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Review Article

Restoration techniques of fractured endodontically treated teeth

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ABSTRACT

This literature review aims to discuss and collect evidence about restoration techniques of fractured endodontically treated teeth. According to studies in the literature, root canal treatment and restoration of endodontically treated teeth have been reported as two separate clinical procedures although many aspects of both procedures are similar. Conducting restoration procedures following endodontic treatment has been reported to be so important as the first obturation of the root canal, and it has been reported with many advantages and favorable events, including eradication and minimizing the presence of bacteria and microorganisms, which might induce serious complications to the affected teeth. Additionally, the literature review discusses the technique of interim restorations, which has been reported to have favorable advantages and outcomes. However, it should be noted that the process is temporary and definitive restorations must be conducted later on. Also, this research investigates the different substances that should be used with the modality, and the different approaches that were previously reported to restore mature and immature affected teeth. Finally, evidence shows that amalgam-based restorations are becoming inferior to resin composite-based restorations which are also more superior to the stainless-steel crown-based ones. Unifying the guidelines for clinical practice is encouraged to obtain favorable outcomes. All the detailed techniques are presented and fully discussed within the main text of this research.

Keywords: Dentistry, Management, Endodontics, Restorations

INTRODUCTION

According to studies in the literature, root canal treatment and restoration of endodontically treated teeth have been reported as two separate clinical procedures although many aspects of both procedures are similar. Conducting restoration procedures following endodontic treatment has been reported to be so important as the first obturation of the root canal, and it has been reported with many advantages and favorable events, including eradication and minimizing the presence of bacteria and microorganisms, which might induce serious complications to the affected teeth.[1-3] Many investigations have been published

regarding the restoration techniques that were reported with various types of fractures following endodontic treatment modalities. However, no clear guidelines and protocols were drawn for such procedures.[4,5] Accordingly, this literature review aims to discuss and collect evidence about restoration techniques of fractured endodontically treated teeth.

METHODS

This literature review is based on an extensive literature search in Medline, Cochrane, and EMBASE databases on 4th June 2021 using the medical subject headings (MeSH), and a combination of all possible related terms. This was followed by the manual search for papers in Google Scholar and the reference lists are included at the end of this research.[6,7] This research discusses the restoration techniques of fractured endodontically treated teeth that were screened for relevant information. There are no limits on date, language, age of participants, or publication type. Many techniques have been previously proposed for restoring the fractured teeth during endodontic treatment. The following section discusses the common techniques and the various aspects that should be considered during the clinical settings that should be considered by the attending dentists and surgeons.

DISCUSSION

Interim restorations

Provisional, interim, or temporary restorations must be effectively done with materials that prevent leakage to intervene against the progression of any microleakage events and the development of bacterial-related adverse reactions.[8-10] It was previously demonstrated that coronal microleakage is estimated to be the most common cause of endodontic treatment failure. Contamination of the root canal due to incompetent restorations can significantly lead to endodontic treatment failure and periapical inflammation. Obtaining a poor coronal seal was previously reported with performing interim restorations.[11,12] They mainly depend on providing short-term effective functions and esthetics, with preservation of the hard and soft tissues intact and with no complications until the establishment of the definitive restorations are performed. Additionally, a previous investigation reported that following root canal therapy results in better survival rates of the corresponding endodontic-treated teeth which were significantly associated with the early inauguration of interim restorations.13 Selecting the appropriate material is a challenge that should be considered when performing interim restorations, and the process mainly depends on the intended duration of the restoration. For instance, cement as zinc oxide eugenol (ZOE) should be used for short-term interim restorations that are indicated to last for a maximum duration of 1-2 weeks.[14] On the other hand, more durable cement types should be used when the definitive restorations are expected to be delayed, as resin-modified glass ionomers (RMGIs), Glass ionomers, Polycarboxylate, or Zinc Phosphate. These substances were previously reported to be more durable with favorable seals against dentin in the affected teeth, which allows them to be associated with both long and short-term outcomes with interim restorations. However, it should be noted that these substances can only be used for a while, and cannot replace definitive restorations.[15] Using calcium sulfate for interim restorations was also previously reported in the literature. However, full removal of these fillings before definitive restorations are required to prevent the development of any potential complications. Moreover, it was previously demonstrated that neither Cavit™, Intermediate Restorative Material (IRM®), or TempBond™ were associated with adequate prevention of 30-day coronal leakage after being installed as interim restorations.[11] It was also reported that interim restorations were associated with worse endodontic treatment prognosis when compared to definitive restorations, even if the latter was conducted later on.[16]

