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Evaluation of Clinical and Radiographical Outcome of Apexification Therapy Utilizing PRF & MTA With CBCT – A Case Series

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Abstract

Aim : To examine the clinical and radiographic appearance of teeth that suffered premature interruption of root development and were treated by mineral trioxide aggregate (MTA) apical plug technique and platelet rich fibrin as a matrix.

Summary: Four teeth with immature root apices in 4 patients were treated nonsurgically by the manual application of MTA in the apical portion of the root canal under microscopic vision. Follow-up evaluations were performed at 3months, 9 and 12 months after treatment.

Keywords: Mineral trioxide aggregate, necrotic pulp, one visit apexification, open apices. Platelet rich fibrin

Introduction

Trauatic injuries and dental avulsions can lead to pulpal necrosis and hence the root development can be disturbed. Open apex develops due to this trauma and hence apical closure is not obtained. Due to this open apex there is a loss of natural constriction at the apical end thus, making the shaping and cleaning as well as obturation of the root canal is challenging. Special care is taken when treating such cases as these teeth often reflect thin and fragile root walls.[1] In order to overcome this problem, an apical barrier is established. The procedure of this apical development is termed apexification.

Apexification is a method of inducing apical closure through the formation of mineralized tissue in the apical region of a nonvital tooth with an incompletely formed root (open apex). A numerous materials have been used for the apexification. Earlier calcium hydroxide apexification is done in an immature apex, but due to some inadequacy provided by calcium hydroxide like prolonged treatment time, need for multiple visits and radiographs, difficulty of the patient's recall management and increase in the risk of root fracture after dressing with calcium hydroxide for extended periods.[2] Mineral Trioxide Aggregate have been used to treat such cases which is an alternative to calcium hydroxide apexification. It is a one-step apexification technique as an artificial barrier. The advantage of MTA apexification are: (i) Reduction in treatment time (ii) possibility to restore the tooth with a minimal delay (iii) no changes in the mechanical properties of dentine (iv) excellent biocompatibility and (v) stimulation of repair.

Therefore, single visit apexification technique was introduced as an alternative for multiple visit apexification with calcium hydroxide.

Because of the wide open apices there is a chances of extrusion of the material beyond the apex. In order to overcome this problem a matrix has been advocated over which mineral trioxide aggregate was condensed. Platelet rich fibrin (PRF) which is a second generation platelet concentrate can be used as a resorbable matrix material against which MTA apical barrier can be placed. PRF was first described by Choukroun et al. in France. It has been shown to have several advantages such as ease of preparation, autologous, promotion of wound healing, bone growth, bone maturation and hemostasis. This case series describes the management of an immature tooth (with open apex) with a one-step apexification procedure with MTA apical barrier and autologous PRF membrane as a matrix.[3] However none of the aforementioned methods can promote root development.

Case Reports 1

A female patient of 18 year old came to the department with a chief complaint of pain in the upper right cental incisor. Clinically, we found that there was complicated crown fracture (Ellis class III) in relation to upper right central incisor (11). The tooth was carious and fractured which showed positive response to tender on percussion and palpation. There was no response to the pulp vitality tests using, cold test and electric pulp testing (figure 1a,1b,1c,1d,1e).

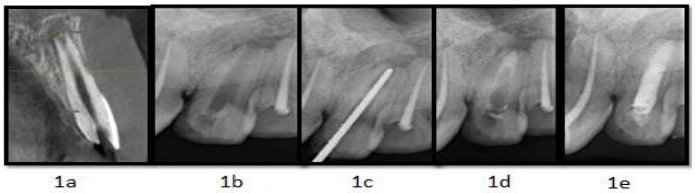

Figure 1(a,b,c,d,e): showing pre-op CBCT, pre-op radiograph, working length,MTA placement, Obturation respectively.

Case Report 2

A male patient of 19 years old came to the department with a chief complaint of pain in the upper left cental incisor. The incisor was slightly tender to percussion. No mobility was seen. On electric pulp testing, the upper right central incisor (11) was non-responsive.

