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A novel approach for the management of open apex: Bioroot Inlay

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Abstract

When immature teeth experience trauma or decay, pulp necrosis can occur. This stops dentin formation and root growth, resulting in wide root canals with thin walls and open apices. The success of endodontic treatment in nonvital teeth with open apices depends on an apical barrier that prevents the penetration of toxins and microbes from the root canal into the periapical tissues. Orthograde placement of MTA Plus can be difficult and often requires multiple X-rays. To overcome the shortcomings of traditional placement techniques, in this case report, an innovative custom-made BioRoot inlay technique was used to obturate a tooth with an open tooth.

Keywords: Apical barrier, BioRoot Inlay, MTA Plus, Open apex.

Introduction

Facilitation of tooth root development occurs through stimulation and differentiation of Hertwig's Epithelial Root Sheath (HERS) and surrounding progenitor cells, resulting in continuous deposition of dentin and cementum. During the period of root apex closure, any damage caused to the tooth can impede the process and result in the root canal becoming wider with thin and

delicate walls. This can make the tooth more susceptible to fracture during and after treatment. It is crucial to create an artificial apical barrier or close the apical foramen with calcified tissue to enable the build-up of filling material and ensure proper apical sealing. Failure to do so impairs the root canal instrumentation and prevents a suitable apical stop. (1)

Various techniques for managing open apex in nonvital teeth included custom-fitting filling material, paste fills, and apical surgery. Calcium hydroxide is commonly used for the establishment of an apical barrier. Still, it has drawbacks, including variability in treatment time (3–21 months), unpredictable apical closure, difficulties in patient follow-up, delayed treatment, and retrieval challenges. (2)(3) The reparative dentin bridge, shaped by calcium hydroxide, is often porous with numerous tunnel defects. These defects destroy the sealing ability of the bridge, allowing calcium hydroxide particles to migrate and bacteria to leak through. This can lead to the formation of islands of soft connective tissue and give the barrier a "Swiss cheese" consistency. In addition, the root canal walls become fragile, making them more prone to fracture under normal mastication forces. (4)(5)

The introduction of mineral trioxide aggregate (MTA) helped the endodontics domain because of its biocompatibility and bioactivity.

MTA induces a dentine bridge formation that is faster and with better integrity than that formed by calcium hydroxide. (6) However, due to its longer setting time, wash-out potential and poor handling properties resulted in the development of newer materials. Recently, MTA Plus (Prevest Denpro, Jammu, India) has been introduced to the market, which is a new variant of MTA that provides finer particle size and an anti-washout gel that leads to higher ion release and good bioactivity. (7)

Orthograde delivery of MTA Plus is more technique-sensitive and requires multiple radiographs for verification, and retrograde placement of MTA Plus requires surgical intervention. To use the advantages of MTA Plus and to overcome the disadvantages of placement techniques, an innovative approach was made to obturate the tooth with open apex and apical resorption using a custom-fit prefabricated BioRoot inlay as an alternative to gutta-percha obturation. (8)

Case Report

A 20-year-old female patient presented to the Department of Conservative Dentistry and Endodontics with a chief complaint of a broken upper front tooth for the past two years. The patient provided a history of trauma two years back. Clinical examination revealed Ellis class III fracture with 11. The tooth did not respond to thermal (Endofrost; Coltène/Whaledent, Langenau, Germany) and electric pulp testing (Pulp Tester; AT Analytic Technology, Redmond, WA, USA). The tooth did not demonstrate any abnormal mobility or sensitivity to percussion. Radiographs revealed a wide canal with an open apex and periapical radiolucency in relation to 11 [Figure 1A]. Pre-operative CBCT analysis confirmed the findings [Figure 1B]

The tooth was isolated with a rubber dam, and the operating field was disinfected with 5.25 % Sodium Hypochlorite. Access opening was done, and the working length was determined [Figure 2(A)] as 19 mm with a 140-size file by digital radiography.

Minimal circumferential filing was done with 3% sodium hypochlorite (NaOCl) (Prime, Mumbai). The canal was dried, and calcium hydroxide intracanal medicament was placed there. [Figure 2B] The patient was reviewed after a month and was asymptomatic. The intracanal medicament was removed by instrumentation and irrigation with 3% NaOCl and 17%

ethylenediaminetetraacetic acid (RC Help, Prime Dental Products).

The canal was dried. Light body impression of the root canal space [Figure 2C,D] was made with the smart Wetting™ impression material (Aquasil LV, Dentsply Caulk, Germany). The light body impression of the root canal space was placed in a putty impression (Aquasil, Dentsply Caulk, Germany) material. [Figure 2E] The putty impression was split into two halves to aid in retrieving MTA as a single plug. The apical end of the putty impression was cut to expose the apical part of the root inlay to maintain a moist environment for the initial set of the plug. This split putty was stabilized. [Figure 2F]

A thick mix of MTA Plus (Prevest Denpro, Jammu, India) was prepared and carried with a carrier into the putty canal impression. [Figure 2G] MTA Plus was compacted with a plugger, and a root canal instrument was placed at the coronal end for trial and placement. Moist cotton was placed at both ends of the putty impression. The Bioroot inlay was allowed to be set for 24 hours.

