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CASE REPORT

Retreatment of endodontically failed tooth with wide-open apex using platelet rich fibrin membrane as matrix and an apical plug of Biodentine™

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ABSTRACT

The primary reason for an endodontic failure is the persistence or regrowth of bacteria within the root canal system, and such cases require retreatment. The tooth root development and closure of its apex occurs till 3 years after the eruption. Traumatic injuries during this development period result in endodontic complications. While dealing with a tooth, with an open apex the prime objective was eliminating bacteria from the root canal system with minimum irritation to the periapical tissues and induction of apical closure to produce favorable conditions and to confine the root canal filling within the canal space. Traditionally as supported by literature multiple dressings of calcium hydroxide medicament were advocated to induce apical barrier formation followed by an evolution of the apical artificial barrier technique where the mineral trioxide aggregate (MTA) was used. Recently introduced Biodentine™ is similar to MTA with its basic composition, which can be used as its substitute. The main difficulty associated while treating teeth with wide-open apices are preventing the overfilling of the restorative materials that serve as an artificial barrier. Use of a matrix overcomes this challenge. Platelet-rich fibrin (PRF) a matrix of autologous fibrin, embedded with a large quantity of platelet and leukocyte cytokines during centrifugation can be successfully used as an apical membrane. The present case, reports a novel procedure of apexification of endodontically failed central incisor with open apex using PRF as apical membrane and Biodentine™.

Key words
Apexification, Biodentine™, open apex, platelet rich fibrin, retreatment

INTRODUCTION

Endodontic failures are attributed to inadequacies in shaping, cleaning, and obturation in the first hand and the others like iatrogenic events or re-infection of the root canal system due to failed coronal seal post-endodontic treatment.[1-3] The sum of all is resultant in subsequent leakage and bacterial contamination.[4]

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Root canal obturation is aimed with an objective to provide a complete obliteration of the root canal in all dimensions to create a fluid-tight seal, preventing ingress of bacteria and their toxins,[5,6] and also inhibiting their flow into the periradicular area. Epley *et al.*[7] and Schilder[8] have suggested, an ideal root canal obturating material should be well-adapted to the radicular dentine walls and to all its irregularities and the entire length of the canal be densely compacted with a homogeneous mass of root canal filling material. Inadequate obturation, unfilled/under extended root fillings might require retreatment before their coronal restoration of the teeth being dealt with.[9] These unfilled areas might contain bacteria that can multiply when in contact with nutrients via the periapical region or lateral and accessory canals.[10]

Tooth with a wide-open blunderbuss apex has always presented a challenge to the clinician for its successful

endodontic management. The biggest endodontic challenge while treating these teeth being, successfully obtaining an apical seal. The treatment option for treating such cases of "apexification" that is, a method to induce a calcified barrier in a root with an open apex.[11]

Conventional approach of apexification was to induce the formation of an apical barrier using multiple calcium hydroxide dressings, while the recent approach is to form an artificial apical barrier by the placement of restorative material as an apical plug. An apical barrier aids the obturating material to confine within the root canal system.[12] However, while treating cases with wide-open apices is a clinical challenge to confine the restorative material to be used as an apical plug, within the canal. Hence, the use of apical matrix evolved against which the restorative material could be condensed or packed against.

Platelet-rich fibrin (PRF) described first by Choukroun *et al.*,[13] belongs to a new generation of platelet concentrates, presenting a upper hand such as easy preparation, lack of biochemical handling of blood making this preparation strictly autologous, promotion of wound healing, bone growth, bone maturation, and hemostasis.[14] A membrane can be obtained as a result of squeezing out the fluids in the fibrin clot of the prepared PRF.[15]

The case discussed in the paper presents successful one-step apexification and completion of the treatment on the same day of endodontically failed central incisor with open apex using PRF membrane and an apical plug of Biodentine™ followed by the obturation of the root canal using injectable thermoplasticized gutta-percha, yet to be reported in literature. The 6-month radiographic follow-up showed completely healed periapical lesion and the tooth presented to be symptomless.

CASE REPORT

A 22-year-old healthy male patient was referred to the Department of Conservative Dentistry and Endodontics with a chief complaint of discolored tooth and pain in previously endodontically treated tooth, in the upper front region for evaluation and treatment. History revealed that the patient had suffered trauma at the age of 9 years and had visited a private dentist prior for the treatment of the same. The preoperative radiograph presented a root canal filling, which was short of the apex, a wide-open apex and associated apical radiolucency with tooth number 21, suggestive of non-healing chronic lesion [Figure 1a]. The decision was made to retreat the tooth number 21 following apexification of the same tooth by using artificial barrier technique by placing an apical plug of Biodentine™ of 5 mm against a placed matrix of PRF.

