

Stepwise Excavation A Conservative Community-Based Dental Treatment of Deep Caries to Preserves the Tooth Vitality

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Abstract

Operative dentistry not only requires technical expertise and an in-depth understanding of materials science, but knowledge in cariology and pulp biology is also essential. Treatment of deep caries 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 . Clinical study on stepwise excavation of deep carious lesions in vital permanent teeth: a18-month follow-up study shown this technique is a conservative community based treatment. This study reports results from treated deep carious lesions by using stepwise excavation. The material comprised 35 teeth with deep carious lesions at risk of pulp exposure if the demineralized dentin was eliminated completely. These patients were from 13 to 25 years of age, the teeth that were selected didn't have spontaneous or percussion pain or periapical pathology. At 6-7 months after sealing the cavity, only sensitivity tests, like thermal stimulation, were done to evaluate pulp vitality. The rationale for this approach is that by this point any remaining bacteria will have died, residual infected dentin as well as affected dentin will have remineralized and reparative dentin will have been generated ,making it easier to remove any remaining carious tissue. In a study survival rate for permanent molars 93% shown that treatment of the teeth with this technique will decrease the number of pulpal exposure during carious tissue removal from teeth with deep caries lesions. This technique is a conservative community based treatment which helps the public dental health with less expense while maintaining pulp vitality.

Key Words: Operative dentistry, Pathology, Dental health, Caries

Introduction

Operative dentistry not only requires technical expertise and an in-depth understanding of materials science, but knowledge in cariology and pulp biology is also essential.

Treatment of deep caries 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. Pulp vitality is extremely important for the tooth viability, since it provides nutrition and acts as biosensor to detect pathogenic stimuli. In 1938, Bodecker introduced the Stepwise Excavation (SWE) technique for treatment of teeth with deep caries for preservation of pulp vitality, It is a conservative approach to treat deep dental caries lesions where the exposure of the pulp is probable. In case of pulpal exposure, Root Canal Treatment (RCT) is the routine treatment method. However, RCT is an expensive treatment also most of the patients in Saudi Arabia have phobia from RCT; patients may become inclined to have their teeth extracted to avoid the RCT expenses and visits. Consequently, this leads to poor dental health of people, which in turn affects overall health of the community [1,2].

Stepwise Excavation is an old concept but has probable gained a growing interest in the recent years from different researchers due to advances made in techniques and dental materials with good sealing ability and antibacterial properties such as Calcium Hydroxide or MTA (Mineral Trioxide Aggregate). Clinical study on stepwise excavation of deep carious lesions in vital permanent teeth: A 12-month follow-up study shown this technique is a conservative community based treatment.

Aim

The success of the treatment depends directly on adequate clinical and radiographic diagnosis and good planning, in the case of teeth with vital pulp, the carious tissue should be removed with caution to avoid accidental pulp exposure¹. the aim of this clinical study is to clarify that the use of stepwise excavation technique for treatment of teeth with deep caries for preservation of pulp vitality by isolation any remaining bacteria will have died, residual infected dentin as well as affected dentin will have remineralized and reparative dentin will have been generated so diminishing progression of the lesion or even arresting it. And through a review of the literature, to discuss the advantages, limitations and indications of this technique.

Materials and Methods

Thirty five female patients from thirteen to twenty five year old come to my dental clinic in Medical

Center of Umm Al-Quraa University complaining of non-spontaneous pain. Criteria for selection of the patients according to

- Examination & history of complains the material comprised 35 teeth with deep carious lesions at risk of pulp exposure if the demineralized dentin was eliminated completely
- Deep dentinal lesions likely to result in pulp exposure during single excavation
- Clear evidence of pulp vitality and no evidence of irreversible pulpitis
- No history of spontaneous or prolonged pain
- Positive pulp vitality test (electric, thermal, mechanical).
- Negative to percussion/palpation.
- Radiographically: >75% through dentin and no periradicular pathosis.

-Reliable patient controls and follow up in place1.

