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Vital pulp therapy using laser and A-PRF+ synergy: A case report

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Abstract
Background: Direct pulp capping (DPC) preserves pulp vitality and induces dentinogenesis. Combining an autologous, growth factor-rich A-PRF+ scaffold and a hermetic MTA seal with diode laser irradiation provides rapid haemostasis, deep decontamination, and photobiomodulation to optimize pulpal healing.
Case Description: A 14-year-old female presented with symptomatic reversible pulpitis in tooth 36. Following caries removal, pinpoint pulp exposure occurred. Haemostasis and disinfection were achieved using a GaAlAs diode laser (1000 mW, continuous wave). An autologous A-PRF+ membrane was placed over the pulp wound, sealed with MTA, and permanently restored with composite after 24 hours. At the 3- and 6-month follow-ups, the tooth was functional, asymptomatic, responded normally to sensibility tests, and showed radiographic evidence of no periapical pathology.
Conclusion: The synergistic protocol of diode laser irradiation, A-PRF+, and MTA presents a biologically driven, predictable approach for vital pulp therapy.

Keywords: Direct pulp capping, diode laser, A-PRF+, mineral trioxide aggregate, vital pulp therapy

Introduction

Preserving dental pulp vitality is paramount in conservative dentistry, as a functioning pulp sustains physiological dentinogenesis and proprioceptive defense against microleakage. [1] Vital pulp therapy, specifically direct pulp capping (DPC), serves as a minimally invasive alternative to extensive pulpectomy in teeth with reversible pulpitis. [2] The definitive objective of DPC is the induction of a dense, protective dentin bridge across the pulpal exposure site. [3]
Traditional calcium hydroxide has demonstrated long-term limitations, including high solubility and porous dentin bridge formation with tunnel defects. [4] Although mineral trioxide aggregate (MTA) provides superior biocompatibility and hermetic sealing against dentinal walls, it remains an inert synthetic cement devoid of cellular elements. [5]
To enhance regenerative kinetics, advanced platelet-rich fibrin plus (A-PRF+) has emerged as an autologous bioactive matrix that delivers a sustained physiological release of growth factors to accelerate the differentiation of dental pulp stem cells into odontoblast-like cells. [6] Concurrently, diode laser irradiation achieves immediate pulpal haemostasis through targeted haemoglobin absorption and eliminates deep microorganisms within dentinal tubules. [7] Furthermore, low-level laser application shortens the post-exposure inflammatory phase, enhances dentinogenesis, and upregulates reparative gene expression. [8] Combining diode laser therapy with autologous A-PRF+ and MTA creates a multimodal synergy that optimizes the microenvironment for pulpal repair.

Case Report

A 14-year-old female patient reported to the Department of Conservative Dentistry and Endodontics with the chief complaint of pain in decayed teeth in the lower left back tooth regions for the past few weeks. The patient's medical history was non-contributory. Clinical examination revealed deep carious involvement on the mesio-occlusal surface of the left mandibular first molar (36). The tooth was non-tender to vertical and horizontal percussion, and periodontal probing depths were within normal physiological limits. The tooth exhibited a positive, physiological response to cold test using refrigerant spray (Coltene Whaledent). Intraoral periapical radiographic examination revealed deep radiolucency on the mesio-occlusal aspect of tooth 36 approaching the pulp chamber, with no associated periapical changes or periodontal ligament widening. A clinical diagnosis of symptomatic reversible pulpitis was established.
The patient and her guardians were informed that direct pulp capping (DPC) using a combination of diode laser, autologous platelet-rich fibrin (PRF), and mineral trioxide aggregate (MTA) was planned to preserve pulp vitality. Detailed treatment procedures and alternatives were explained, and written informed consent was obtained. Preoperative hematological investigations confirmed normal bleeding time, clotting time, and platelet count.
Local anaesthesia was administered via an inferior alveolar nerve block using 2% lignocaine with 1:200,000 epinephrine, followed by isolation of tooth 36 with a rubber dam. Access to the carious lesion was gained using a high-speed air-rotor handpiece with a round diamond bur under dental operating microscope. Soft, infected carious dentin was systematically removed from the periphery using sterile spoon excavators. Upon complete caries excavation, a single pinpoint pulpal exposure with active bleeding was observed on the mesial aspect of the cavity floor.

Pulpal haemostasis and cavity decontamination were immediately carried out using a GaAlAs diode laser operating at 1000 mW power in continuous wave and contact mode using an endodontic tip, applied for two cycles of 60 seconds each. Concurrently, 10 mL of whole venous blood was collected from the patient's median cubital vein into a sterile glass tube without anticoagulants and centrifuged immediately at 1300 rpm for 8 minutes to prepare an A-PRF+ clot.