The tooth number 21 was isolated under rubber dam (Hygienic Corp., USA), and the access cavity was re-opened under magnification (loops × 2.5, Carl Zeiss, Germany). The bulk of gutta-percha was removed using the universal ProTaper Retreatment Files (D1-D3) (Dentsply Maillefer). These files were used till no gutta-percha was visible on the file when it was withdrawn from the root canal. Endosolv R (Septodont, Paris, France) was used as a gutta-percha softener. A drop of Endosolv R (10 µl) was placed in the canal before using files. This was followed by the use of hand H-Files in circumferential rimming motion to facilitate the removal of the residual root canal filling. The working length was then established using an electronic foramen locator and confirmed by a radiograph [Figure 1b].

The canal was thoroughly debrided with a copious irrigation of 3 ml sodium hypochlorite (1%), 3 ml of 2% chlorhexidine, and 5 ml normal saline, coupled with ultrasonic agitation (Irrisafe, Satellec, France). The canal was dried with larger sized sterile paper points, and intracanal dressing of triple antibiotic paste containing minocycline, ciprofloxacin, and metronidazole (100 µg each ml^{-1}) with propylene glycol as the vehicle was packed 1 mm short of the radiographic apex. A sterile cotton roll was placed in the coronal chamber and the access cavity was temporized with resin-modified glass ionomer cement (Fuji II LC, GC, Bonneuilsur Marne, France) [Figure 1c], and the patient was recalled after 2 weeks.

At the 2-week recall, the tooth was asymptomatic. At this appointment, it was scheduled to use PRF membrane as an internal matrix against which Biodentine™ would be packed against as an apical barrier followed by obturation of the tooth in the same appointment. Informed consent of the patient was obtained in writing

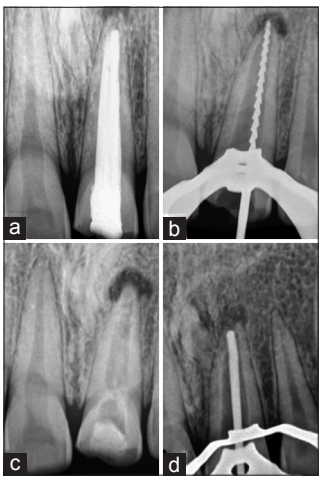

Figure 1: (a) Preoperative radiograph showing under filled tooth number 21. (b) Working length radiograph after the removal of root canal filling. (c) Placement of intra-canal medicament. (d) Master cone (number 80, 0.02% butt end) selection radiograph

after thoroughly explaining the clinical procedures and clearing all questions rose by the patient. The root canal was flushed with 3 ml of normal saline. The canal was dried with absorbent paper points. A master cone was selected which snugly fitted till the apex for helping pack the PRF membrane at the apex (number 80, 2% butt end) [Figure 1d].

Platelet-rich fibrin preparation was done by the protocol developed by Choukroun *et al.*[13] Patient's whole venous blood (around 10 ml) was collected in two sterile vacutainer tubes without anticoagulant and centrifuged in centrifugation machine at 3000 rpm for 10 min. This led to the formation of three layers: Upper-straw-colored acellular, red-colored lower fraction containing red blood cells, and the middle fraction containing the fibrin clot. The upper-straw colored layer was removed, and the middle fraction was collected 2 mm below to the lower dividing line, which was PRF. The PRF clot was retrieved, and fluids were squeezed out to obtain a PRF membrane as described by Kobayashi *et al.*[16] using two spoons. PRF membrane was then placed in the coronal cavity and gently compacted using the preselected master cone to produce a barrier at the level of the apex. Biodentine™ powder capsule was mixed with the liquid component in an amalgamator as per the manufacturers instructions and was introduced into the canal and compacted using Schilders pluggers (Dentsply Caulk, Milford, DE, USA) against the PRF membrane. A radiograph was taken to confirm adequate placement of Biodentine™ to form an apical stop approximately 5 mm thick [Figure 2a]. A sterile cotton pellet was placed in the canal and the cavity was sealed using MD-temp for 10 min, followed by obturation of the root canal using injectable thermoplasticized gutta-percha (E and Q Plus Meta Biomed Co ltd., Korea) [Figure 2b]. The access cavity if the tooth was then restored using composite resin followed by placement of metal free full ceramic crown. The 6-month radiographic follow-up presented a completely healed periapical lesion [Figure 2c] and a symptomless tooth.

