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Clinical Technique/Case Report

Stepwise Excavation in a Permanent Molar: 17-year Follow-up

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Clinical Relevance

Due to the risk of pulp exposure in deep carious lesions, stepwise excavation can be a conservative and successful option for selected cases, when signs and symptoms of a normal pulp are present.

SUMMARY

The current study presents a 17-year clinical report of stepwise excavation and indirect pulp capping in a lower right first molar, with great dentin destruction and a lack of dentin support of the cusps. At the first appointment, indirect pulp capping with calcium hydroxide and a temporary filling with zinc oxide cement were performed to minimize the risk of pulp exposure during excavation. After 45 days, the remaining carious tissue was removed and a restoration with glass-ionomer lining (Vitrebond) and resin composite (P-50) was performed. Satisfactory morphology and function of the restoration and pulp vitality were preserved for 17 years, thus indicating that stepwise excavation can be a good treatment alternative in selected cases.

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INTRODUCTION

An important concern in the treatment of deep caries lesions is the maintenance of pulp vitality.[1-2] Traditionally, restorative procedures involve the removal of soft demineralized dentin before the filling is placed. However, this approach may result in an invasion of bacteria if mechanical exposure of the pulp occurs. In order to minimize this problem, stepwise excavation and indirect pulp capping become an interesting possibility.

Stepwise excavation consists of removal of the infected dentin and preserving a layer of deeper caries-affected dentin, if pulp exposure is probable during excavation.[3-5] Thus, the first step consists of partial caries removal, indirect pulp capping with calcium hydroxide and cavity sealing. After an 8 to 12 week absence of signs and symptoms of pulp pathology,

when pulp healing and deposition of tertiary dentin is expected, the remaining carious tissue is removed and the tooth is restored.[6]

Studies demonstrate that partial caries removal in deep lesions minimizes the risk of pulp exposure when compared to complete excavation.[3,7] Stepwise excavation controls caries progression[1,4] and induces physiological defense mechanisms in the pulp-dentin complex.[3] Calcium hydroxide has been used as a classic liner due to its ability to stimulate the formation of sclerotic and reparative dentin, other than reducing the number of microorganisms.[4] An increased possibility of repair is expected when there is no pulp exposure.[3] If pulp exposure occurs during excavation, the results from stepwise excavation are uncertain due to infection of the pulp, and the possibility of a successful outcome is reduced.[2]

PURPOSE

This paper presents the 17-year follow-up of a tooth restored according to stepwise excavation and discusses the most relevant aspects related to a potentially successful outcome.

Potential Problems

The possibility of pulp exposure during excavation is present in deep carious lesions. Therefore, stepwise excavation can be used to minimize the risk of exposure and, consequently, avoid endodontic treatment. If pulp exposure occurs, the results from stepwise excavation are uncertain, due to pulp infection, and the possibility of maintaining tooth vitality is reduced.[2]

Advantages and Disadvantages

The main purpose of stepwise excavation is to preserve tooth vitality, which, if achieved, preserves dental structure. Otherwise, endodontic access will produce a phenomenon known as elongation of the dental cusps, which deflect during mastication and, as a result, increases the risk of dental fractures. When compared to sound teeth, those that are submitted to endodontic access and restored with resin composite are less resistant to compression stresses.[8] Therefore, the preservation of tooth vitality may indirectly minimize dental fractures.

Other than requiring two sessions and waiting for a period of time before the final restoration, a recognized disadvantage of the stepwise excavation is failure in pulp repair. In situations of deep cavities, when dentin has been exposed for long periods of time and chronic pulp inflammation is present, pulp necrosis might occur. In these situations, pain and discomfort may be present after the first intervention and endodontic treatment is inevitable.

DESCRIPTION OF THE TECHNIQUE AND DISCUSSION

A female patient (24-years old) presented an occlusal caries lesion in the lower right first molar with great dentin destruction and a lack of dentin support to the cusps (Figure 1). In the radiograph, a radiolucent image was near the pulp and no periapical alteration was visible (Figure 2). The patient reported only transient pain to cold and sweet shortly before treatment. Positive responses to cold and negative responses to percussion were detected clinically as compatible with normal pulp; therefore, a treatment plan was guided to preserve tooth vitality.