Example of one case, 20 year female patient attended in the clinic by clinical examination, the presence of an extensive cavity was noted (Figure 1) and through a radiographic exam, it was verified that the lesion extended well into the dentine with risk of pulp exposure during removal of carious tissue (Figure 2). Pulp vitality assessment with cold was performed, the diagnosis being reversible pulpitis. Isolation of the operating area was carried out to avoid contamination, Access to the cavity was performed with high speed spherical diamond tips. The carious dentin was removed with sharp curettes, starting with the dentine above the pulp wall and the remaining carious dentin was left on the pulp wall. At this



Figure 1. Clinical appearance of dental caries lesion in tooth 15, before treatment.

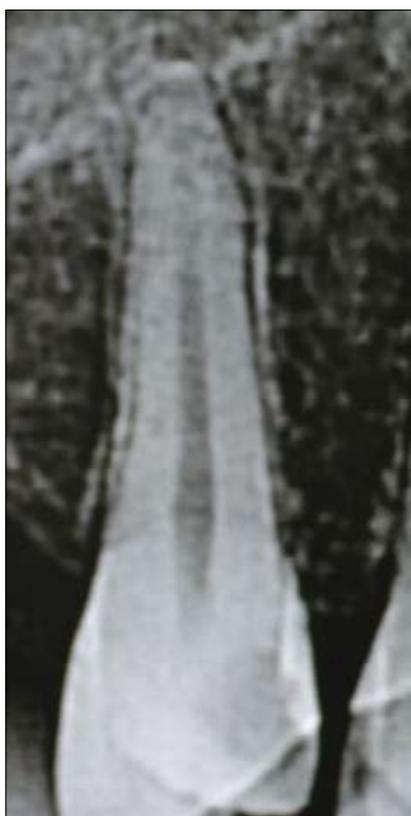


Figure 2. Radiographic view of the extension of the carious lesion, indicating risk of pulp exposure during removal of carious dentin.

point, diagnosis between demineralized and contaminated dentin is critical; if only demineralized dentin is present, definitive restoration treatment with pulp protection with calcium hydroxide or MTA (Mineral Trioxide Aggregate) can be performed. However, if there is any doubt about the remaining dentin being contaminated, the ideal solution is to perform provisional sealing before definitive restoration. In this case, as there was a large amount of softened dentin, the cavity was cleaned with air/water jets and a layer of calcium hydroxide paste was applied to the entire pulp wall for this case (Figure 3). The cavity was provisionally sealed with a hybrid material of glass ionomer cement and composite resin (Vitremer 3M ESPE) which is outstanding because it releases fluoride and is more resistant to occlusal forces. The signs and symptoms of reversible pulpitis disappeared, the patient did not return for treatment after 90 days and it was only after 12 months that it was possible to contact and resume treatment. However, systematic observations of pulp vitality should be made during the waiting period1, because the possibility exists of asymptomatic pulp necrosis developing. After 12 months, a radiographic exam was performed and the formation of a thin layer of tertiary dentin and normal periapical appearance was noted [3-9]. The tooth was isolated with a rubber dam and the temporary sealing was removed with high speed spherical diamond tips. Dentin presented a dark color, with a hard consistency on probing, with an appearance of dentin with arrested caries. Thus, the decision was taken not to remove this residual tissue. Etching was performed with 37% phosphoric acid for 20 seconds on the enamel and 15 seconds on the dentin. The acid was removed with jets of water and the cavity was softly dried with jets of air, taking care to keep the dentin humid for the application of the adhesive system. Two layers of a water and alcohol-based single-bottle adhesive system (Single Bond, 3M ESPE) were applied for 5 seconds and the solvent evaporated with air jets. Next, the adhesive was activated for 20 seconds. A layer of



Figure 3. Temporary restoration of tooth 15, using a resin-modified glass ionomer cement, after partial removal of decayed dentin.

resin-modified glass ionomer was applied as an indirect pulp protector (Vitremmer, 3M ESPE) and it was photo-activated for 40 seconds. The restoration was formed with nanoparticle composite resin (Z350, 3M ESPE) inserted in layers using the incremental technique [3].