The obtained A-PRF+ membrane was gently compressed and positioned directly over the laser-treated pulpal exposure site. A layer of MTA (Premixed mineral trioxide aggregate, e-MTA Putty) was carefully adapted over the membrane to ensure a hermetic seal against the surrounding dentinal walls. A sterile, moist cotton pellet was placed over the MTA to facilitate its hydration and setting, and the cavity was temporarily sealed.

After 24 hours, the temporary restoration and cotton pellet were removed, and the complete set of the MTA was clinically verified. A layer of resin-modified glass ionomer cement (RMGIC; GC Fuji II LC, GC Corporation, Tokyo, Japan) was applied over the set MTA as a protective base/liner and light-cured according to the manufacturer's instructions. Following the enamel and dentin bonding adhesive protocol, a definitive composite restoration was placed incrementally using a Giomer-based restorative resin (Beautifil series composite; Shofu Inc., Kyoto, Japan) to establish a coronal seal.

Follow-Up and Outcome

Follow-up examinations conducted at 3- and 12-months post-treatment revealed that tooth 36 remained completely asymptomatic and functional. The tooth responded positively to cold, thermal and electric pulp sensibility tests. Follow-up intraoral periapical radiographs confirmed normal periodontal ligament space, intact lamina dura, absence of periapical pathosis.

Discussion

The primary objective of vital pulp therapy is to manage infection, eliminate inflammation, and stimulate progenitor pulpal cells to differentiate into odontoblast-like cells capable of secreting reparative tertiary dentin. [9] In the present case, the young age of the patient (14 years) favoured pulpal repair due to high pulpal vascularity and cellularity. [10]

Haemorrhage control is a critical prognostic determinant during pulp exposure, as uncontrolled bleeding indicates irreversible deep inflammation and impairs restorative adhesion. [1] While conventional chemical haemostatics may yield variable outcomes, diode laser irradiation provides immediate photothermal coagulation due to targeted absorption in haemoglobin. [1] The diode laser generates a sterile superficial coagulation layer, beneath which minimal reversible thermal alteration occurs, creating a receptive bed for cell migration without disrupting the deeper pulp core. [1] Concurrently, near-infrared diode wavelengths penetrate deeply into dentinal tubules to eradicate residual bacterial pathogens. [1] At sub-thermal levels, diode laser irradiation delivers photobiomodulation (PBM), modulating inflammatory mediators and accelerating dentin bridge mineralization kinetics. [8]

Advanced Platelet-Rich Fibrin Plus (A-PRF+) serve inductive biological scaffold prepared via the low-speed centrifugation concept (LSCC). [6] It possesses a porous, interfibrous architecture that facilitates cell migration and entraps high concentrations of platelets and leukocytes. [6] This matrix provides a continuous release of key growth factors (such as TGF-β1, VEGF, and PDGF), promoting the chemotaxis, proliferation, and cytodifferentiation of dental pulp stem cells to induce thicker and faster reparative dentin bridge formation. [5]

Sealing the A-PRF+ membrane with e-MTA Putty provides mechanical stability, continuous high alkalinity for antimicrobial defense, and a hermetic bacterial seal against microleakage. [7] Calcium silicates induce mineralized bridge formation without cytotoxicity. [7] Furthermore, completing the coronal seal with the Beautifil series composite restoration effectively prevented microleakage, which is vital for long-term clinical success.

Conclusion

The synergistic application of diode laser irradiation, an autologous A-PRF+ membrane, and e-MTA Putty provides a predictable, biologically active protocol for direct pulp capping in young permanent teeth with reversible pulpitis. Diode laser application ensures immediate pulpal haemostasis, deep tubular decontamination, and photobiomodulative cellular stimulation, while A-PRF+ delivers a continuous physiological release of vital growth factors to drive odontoblastic differentiation and reparative dentinogenesis. Sealed with MTA and a definitive composite restoration, this combined technique successfully preserves dental pulp vitality and promotes hard-tissue barrier formation.