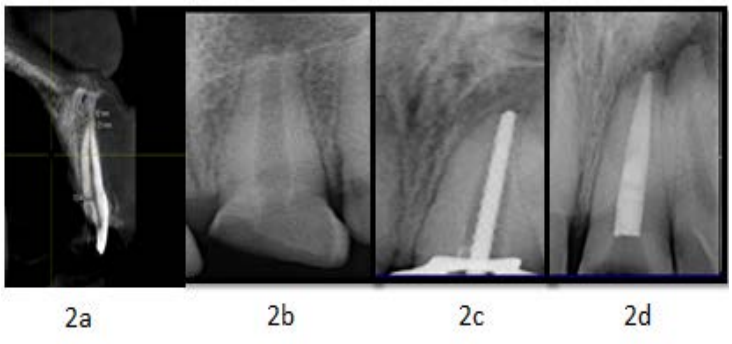

Figure 2(a,b,c,d): showing pre-op CBCT, pre-op radiograph, working length, MTA placement and Obturation respectively.

Case Report 3

A male patient of 21 years old came to the department with a chief complaint of pain in the upper left cental incisor.Clinical examination revealed grayish discoloration of tooth 21 and attempted access preparation in the same tooth. The tooth did not demonstrate any abnormal mobility or sensitivity to percussion. Both cold and electric sensibility tests failed to elicit any response. Periapical radiograph showed well-defined periapical radiolucency and wide open apex in relation to tooth 21. The final diagnosis was pulpal necrosis with chronic apical periodontitis in relation to tooth 21.

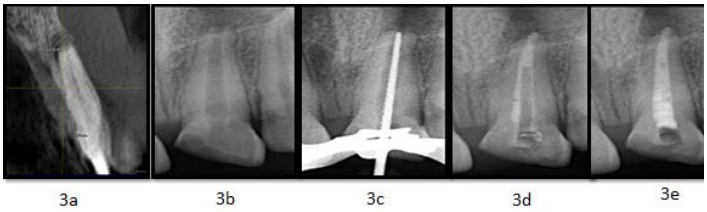

Figure 3(a,b,c,d,e): showing pre-op CBCT, pre-op radiograph, working length, MTA placement and Obturation respectively.

Case Report 4

A female patient of 20 years old came to the department with a chief complaint of pain in the upper left cental incisor. The incisor was slightly tender to percussion. No mobility was seen. On electric pulp testing, the upper right central incisor (11) was non-responsive.

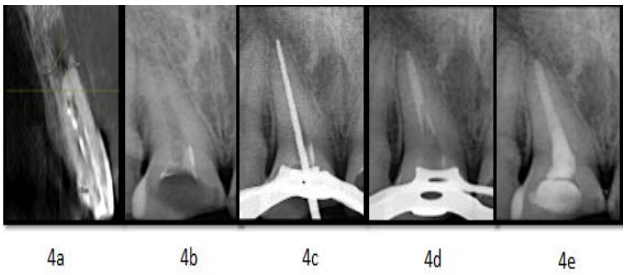

Figure 4 (a,b,c,d,e): showing pre-op CBCT, pre-op radiograph, working length, MTA placement and Obturation respectively.

Procedure

A peri-apical radiograph was taken which showed an open apex associated with peri-apical lesion. A preoperative CBCT Scan was taken to evaluate the extent of lesion, diameter of apical foramen and root length. Non-surgical treatment Apexification is opted for the patient. Patient was administered local anesthesia, access cavity was then prepared under rubber dam isolation. Working length is the determined with a no. 15 k file and confirmed with RVG Root canal was then prepared upto no. 80 k file. The canal was the irrigated with 1% NaOCl and saline. The canal was then dried with paper points and triple antibiotic paste (metronidazole, minocycline, and ciprofloxacine) was placed in the canal as an intra canal medicament. After that the access cavity was sealed with a temporary restoration.