It should be noted that installing temporary restorations might be required between the different sessions to prevent the accumulation of bacteria in the root canal and intervene against the development of any complications.[17] Maximizing the thickness of the used material and minimizing the height of the cotton pellet is recommended, in addition to using a sponge rather than cotton to reduce the rate of bacterial growth.[18] In another context, provisional onlays or crowns might be indicated in severely damaged teeth, and many substances as resin composites and acrylic have been recommended for such purposes, which has been previously reported with both indirect and direct interim restorations, with the former providing more favorable marginal integrity than the latter.[19] The installment of temporary posts might also be indicated together with the interim restorations for select premolar and coronally compromised anterior teeth. However, it should be noted that such a process should be approached with minimal cement materials for easy removal of the posts during definitive restorations. Zinc oxide-based cement materials are the main materials that have been used for luting provisional crowns whether the types containing eugenol or others without it. Among studies in the literature, evidence was controversial regarding using these materials with resin composites and their abilities to prevent polymerization and enhance the adherence to the underlying dentin.[20,21] Finally, all the materials and pellet cotton that has been used for interim restorations should be adequately removed before conducting definitive restorations to obtain better outcomes and enhance the prognosis of endodontic treatment.

Techniques of restoring mature teeth

Following obturation and before removing the dental dam, foundation restoration should be conducted immediately even when the symptoms and signs were not still absent following this procedure. Following this, it has been previously demonstrated that it is considered safe to

remove the obturation materials.[22] Endodontic treatment modalities can now be inaugurated and preparation of the post space modalities can be done during this procedure of following it, as previous investigations have reported that the leakage outcomes are similar irrespective of the time of post space preparation.[23] However, interventions against potential contamination should be conducted at all stages. Using a composite resin buildup and a fabricated post can then be used for the restoration of the structural compromisation of an anterior tooth. However, it should be noted that the cemented post might be only attached to the most apical area within the post space when it is too wide. This can lead to the development of significant complications due to the potential breakdown of the cemented post leading to leakage, post-retention loss, caries, and failure of the crown. Using custom cast posts was also recommended for certain situations with loss of main structures of the tooth and root canal, aiming at achieving better adaptation with the new morphology of the root canal. It should be noted that removing the obturation materials by a single millimeter beneath the floor of the pulp is recommended. Besides, excess sealers should also be removed because, for instance, zinc oxide-based ones can significantly lead to the inhibition of polymerization, and it can lead to preventing the glass ionomer potential adhesions to the corresponding dentin.[24]

It has been previously reported that the majority of the affected anterior teeth can be successfully restored using dental resin composites. It is also recommended that the structure of the tooth should be preserved as much as possible because root canal filling is usually associated with thinning of the tooth wall, in addition to the weakness noticed with crown preparations.[25] In fractured anterior teeth with no access opening, it is recommended that direct restoration of the lost parts is preferred to obtain better outcomes with no further impact on the remaining structure of the tooth. After pacing the gutta-percha below the cementoenamel junction by few millimeters, using a glass ionomer is required to decrease the need for excess bulk of resin composites and to preserve the materials that were used in the root filling process. Although the installation of posts does not strengthen the affected teeth, they prevent any further weakening of these teeth by preventing any further dentin removal.[26,27] To establish a corona-radicular workup in a posterior tooth, 2-3 intact walls are necessary.[27,28] Early sealing of the canal should also be sought with suitable barriers as hydrophilic resin, flowable composite resin, or glass ionomer if early restoration could not be obtained.[29,30] For premolars with retained palatal and buccal walls, they can be normally restored by approaching a core buildup as definitive restorations with no need for post-placement modalities. Many studies have been previously published and guidelines were announced to report on the suitable characteristics of the process of post-placement.[31,32] However, it was also reported that irrespective of the type and characteristics of the used posts, using a cervical ferrule should be approached by 2 mm to the tooth structure to prevent any potential fractures to the root.[33]