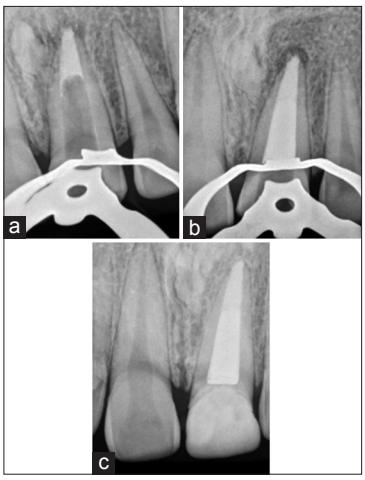

Figure 2: (a) Placement of 5 mm thick Biodentine™ apical plug against the placed matrix of platelet rich fibrin at the apex. (b) Radiograph after obturation of the tooth number 21 using injectable thermoplasticized gutta-perch. (c) 6-month follow-up radiograph presenting completely healed periapical lesion

DISCUSSION

In conventional dental practice, calcium hydroxide dressings intermittently changed over a period of 6–20 months has been the first choice to induce a calcific barrier in cases with wide-open apices.[17] The main problem with this method is its unpredictability, lengthy procedure, and temporary coronal restorations during inter-appointment dressings. This may cause contamination and finally resulting in re-infection. This conventional approach also requires a high level of patient's acceptance, as most of them will be unwilling for such a lengthy procedure, hence one visit apexification developed.[15]

Most important concern, while treating a previously treated tooth and associated secondary infection, is disinfection of the root canal and preventing the reoccurrence of a periapical lesion. Lesion sterilization and tissue repair is based on the concept of thorough disinfection of the root canal system to promote better healing conditions, suggests the use of triple antibiotic pastes. As the case presented was associated with secondary infection, hence the choice of triple antibiotic paste as an intra-canal medicament was made for adequate disinfection. Nevertheless, such cases present with highly resistant bacteria such as *Enterococcus faecalis* and *Candida* species wherein calcium hydroxide is ineffective and hence was not used.[18]

One-step apexification by an artificial apical plug technique is a faster treatment approach to overcome the conventional calcium hydroxide apexification. Mineral trioxide aggregate (MTA) due to its biocompatibility and less cytotoxic nature, alkaline pH and presence of calcium and phosphate ions, having the capacity to attract blastic cells and promote favorable conditions for cementum deposition, is the material of choice for such procedures has been successfully reported in literature.[19] The initial setting time for MTA is 2 h 45 min to 3 h.[20] This extended setting time is a major drawback of MTA. MTA being hydrophilic requires moisture to set; hence it is advised to place a moist cotton pellet in the first visit followed by permanent filling in the second visit.[21,22]

Recently introduced Biodentine™, similar to MTA in basic composition has the addition of setting accelerators (calcium chloride). The decrease in setting time of Biodentine™ was achieved by a combination of different effects. First particle size greatly influences the setting time, since the higher the specific surface, the shorter the setting, adding calcium chloride to the liquid component accelerates the setting and the decrease of the liquid content in the system decreases the setting

time to harden within 9–12 min.[23] As the setting time is less, Biodentine™ does not require a two-step obturation, resulting in the completion of treatment on the same day. Hence, it was used in the present case as an alternative to MTA.

The considerable test is encountered by an operating clinician, especially treating teeth with wide-open apices, is the successful prevention of periapical extrusion of the restorative material when used as an artificial apical plug, into the periodontal tissues. The extruded material may result in an inflammatory process, complicating to such an extent that the repair would impossible. Hence, using a matrix at the periapex especially in teeth with open apices avoids this extrusion of the material as it can be condensed against this matrix. This also aids in the reduction of leakage in the sealing material and allows a favorable response of the periodontal tissues.[15]

Various materials can be used in the formation of the apical barrier during apexification have been reported in the literature. They include calcium hydroxide, hydroxyapatite, resorbable collagen and calcium sulfate. In this case, a contemporary concept of using PRF as an apical matrix membrane was performed taking into consideration the merits of PRF over the other materials. PRF is a matrix of autologous fibrin, which gets embedded by a large quantity of platelet and leukocyte cytokines during centrifugation.[23,24] These cytokines present are released progressively over time (7–11 days), as the fibrin disintegrates.[25]

The PRF membrane that is applied in such cases, results/helps in rapid angiogenesis and a resultant easier remodeling of fibrin.[26] The necessary parameters of PRF resulting in optimal healing include; fibrin matrix polymerized in a tetra molecular structure, the incorporation of platelets, leukocyte, and cytokines, and the presence of circulating stem cells.[27] PRF also results in stimulation of the osteoblasts, gingival fibroblasts, and periodontal ligament cells proliferation as a mitogen and also releases various growth factors such as platelet-derived growth factors and transforming growth factors with resultant optimal healing.[28] Most important, PRF being totally autologous is most biocompatible than any other material that may be/are used as matrix for apexification procedures with such cases presenting wide-open apices.

CONCLUSION

The combination of PRF as a matrix and Biodentine™ as an apical barrier used in the present case demonstrated an alternative, which may prove as an effective option for creating artificial root-end barriers. To the best of our knowledge, such a combination is yet to be reported in the literature and hence was used and observed for a period of 6 months, where complete healing was observed. Furthermore, using Biodentine™ in the present case resulted in the completion of the treatment in a single appointment and could be regarded as a valid alternative over MTA while managing such cases. However, further long-term controlled clinical trials are necessary to investigate the predictability of the outcome of the technique and Biodentine™ as an effective alternative for MTA.

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