, besides preserving more of the tooth structure, they also enable the creation of a favorable environment for remineralization and repair of the pulpal tissues [4,10,11]. To minimize the risks of pulp exposure and postoperative pulpal complications, two alternative options have been proposed:

Stepwise technique (complete excavation in two steps)

In this technique removal of decayed tissues in two stages. complete removal of the softened tissue from the walls surrounding the cavity and of the most softened and infected dentin on the pulp wall should be performed, with part of the disorganized dentin remaining at the bottom of the cavity, cavity may be filled with calcium hydroxide-based material, and sealed with temporary restorative material, remaining for a period of 2 to 9 months, or even 12 months, in the first stage of the treatment, then the cavity reopened for potential supplemental removal of the decayed tissue that remained in the cavity, followed by definitive restoration in the second stage [4,8,10,12,13].

One of the advantages of stepwise excavation is the possibility of clinically monitoring the alterations that occur in the dentine during the treatment intervals. Several studies have demonstrated the dentine after the treatment intervals become dried, hardened and darker, indicated that the carious lesion has been arrested. The results of microbiologic analysis between the stages of stepwise excavation have demonstrated that the total colony forming unit (CFU) counts of *S. mutans* and *Lactobacillus* were gradually

reduced during the treatment. Also the distribution of the species found in the dentine after the treatment interval did not characterize the typical microbiota of deep lesions, which confirms the clinical findings that lesions had been arrested [8,10-18].

Partial (incomplete/selective) excavation

Partial removal of decayed tissue in a single session consists of removing the infected dentin and preserving carious dentin remains close to the pulp and the cavity is sealed with a definitive restoration. This concept is based on substantial evidence that removal of all carious dentin in deep carious lesions is not required for successful lesion management, provided that the restoration can effectively seal the lesion from oral environment. This technique showed lower long-term costs, longer-retained teeth and better pulp preservation than complete excavation (in one or two steps) [8,10,11,16]. The partial removal of carious dentin and sealing of the tooth can result in a significant reduction of microorganisms present in the remaining dentin, giving scope to control deep caries lesions while maintaining the integrity of the pulp tissue [12,14,15,17].

Partial caries removal technique could be preferable more than Stepwise technique because of the re-opening the cavity during stepwise excavation may lead to pulp exposure during cavity re-opening and in stepwise excavation is the use of temporary restoration between sessions, which may become lost or are forgotten by patients, which would increase the chances of failure of the technique [10,14].

Discussion

The initial removal of the cariogenic biomass appears to be essential for control of caries progression of caries progression. A significant reduction of aciduric bacteria such as mutans streptococci and *Lactobacillus* spp. suggested that there was absence of caries lesion activity, and the restored microenvironment was less activity, and the restored microenvironment was less acidic as compared to carious tissue environment [12,14-17]. Lula E.C.O et al. [18] were compared microbial counts between categories of carious dentin color, consistency and humidity, and to evaluate the correlation between these characteristics and the presence of cariogenic microorganisms in deep cavities (2/3 or more of the dentin thickness) submitted to partial caries removal they found Arrest of dentinal caries lesions was observed after sealing, which was characterized by a reduction of bacterial counts and changes in dentin color, consistency and humidity, irrespectively of baseline dentin characteristics. The sealed carious dentine was less infected than the remaining dentine left after conventional caries removal and sealing and not necessary to remove all carious dentine before the restoration is placed because over time, sealing of carious dentine results in lower levels of infection than traditional dentine caries removal [19]. They found the number of anaerobic and aerobic bacteria, lactobacilli, and mutans streptococci decreased at the end of treatment ($p<0.05$). Significantly less anaerobic bacteria ($p<0.01$), aerobic bacteria ($p=0.02$), and mutans streptococci ($p<0.01$) growth was observed after Incomplete caries removal-Seal compared to Complete caries removal. The difference in

lactobacilli was insignificant ($p=0.08$). The amount of bacteria detected after conventional caries removal was higher than that which remained in sealed caries lesions. Singhal D, et al. [17] were compared microbial counts in cavities submitted to complete caries removal and partial caries removal using either hand instruments or burs before and after 3 weeks of restoration, their results showed Three techniques of caries removal showed significant ($P < 0.05$) reduction in all microorganisms studied after 3 weeks of evaluation, but there was no statistically significant difference in percentage reduction of microbial count among three groups. That's can be explained by (Van Thompson et al in 2008) [8]. The cariogenic bacteria, once isolated from their source of nutrition by a restoration of sufficient integrity, either die or remain dormant and thus pose no risk to the health of the dentition.

