

A case of complete and successful Regenerative Endodontic Procedure in immature permanent pulpless tooth.

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Abstract:

Background:

Regenerative endodontics is the discipline that gives emphasis on biologically restoring the pulp-dentin complex to revive vitality in non-vital teeth. It is aimed to re-establish natural structure and function by implementing advancements in tissue engineering.

Advancement in stem cell applications, biometric scaffold, growth factors, signaling molecules, and clinical protocols together contribute to successful outcomes.

Keywords: Pulp-dentin complex, Regenerative endodontic procedure (REP), Scaffold, Signaling molecules, Stem cells, Platelet rich in fibrin (PRF), Ethylene diaminetetraacetic acid (EDTA), Mineral trioxide Aggregate (MTA).

Date of Submission: 12-09-2026

Date of Acceptance: 22-09-2026

I. Introduction:

Endodontic therapy or apexification is an effective measure in preserving immature nonvital teeth maintaining their function but leaving them in a non-vital state which lack the sensory, immune, and regenerative properties that are inherent characteristics of vital pulp tissue. Non-vital teeth often become brittle due to lack of blood supply and cellular activity.¹ Regenerative endodontics focuses not only preserving the tooth but also actively regenerating the damaged or necrotic pulp tissue reinstituting its vascular supply. So, Regenerative endodontic is aimed to biologically restore the tooth's pulp-dentin complex, allowing it to regain its functions.²

Immature permanent nonvital teeth where apexogenesis is the choice of treatment, regenerative approach ensures promiseable prognosis. Incomplete root development along with thin dentinal wall possess several challenges during conventional endodontic therapy. Regenerative endodontic procedure not only promotes root development and thickening of dentinal walls but besides apical closure restores vascular supply.

The concept of REP lies in the fact that if there any viable pulp tissue present in the apical part of root canal that can proliferate or differentiate into odontoblast like cells under the influence of Hertwig's epithelial root sheath and lay down atubular dentin leading to apexogenesis and thickening of dentinal wall. REP therefore require a scaffold, viable stem cell, cytokines and growth factors.

An ideal scaffold should allow seeding of stem cells, release growth factors, and possess biodegradable properties.^{3,4}

PRF introduced by Choukroun in 2001, acts as an autologous biodegradable scaffold and the rich source of platelet, cytokines and growth factors. Dense fibrin matrix of PRF helps in migration of fibroblast and endothelial cells that aid in revascularisation.⁵

Along with appropriate scaffold, an efficient and effective disinfection protocol is considered as a prerequisite for regenerative endodontic procedure⁶.

II. Case Report:

A female patient aged 18 yrs came to the department of Conservative Dentistry and Endodontics of Dr R Ahmed Dental College & Hospital, Kolkata with the history of pain and swelling in periapical region of maxillary right central incisor. Patient gave the history of trauma several years back.

On clinical examination, the maxillary right central incisor was fractured and tender on percussion. Tooth vitality test responses negative. Radiological observation revealed the tooth having wide open apex, thin dentinal walls with periapical radiolucency.

Regenerative approach was decided as the choice of treatment plan with the consent of the patient.

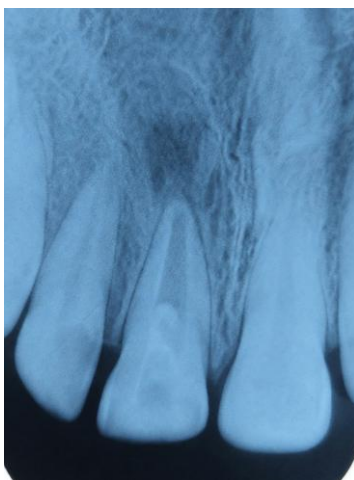
Under local anaesthesia (2% lignocaine) an access cavity was prepared with Tungsten Carbide round bur in air turbine handpiece with copious water after application of rubber dam. Working length was determined with an Apex locator, (Root ZX, Morita) and Radiographically. Biomechanical preparation, BMP was completed 1mm short of working length. Low concentration of NaOCl (1.5%) was used for irrigation during BMP and delivered with a 30 gauge side vented needle. Tooth was then closed with temporary restoration after giving Ca(OH)_2 as intracranial medicament within the canal.