The destruction of dentin and proximity of the lesion to pulp was confirmed after partial excavation (Figure 3). Stepwise excavation significantly reduced the chance of pulp exposure when compared to immediate complete excavation.[3] According to the stepwise excavation, indirect pulp capping with calcium hydroxide paste (Figure 4) and a temporary filling with zinc oxide cement (Figure 5) followed removal of the infected dentin. The high pH of calcium hydroxide associated with sealing of the cavity has been found to significantly reduce the counts of anaerobic and aerobic bac-

Figure 1. *Clinical aspect of the carious lesion in the lower right first molar.*

Figure 2. *Great dentin destruction and no periapical alteration at the periapical radiograph.*

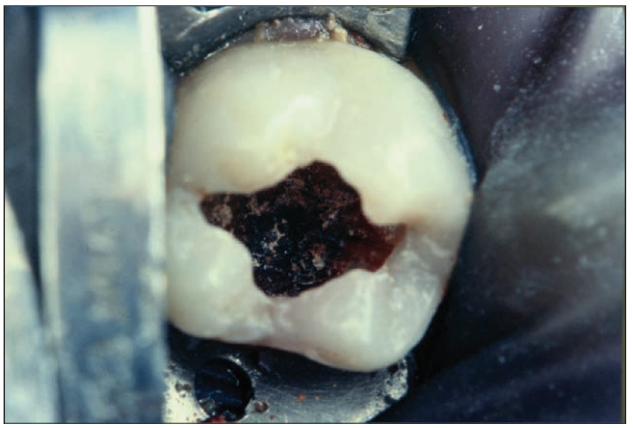

Figure 3. *Clinical aspect of the tooth after partial caries excavation.*

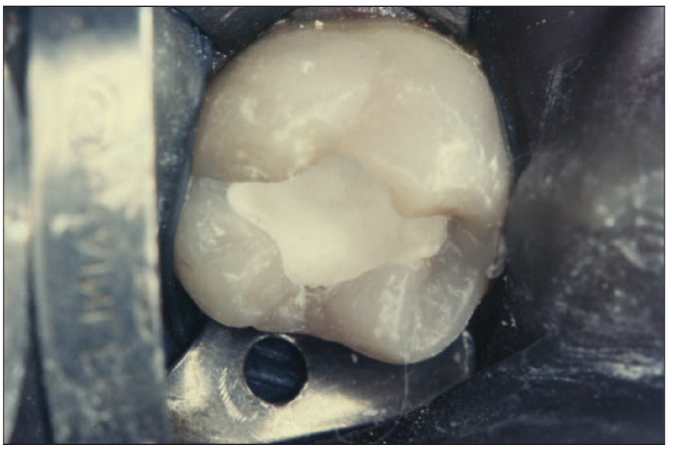

Figure 4. *Calcium hydroxide paste applied on the remanescent carious dentin.*

Figure 5. *Temporary filling with zinc oxide cement.*

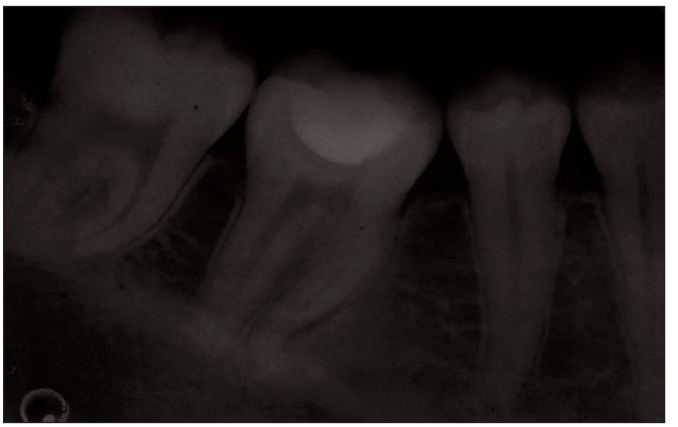

Figure 6. *Periapical radiograph at the 45-day recall.*

Figure 7. *Excavation of the carious tissue and finishing of the enamel margins. Presence of sclerotic dentin.*

Figure 8. *Resin modified glass-ionomer lining.*

teria, *Lactobacilli* and *Streptococci mutans*, and thus arrest lesions after incomplete caries removal.[1,4]

At the second visit (after 45 days), the patient reported no spontaneous pain. Response to cold stimulus was immediate and declined quickly, similar to the response registered in the adjacent tooth. Vertical percussion with an instrument did not result in increased sensibility when compared to the adjacent tooth. In the radiograph, no radiolucency was visible in the periapical area (Figure 6). All these signs and symptoms were compatible with the response of normal pulp and the restorative procedure was carried out.