Whilst there is evidence that partial caries removal can be the elective treatment, there is insufficient evidence to indicate whether it would be necessary to re-enter and excavate further in a stepwise excavation [20]. Later Maltz M, et al. [21] found there is no need to re-open a cavity and perform a second excavation for pulp vitality to be preserved and no adverse events relating to soft demineralized dentin left on the pulpal wall of the cavity were observed, when they compared partial caries removal vs. stepwise for 3 years follow up. Same authors in 2013 by multicenter study with 18 months follow up, they reached to the same conclusion that the procedure of reopening the cavity to remove the residual infected dentine is not necessary and the retention of carious dentine does not interfere in pulp vitality [22].

The conventional treatment of deep carious lesions by Total caries removal compromised pulp vitality that making the Partial caries removal the elective treatment of choice in these carious lesions. Several studies reach to these results such as the systematic review of Ricketts D, et al. [20] that the partial caries removal in symptomless, primary or permanent teeth reduces the risk of pulp exposure and the study of Rando-Meirelles MPM, et al. [23], the partial removal of carious dentin in a single session in permanent teeth could be indicated to maintain pulp vitality since no unsatisfactory clinical and radiographic results were shown after twenty four months follow up for the permanent teeth performed partial caries removal. Schwendicke F, et al. [24] found incomplete caries removal seems advantageous, particularly in the treatment of caries in proximity to the pulp, since it significantly reduces the risks of pulpal exposure and post-operative pulpal symptoms compared with complete excavation. Both Stepwise and partial excavation reduced the incidence of pulp exposure in symptomless, vital, carious primary as well as permanent teeth.

Dalpian DM, et al. [25] were to analyze the outcomes of partial caries removal (Partial caries removal) restorations in primary teeth in their retrospective study they found after follow-up period ranged from 1 to 50 months for 254 teeth in 118 subjects, overall success rate for Partial caries removal was 80.3% (204/254) and the Partial caries removal restorations showed high rates of clinical and radiographic success when performed in primary teeth and constitute an important minimal intervention alternative

for treatment of acute deep dentin. A significant association was found between high final visible plaque index and PCR failure ($P = 0.002$). Franzon R, et al. [26] were compared 24-month pulp health outcomes of partial caries removal (Partial caries removal) and (Total caries removal) with composite restoration in primary molars in their randomized control trial that included 120 teeth and they found The clinical and radiographic success rates of Partial caries removal and Total caries removal in primary teeth with deep carious lesions were high and did not differ significantly, Success rates were 92 and 96% in the Partial caries removal and Total caries removal groups, respectively ($p = 0.34$) and The success rate affected by the shape of the cavity which is lower in occlusoproximal (92%) than in occlusal (100%) lesions ($p = 0.08$), the partial caries removal has significantly lower operative time than Total caries removal and lower incidence of pulp exposure in 2 and 27.5% of teeth treated with Partial caries removal and Total caries removal, respectively ($p<0.01$).

Conclusion

With the limitation of this review we found the Partial caries removal reduces the risks of pulpal exposure, post-operative pulpal symptoms and preserve tooth vitality. No risk to left infected dentine under the restoration sufficiently sealed and no need for reentry to remove the residual dentine. It showed high success rate both clinically and radiographically.

Partial caries removal showed significant reduction in bacterial count, results in lower levels of infection than traditional dentine caries removal.

These findings make the Partial caries removal the elective treatment of choice in carious lesions with proximity to the pulp in primary and permanent teeth.

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