Techniques of restoring immature teeth

The main goal of restoration of these teeth is to preserve as much as possible of the affected structure. Previous investigations have reported that stainless steel crowns or preformed metal crowns should be used for immature teeth until placing the implants for these affected teeth with space maintenance to prevent any potential complications because these teeth are more prone to fractures and other subsequent adverse events.[34,35] Other more recent investigations have evaluated the use of regenerative techniques and innovative obturation modalities through the application of different materials as mineral trioxide aggregate and bioceramics that have been previously reported to stimulate the growth of the nerve roots within a dead or necrotic tooth tissue. These effects, in addition to increasing the thickness of the walls of the affected teeth, have been indicated by previous investigations.[36,37] Using amalgam as the core material for dental restorations, successful procedures were reported with affected teeth that have been observed with huge loss of the coronal structures.[38] However, it has been reported that using amalgam instead of dentin in such procedures can significantly increase the risk of complications as contamination and bacterial infections, in addition to fractures.[35,39,40] Accordingly, adopting stainless steel crowns in such procedures is recommended to prevent potential crown fractures and other complications as microleakage and bacterial contamination.[35] These modalities were previously validated with no or reduced adverse events on periodontal health. On the other hand, poor installation and adjustment of the modality have been previously reported to cause inflammation and increased risk of the compromised periodontium, in addition to potential microleakage and tooth affection.[38,41,42] It has been previously demonstrated that translucent cores of resin composites are also effective materials that can be used in restoration procedures with favorable outcomes, with reported improved strengths and resistance to fractures decreasing the need to perform further preparation and retention procedures. It was also reported that these materials reduce the time taken to polymerization, and therefore, enhancing the relevant outcomes.[43] Many materials have been reported in the literature and validated by various studies, and among them, Light-Core™ (Bisco, Inc., Schaumburg, IL, USA), Build-It™ (Pentron, Inc. Orange, CA, USA), and Clearfil™ Photo Core (Kuraray Co. Ltd., Osaka, Japan) are reported to be efficacious.[44] Recently, it has been demonstrated that composite restorations are becoming more popular than amalgam-based ones, however, higher replacement rates have been reported.[45] Within the surgical settings of primary teeth restorations with vital pulps, studies are indicating that composites are rapidly replacing amalgam-based restorations and the reported favorable outcomes with the former are increasing with time due to the recent technological advances in the field.[46,47] Using these modalities has been reported with many advantages including the effective preservation of the affected tooth structure, which is even more efficacious than using the

stainless steel crown modalities and the amalgam-based restoration approaches.[48,49]

CONCLUSION

This literature review discusses and gathers evidence about restoration techniques of fractured endodontically treated teeth from various studies in the literature. Also, it discusses the technique of interim restorations, which has been reported to have favorable advantages and outcomes. However, it should be noted that the process is temporary and definitive restorations must be conducted later on. In addition, this research reviewes the different substances that should be used with the modality, and the different approaches that were previously reported to restore mature and immature affected teeth. Finally, evidence shows that amalgam-based restorations are becoming inferior to resin composite-based restorations which are also more superior to the stainless steel crown-based ones. Unifying the guidelines for clinical practice is encouraged to obtain favorable outcomes.

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