Results and Discussion

The extent to which the carious dentin should be removed is an important decision for the clinician before placing a restoration, especially in deep caries lesions where the vitality of the pulp can be compromised. Although some morphological studies have shown a defined boundary between the highly caries infected and the caries affected dentin, clinically this presents a subjective and difficult decision regarding the amount of dentin that should be excavated. Some studies have shown that is not possible to eliminate all the micro-organisms even during a conventional caries removal, as a few bacteria will remain even after all soft dentin is removed. However, some studies that have evaluated activity and progression of lesions restored with remaining infected dentin, have shown that the majority of the lesions appeared to be arrested both clinically and radiographically and showed a decrease or absence in micro-organisms with time. Good case selection and good sealing with restorative materials that enhance the dentin’s potential to remineralize are recommended. Providing a good restoration seal has been suggested to be key in arresting and preventing caries progression (Figure 4).

The studies frequently considers the stepwise excavation technique to be a type of indirect protection of the pulp-dentin complex [1-8]. However, in an ideal situation an indirect protection should only be placed on sound or demineralized dentin and the stepwise technique consists of placing biocompatible materials such as Calcium Hydroxide or Mineral Trioxide Aggregate on the carious dentin, in order to stimulate the formation of tertiary, sclerotic or remineralized dentin [9-10]. However, it must be treated as a specific technique, developed to avoid pulp exposure during carious

tissue removal from teeth with deep caries lesions, since it consists of the application of a biomaterial which will remain active on the dentin for a period of at least 45 days and which, if necessary, will later be removed along with the remaining carious dentin. Since there is no evidence that the re-opening procedure is necessary, and provided that the patient does not present irreversible pulpitis, a thin layer of contaminated carious dentin can be left and the tooth can be definitively restored. The stepwise excavation technique is recommended for teeth with deep caries lesions, where the removal of carious tissue in a single step would lead to pulp exposure [11-12]. It is recommended for the stepwise excavation technique, the diagnosis of pulp condition is essential for the success of treatment, as it is necessary for the pulp to present as normal or with reversible inflammation, in order to obtain a potential healing response [2,3,5]. The removal of central cariogenic biomass of dentin and the superficial part of demineralized dentin already guarantees a lower degree of bacterial activity in the cavity, enabling the pulp to react better. However, removal of carious tissue in deep lesions does not need to be as rigorous as traditionally recommended, as there will be repeat intervention for the removal of this dentin [1-12]. Removal of dentin associated with the application of Biomaterial can cause a potential dentin healing response [8-12].

Studies have shown that cavity sealing alone is sufficient to promote hardening of carious lesion that indicates its arrest. It should be noted that only cavity sealing of carious dentin causes a great reduction in the number of microorganisms. Thus, it is supposed that, in order to guarantee success, all that is required is to use good biocompatible sealing material with the purpose of preventing the penetration of aggressive agents and their metabolic products, which affect the pulp through the dentinal tubules. Glass Ionomer cements are outstanding because they are biocompatible, they bond to the dental structure, have a thermal linear expansion coefficient similar to that of the dentin and they also release fluoride that enhances remineralization. It is reported that the action