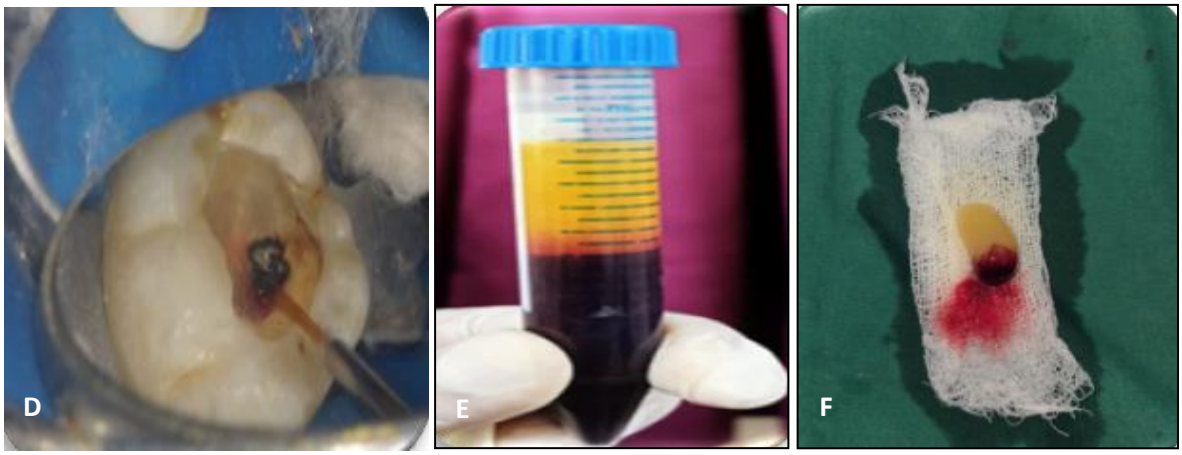

Fig 1: (a) Pre, operative clinical picture (b)Pre, operative radiograph (c)Pulp exposure (d)Haemostasis using diode laser (e), (f) A-PRF+

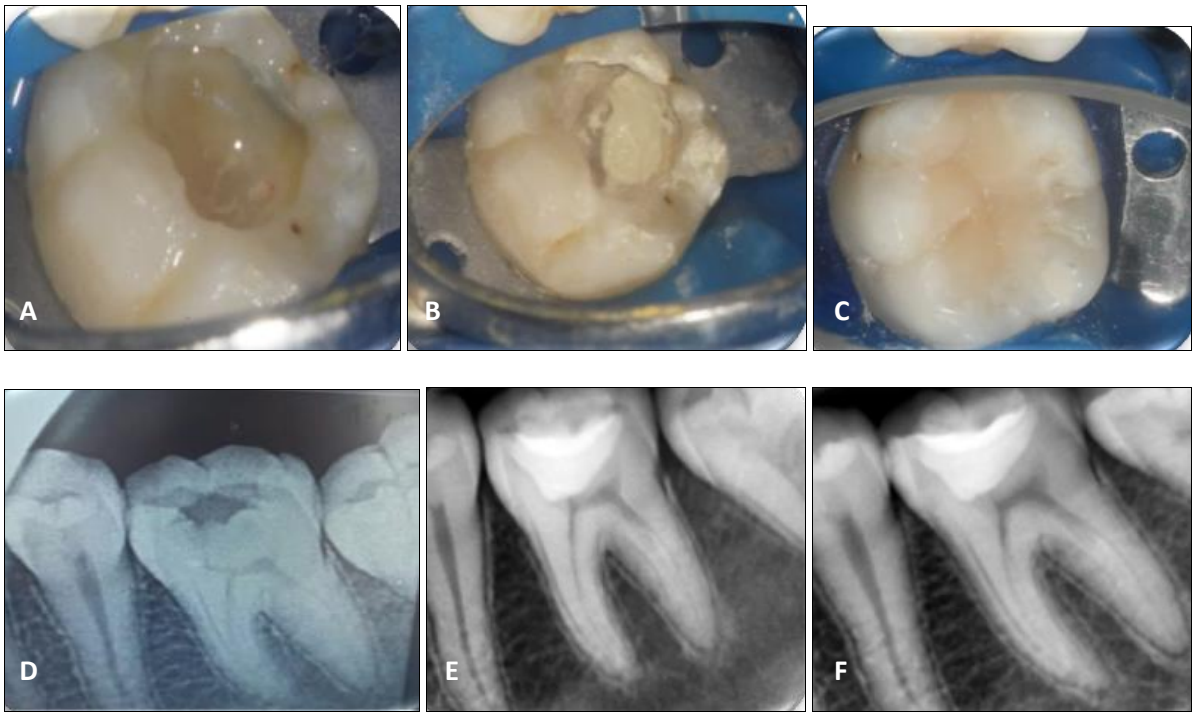

Fig 2: (a) APRF+ placed (b)MTA placed (c)Post op clinical picture (d)Pre-op radiograph (e) Follow up radiograph at 3 months (f) Follow up radiograph at 12 months

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