On the next visit, after seven days the tooth became asymptomatic. PRF was then prepared from patients' own blood drawn from antecubital vein. After centrifuging 10 ml of blood without anticoagulant at 3000 rpm for 10 minutes PRF was separated out of the mixed content within the test tube. The canal was thereafter reaccessed and irrigated with 20 ml of NaOCl (1.5%), copious normal saline and finally with 20 ml of 17% EDTA. After drying of the canal with paper point, freshly prepared PRF was then introduced into the canal upto the working length. MTA was then placed on a collagen membrane (Collacote) placed over the PRF and the cavity was closed with RMGIC (GC Fuji II LC).

The patient was then reviewed at a three months interval clinically and radiographically to observe while healing is prevailing or not. The outcome of REP was then assessed in respect of closure of open apical foramen, thickening of canal wall, lengthening of root and periapical bone healing.



Picture 1
Pre-operative Xray



Picture 2
6 Months follow up Xray



Picture 3
12 Months follow up Xray



PRF

III. Discussion:

Regenerative endodontics evolved as the most efficient paradigm shift that almost replaces the traditional apexification methods. Conventional methods of managing such cases using Ca(OH)_2 was time consuming and unpredictable whereas immediate apexification using MTA, Biodentin etc. is more predictable but the problem

lies with thin dentinal walls that are susceptible to fracture and increase in root length is not possible in absence of vital pulp. Regenerative endodontics successfully manage all of these scenarios.

The expected outcomes in REP in respect of AAE are as follows:⁷

- Resolution of clinical sign & symptoms and healing of bone
- Thickening of root dentin walls and increase in root length.
- Return of Vascularity or neurogenesis.

The prognosis in REP is mainly attributed to Hertwig's epithelial root sheath or Cell rests of Malassez which retain their vitality in presence of infection. They stimulate multipotent stem cells of Dental pulp, Apical Papilla or Periodontal Ligament to differentiate into Odontoblast or Osteoblast like cells that aids in root maturation & bone healing.⁸

PRF plays a crucial role in regenerative endodontics. PRF is second generation platelet concentrate with dense fibrin mesh and cytokines.⁹ As a biodegradable scaffold it supports differentiation and proliferation of pluripotent stem cells for regeneration. Continuous releases of essential cytokines and growth factors (like TGF- β , PDGF, and VEGF) from PRF have the potential to stimulate mesenchymal stem cells of the apical papilla that promote root maturation. TGF- β acts as signaling molecule for odontogenic differentiation whereas PDGF, and VEGF helps in angiogenesis and new capillary formation.¹⁰

PRF also increases protein expression of osteoprotegerin and alkaline phosphatase activity and both are market for odontogenic differentiation.⁹

Due to cytotoxic effects lower concentration of NaOCl (1.5%) was used to preserve the maximum number of viable stem cells in this case whereas final irrigation with EDTA (17%) promotes bioavailability of growth factors i.e. TGF -B, Dentin sialoprotein in dentin matrix to stimulate stem cell proliferation and differentiation.

Martin et al. noticed 6% NaOCl reduced the survival and odontogenic differentiation of apical papilla stem cells but 1.5% of it enhanced the express of dentin sialophosphoprotein in stem cell.¹¹

An effective coronal seal creates an environment conducive to stem cell proliferation and differentiation and promote continued root development.

The success rate of regenerative endodontic ranges from 83% to 93% which depends on control of endodontic infection and presence of stem cells, cytokines and growth factors.⁷

As an intracranial medicament, use of Calcium hydroxide, Ca(OH)₂ or low concentration of Triple antibiotics paste was recommended by American Association of Endodontists, AAE,2021 for control of endodontic infection. Calcium hydroxide has the advantage of being non-toxic and it also promotes the proliferation of stem cells of the apical papilla.¹²

Pain and swelling of apical region were resolved within a week but complete periapical bone healing with thickening of dentinal walls of root and closure of apex was observed at twelve months follow up.

Similar finding was noticed in Shruti Thakkar et al. study where the changes in bone structure were significant twelve months after REP.¹³

Researchers had noticed varying degrees of intracanal calcification in 62% of REP cases with few cases of complete obliteration.¹⁴

IV. Conclusion:

Regenerative Endodontic Procedures utilizing Platelet-Rich Fibrin (PRF) have emerged as a highly effective, biologically based therapy for treatment of immature, nonvital permanent teeth with open apices.

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