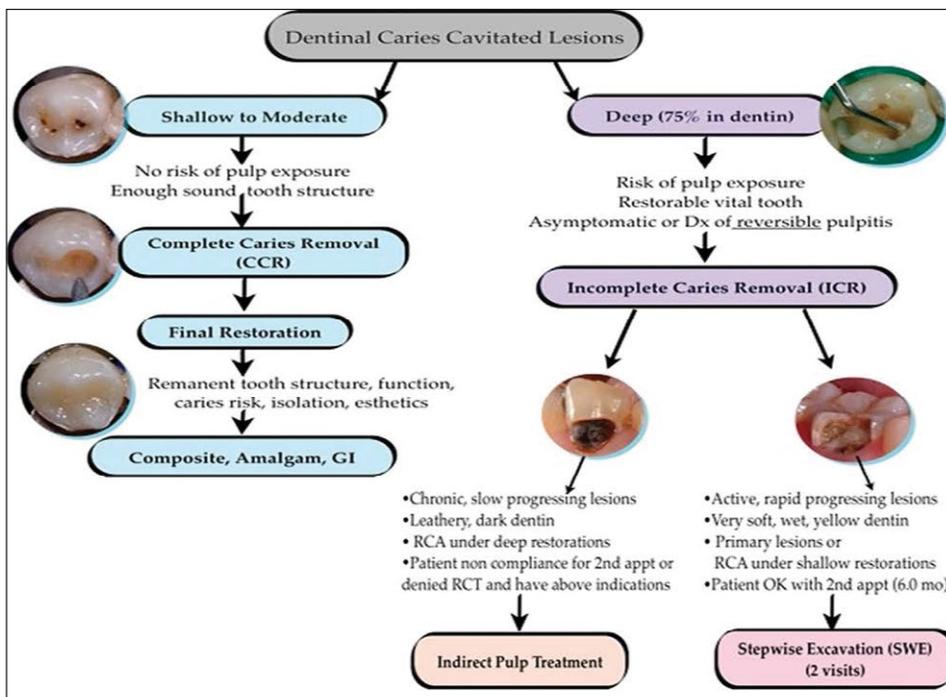


Figure 4. Decision tree for conventional caries removal vs incomplete caries removal.

of fluoride from ionomeric materials is continuous, as this material also presents a sponge effect, incorporating the fluoride from the medium to release them in a situation of cariogenic challenge. Among these materials, the resin-modified ionomers are excellent because, although they may cost more, they can guarantee better esthetics and mechanical resistance while waiting for pulp response [9].

It is important that, at the end of the waiting period, the responses to the pulp sensitivity and radiographic examinations are normal, so that I can proceed with definitive restorative treatment.

Clinical studies have shown high success rates for the stepwise excavation technique [1,8,11], success rate of 63% over 10 years of follow-up, and after removal of provisional restoration an increase in the radiographic density of the remaining dentin is noted, which suggests an increase in mineral quantity with carious lesion arrest and tertiary dentin deposition.

As in the present clinical study, longitudinal clinical assessments show that in 32 cavities (3 patients didn't come to their appointments) findings would imply that by removing some of the carious biomass and sealing the remaining caries from extrinsic substrate and oral bacteria, the caries left behind after the first excavation had become less active. This allows time for pulp-dentine complex reactions to take place so that at the second excavation visit, there is less likelihood of pulpal exposure. It has also been suggested that by changing the cavity environment from an active lesion into the condition of a more slowly progressing lesion, this will be accompanied by more regular tubular tertiary dentine formation. In a study

survival rate for permanent molars 93% shown that treatment of the teeth with this technique will decrease the number of pulpal exposure during carious tissue removal from teeth with deep caries lesions, In case of pulpal exposure, Root Canal Treatment (RCT) is the routine treatment method. However, RCT is an expensive treatment also most of the patients in Saudi Arabia have phobia from RCT, therefore patients may become inclined to have their teeth extracted to avoid the RCT expenses and visits. Consequently, this leads to poor dental health of people, which in turn affects overall health of the community. This technique is a conservative community based treatment which helps the public dental health with less expense and phobia while maintaining pulp vitality [9-14].

Many studies confirm the benefits of partial removal of carious dentin, the application of biomaterial and cavity sealing, and at a later stage, complete removal of carious dentin (stepwise excavation technique) in contrast to the complete removal of carious tissue. Thus, the stepwise excavation technique treatment can be considered a safe therapy, scientifically corroborated, and with a high rate of success [1-3,9-17].

Conclusion

It may be concluded that the stepwise excavation technique has the advantage of avoiding pulp exposure during carious tissue removal from teeth with deep caries lesions and also of changing the cavity conditions [11], promoting dentin formation and pulp repair. This technique is a conservative community based treatment which helps the public dental health with less expense phobia while maintaining pulp vitality.

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