Figure 9. *Final restoration with resin composite.*

Figure 10. *Clinical aspect of the restoration at the one-year recall.*

Figure 11. *Six-year control radiograph.*

Figure 12. *Restoration at the 10-year recall.*

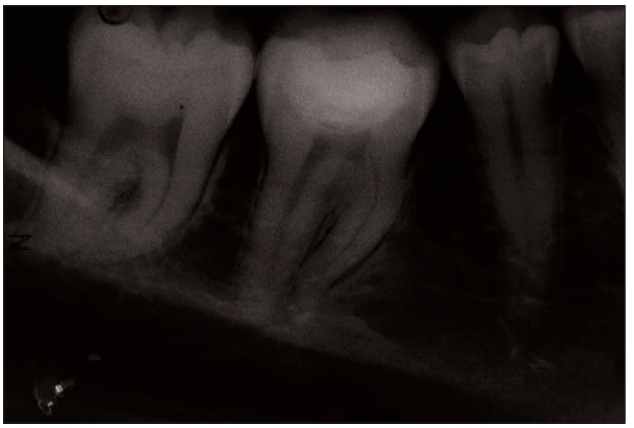

Figure 13. *Periapical radiograph at the 10-year recall.*

Figure 14. *Clinical aspect of the restoration at the 17-year control.*

The temporary restoration was removed under rubber dam and a conservative preparation was performed. It was limited to caries excavation and finishing of the enamel margins (Figure 7). Resin modified glass-ionomer cement (Vitrebond, 3M ESPE, St Paul, MN, USA) was applied as a dentin substitute and light-cured on the pulp floor and undermined cusps (Figure 8). Glass-ionomers are preferably used in undermined cusps, since the high polymerization shrinkage of resin composite can result in microcracking of the enamel or cusp deflection.[9]

Enamel was available for bonding to the resin composite (Figure 8). Enamel etching with 37% phosphoric acid for 30 seconds was carried out. Rinsing and drying were followed by application of the bonding agent (Scotch Bond, 3M ESPE) according to the manufactur-

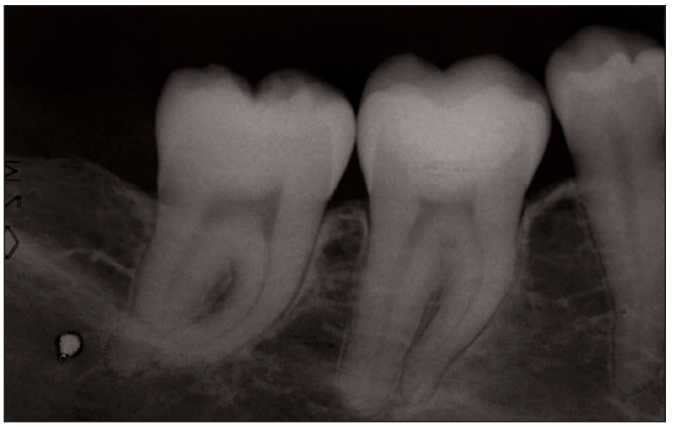

Figure 15. *Normality of the periapical radiograph at the 17-year control.*

er's instructions. Resin composite (P-50, 3M ESPE) was inserted in increments during restoration to minimize shrinkage stresses.[9]

Satisfactory anatomy, color and texture were immediately established with the restoration (Figure 9). Good performance was noticed after one year; despite the slight alteration in texture, no signs of marginal leakage or fracture were observed (Figure 10). After six years, normal pulp response and no radiographic periapical pathology (Figure 11) or marginal gaps were present. Studies demonstrate that the success rate for stepwise excavation varies between 90% during the first six months[4] to 75% at 40-months follow-up.[1] Slight marginal degradation and wear were noticed at the 10-year recall (Figure 12); however, satisfactory marginal sealing, the absence of pain or hypersensitivity and a normal periapical image were observed (Figure 13). A satisfactory performance was still noticed after 17 years, although marginal degradation, color change and wear became more evident (Figure 14). The success of the restoration was confirmed by the absence of marginal leakage, caries or fractures. A normal radiographic image (Figure 15) was observed at the 17-year recall. Pulpal tests, such as sensitivity to cold and percussion, were performed again at follow-up. Sensitivity to the thermal test was compatible to pulp normality; the response was similar to the adjacent teeth and quickly declined when the cold stimulus was removed. No pain was detected during the percussion test.

CONCLUSIONS

Stepwise excavation can be a good treatment alternative in select cases, based on careful pulp diagnosis, supported by evaluation of the history of pain, symptoms and clinical/radiographic findings.

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