After 3 weeks the patient was recalled, the tooth was asymptomatic and non tender on percussion. The canal was then irrigated and dried with paper points.Then we decided to place PRF as a matrix over which MTA is placed as an apical barrier in order to avoid the extrusion of material beyond the apex. Platelet rich fibrin membrane was prepared using the procedure described by Dohan et al. blood (8.5 ml) was drawn by venipuncture of the anticubital vein. This blood was collected in a 10 ml sterile glass tube without anticoagulant, and was centrifuged immediately at 3000 revolutions/min (rpm) for 10 min. After the centrifugation the resultant in the glass tube consisted of the topmost layer of acellular platelet poor plasma, PRF clot in the middle and red blood cell's at the bottom.The PRF clot was squeezed to obtain a PRF membrane.

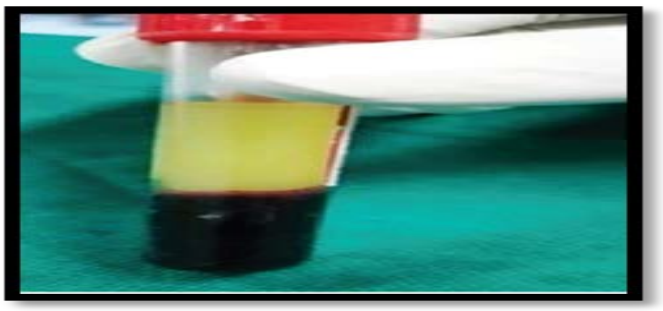

Figure 5: Showing acellular platelet poor plasma, PRF clot in the middle and red blood cell's at the bottom.

The PRF membrane was cut into two halves to reduce the size of the membrane PRF membrane was introduced into the canal and was gently compacted using hand pluggers to form an apical barrier. MTA was mixed according to the manufacturer's instructions and was placed in the apical portion of canal against the PRF matrix, till a

thickness of 5 mm. A wet cotton pellet was placed into the canal, access cavity was sealed with temporary cement. After 1 week the patient was asymptomatic, the tooth was isolated with rubber dam, temporary restoration and cotton pellet was removed. A hand plugger was tapped against the MTA barrier to confirm the setting of MTA. The remaining portion of the canal was obturated using AH plus sealer (Dentsply-DeTrey, Maillefer, Switzerland) and injectable thermoplasticized gutta-percha (Obtura, SpartanEndodontics, Fenton, USA). The access cavity was restored with resin composite. The patient was recalled at 3 months), 9 months and 1 year postoperatively for 4 cases(figure 6,7,8). At 3 months recall, radiograph was taken, which showed a decreased in the size of the lesion, closure of the apical diameter and increase in the root length. Post operative CBCT at 1 year showed complete healing of the lesion, closure of apical diameter and increase in the root length.

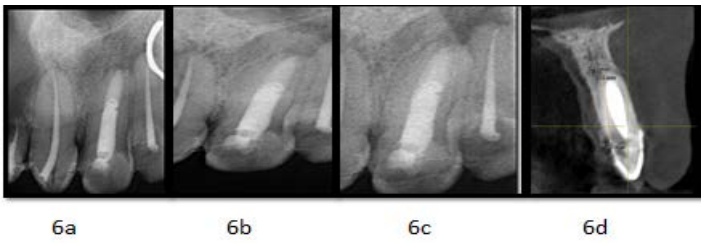

Figure 6 (a,b,c,d): showing 3rd month, 9th month, 12th month, post-op CBCT respectively for case 1.

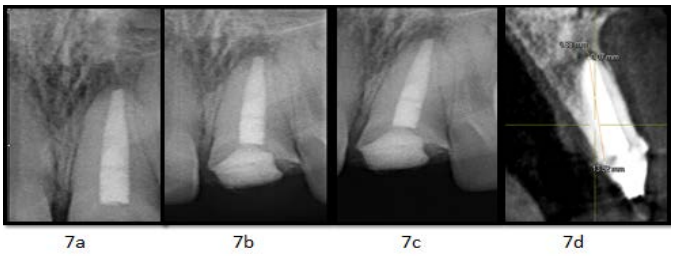

Figure 7 (a,b,c,d): showing 3rd month, 9th month, 12th month, post-op CBCT respectively for case 2.