After 24 h, BioRoot inlay was removed and tried in and was confirmed by digital radiograph. [Figure 2H]. Thorough healing after three months, as seen in the radiograph, followed by sealing the access with Composite Restoration. [Figure 2I]

Discussion

The tooth with an open apex usually poses various technical difficulties, such as incomplete pulp elimination, incomplete apical seal formation, and improper filing due to delicate dentinal and root canal walls. (7) It often causes tooth fractures and root canal therapy failure. This can be avoided by adequately establishing the apical barrier by enhancing hard tissue formation at the apex. The conventional method for treatment of immature open apex teeth is done by apexification with calcium hydroxide followed by obturation of the canal with gutta-percha. The calcium hydroxide cement has excellent biocompatible and antimicrobial properties, which assist in root-end formation. Cvek found that nearly 90% of teeth showed the formation of an apical hard tissue barrier. (4). Having good advantages and success rates, it also had various side effects, such as long duration to achieve root end closure, multiple appointments, high compliance of the patient, and chances of coronal microleakage and decreasing fracture strength.

In order to achieve the proper apical seal, an equally biocompatible material called MTA has been introduced. MTA also assists in the formation of a cementum-like hard barrier when contacting the periapical tissue. This material's main drawback was its high cost, wash-out potential and technique sensitivity based on its setting and handling. MTA Plus is a new MTA variant with finer particle size, good sealing properties and the potential to stimulate cementogenesis.

The orthograde placement of obturation materials is the most common and preferred technique for managing wide-open apex. The lack of definite apical stop the difficulty in achieving three-dimensional alignment of the customized gutta percha and orthogonal MTA Plus, resulting in a marginal gap at the dentin interface. The disadvantages of surgical intervention in the young pulpless tooth are intense crack formation during retrograde cavity preparation or condensation of the filling material. (7)

In this case, an innovative technique, BioRoot inlay, was used to obturate the canal in 11. A custom-made, prefabricated restoration within the tooth root called the “BioRoot Inlay” helps create an apical barrier. This BioRoot inlay was passively placed within the canal and

tightly sealed the sides and apex, forming a monoblock with MTA Plus as a seal. This sealant helps seal minor discrepancies between the plug and the root, providing a three-dimensional seal and resulting in good healing of the periradicular bone.

Thus, in our study, MTA Plus compaction is done extra-coronally to minimize the voids and avoid multiple radiographs for verification during orthograde placement. This BioRoot inlay uses the biologic apatite for its bioactivity and chemical bond using MTA Plus as a sealer because MTA-based sealer (fillapex) has salicylate resin as a component. So in order to evaluate the healing property of MTA Plus, any resin use was not considered during the healing of the lesion. (8)

Conclusion

MTA Plus, when used as BioRoot Inlay, has been shown to induce faster periapical healing. It also promotes root end induction in cases with wide open apex and parallel walls. Thus, this novel technique will serve as a good alternative for nonsurgical and surgical approaches, simultaneously accomplishing a three-dimensional seal.

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Legend Figures

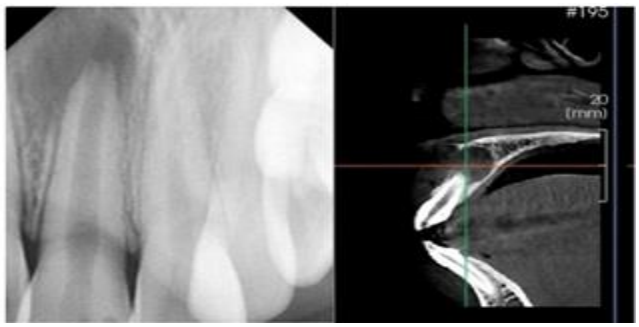

Figure 1(A): Pre-operative periapical radiograph (B)Pre-operative CBCT – saggital section

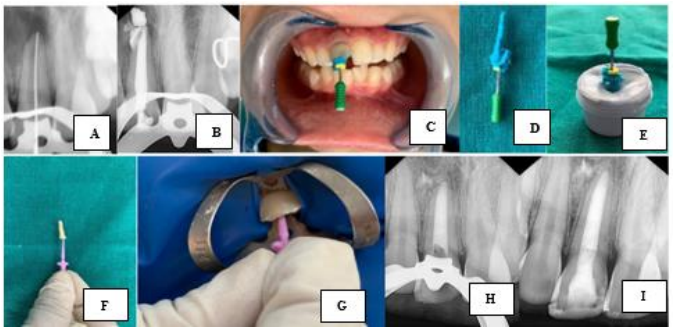

Figure 2: (A)-Working length determination. (B)-Placement of calcium hydroxide intracanal medicament. (C,D)-Light body impression of the root canal space (E,

F)-Retricing MTA plus as a single plug from putty (G)-Bioroot inlay Trial in the root canal space. (H)- Bioroot inlay was allowed to be set for 24 hours (I)-Sealing the access cavity with the Composite.