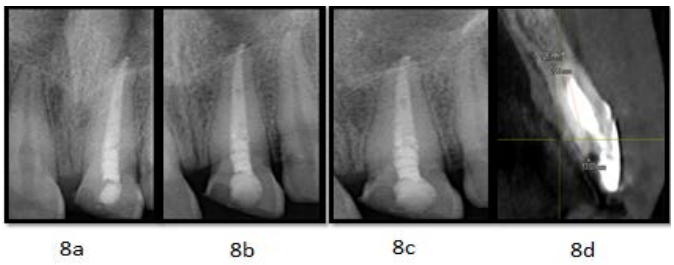

Figure 8 (a,b,c,d): showing 3rd month, 9th month, 12th month, post-op CBCT respectively for case 3.

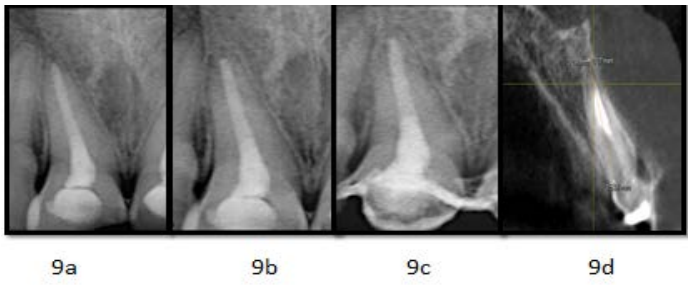

Figure 9 (a,b,c,d): showing 3rd month, 9th month, 12th month, post-op CBCT respectively for case 4.

Discussion

In order to prevent the passage of toxins and bacteria from the root canal into periapical tissues there is a need for the formation of an apical barrier. Apexification procedure aims at formation of an apical barrier, to allow the condensation of root filling material. Earlier Ca (OH) 2 was the material of choice for apexification.[4] Due to the long term multiple appointment procedure, moreover prolonged contact with calcium hydroxide alters the intrinsic property of root canal dentine making it more susceptible to fracture. To overcome this single visit apexification with has been suggested. MTA has become the material of choice for single visit apexification procedure owing to its excellent biocompatibility, minimal microleakage and promotion of bone and PDL formation. The major problem information of an artificial barrier at the apex is the need to limit the material to the apex, preventing over extrusion, which may complicate or prevent repair of tissue. Using a matrix will restrict the

barrier material at the apex and prevent the extrusion of material into the periodontal tissues.[5]

PRF is an immune platelet concentrate which has been used as a matrix. In the present case, Choukroun's technique for making PRF was used. The advantages of Choukroun's technique and PRF in general are[6]

- It contains growth factors including transforming growth factor beta, vascular endothelial growth factor, and platelet-derived growth factor Platelet rich fibrin stimulates osteoblasts, gingival fibroblasts and periodontal ligament cells proliferation as a mitogen
- Platelet rich fibrin is an immune platelet concentrate, collecting all the constituents of a blood sample favorable to healing and immunity on a single fibrin membrane
- Does not dissolve quickly after application
- Completely natural, no use of chemicals
- Low cost and greater ease of the procedure
- Ability to produce PRF in large quantities
- Completely autologous and biocompatible.

Platelet rich fibrin membrane has a soft consistency and it inherently contains some amount of moisture, still it serves as a good matrix material for placement of MTA, this is because MTA has a wet sand like consistency and can be placed without pressure application and therefore it does not require a pressure-resistant matrix for application.[7] Moreover, MTA sets in the presence of moisture and does not require a moisture-free environment. Another advantage of using PRF as a matrix is that it promotes wound healing and repair. In teeth with open apices and thin root canal walls instrumentation cannot be done properly, thus cleaning and disinfection of the root canal system rely on the chemical action of irrigant and intracanal medicament.[8] In the present case canal disinfection was achieved by irrigation with 1% NaOCl and saline. NaOCl is known to be toxic, especially in higher concentrations. There is an increased risk of pushing the irrigant beyond the apex in immature teeth with open apices, therefore a lower concentration of 1% NaOCl was used in the present case.[9] Further disinfection was achieved by the use of triple antibiotic paste as an intracanal medicaments. [10]

Conclusion

The combination of PRF as a matrix and MTA as an apical barrier can be considered as a good option for one-step apexification procedure. However, controlled clinical trials need to be conducted to investigate the predictability of the outcome of the technique.

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