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Research Article

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Modern Strategies for the Management of Pulpitis

Karimli Nurana, Damirciyeva Mehriban, Huseynova Govhar, Alizade Aysel, Aytan Rzayeva, Nacafova Tamilla, Aliyeva Gulnara, Niyazova Gunel, Arkhmammedova Gulshen and Qurbanova Fidan

Azerbaijan Medical University, Azerbaijan

***Corresponding author:** Karimli Nurana, Azerbaijan Medical University, Azerbaijan.

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Introduction

Traditional Root Canal Therapy (RCT) effectively removes diseased or necrotic pulp tissue and replaces it with inorganic materials. Regenerative endodontics is an alternative to conventional RCT by using biologically based approaches to restore the pulp–dentin complex. This review explores emerging techniques, including autogenic and allogenic pulp transplantation, platelet-rich fibrin, human amniotic membrane scaffolds, specialized pro-resolving mediators, nanofibrous and bioceramic scaffolds, injectable hydrogels, dentin matrix proteins, and cell-homing strategies. These methods utilize stem cells, growth factors, and biomaterials to regenerate vascularized, functional pulp tissue.

Future research must focus on refining these techniques to ensure their safety, efficacy, and accessibility in routine practice. By addressing current limitations, regenerative endodontics could redefine the management of pulpitis, offering biologically based treatments that enhance tooth vitality, structural integrity, and long-term prognosis.

The management of pulpitis has traditionally relied on Root Canal Therapy (RCT), a well-established method for treating irreversible pulp inflammation and necrosis. However, RCT often involves replacing the diseased or necrotic pulp with inert materials, leading to the permanent loss of pulp vitality [1]. While effective in resolving infection and preserving the tooth, this approach can compromise long-term outcomes by reducing the tooth's biomechanical strength and increasing the risk of fracture [2]. These limitations highlight the need for alternative therapies that not only address the underlying pathology but also aim to restore the functional integrity of the pulp–dentin complex. Recent advancements in regenerative endodontics have introduced biologically based approaches aimed at preserving or restoring pulp vitality in cases of irreversible pulpitis or necrosis [3]. Regenerative techniques seek to harness the body's intrinsic healing potential, utilizing stem cells, growth factors, and biomaterials to promote tissue regeneration within the pulp space [3,4]. These methods offer the potential to improve treatment outcomes by preserving or restoring vascularization, neural function, and structural integrity, thus maintaining the tooth's long-term functionality [2,3,5].

Materials and Methods

This narrative review aimed to summarize and analyze recent advancements in the treatment of pulpitis, with particular emphasis on regenerative approaches. Unlike systematic reviews with strict eligibility criteria, this broader narrative review sought to explore a wide range of regenerative endodontic techniques, evaluate their efficacy, and identify existing knowledge gaps. Outcomes pertaining to pulp vitality restoration, as well as any reported adverse effects and technique-specific limitations, were also documented.

Autogenic dental pulp transplantation involves transplanting healthy pulp tissue from a patient's own tooth into another tooth, eliminating the risk of immune rejection and cross-infection [6]. This technique uses donor teeth extracted for non-pathological reasons, maintaining the pulp's regenerative potential for revascularization and dentinogenesis. However, its limitations include limited

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donor availability and the risk of donor site morbidity such as discomfort or tooth loss [6,7]. Feitosa et al. demonstrated successful transplantation of a third molar pulp into premolars, observing maintained pulp vitality, reduced periapical lesions, and revascularization within 12 months [7]. Similarly, Haung et al., in a canine model, showed that autologous deciduous pulp transplantation in necrotic immature teeth reduced apical diameter and promoted dentin-like tissue formation compared to standard treatment [8]. Cehreli et al. applied regenerative endodontic treatment (RET) in traumatized incisors of children aged 8–11.5 years, using deciduous pulp as a scaffold [9]. Follow-ups revealed periapical healing, thickened dentinal walls, and progressive apical closure, highlighting autogenic pulp transplantation's potential to restore pulp vitality and support root development in immature teeth [9].

Allogenic dental pulp transplantation involves transferring pulp tissue between two individuals of the same species [10]. Often, a donor tooth—such as a child's deciduous tooth scheduled for extraction or a third molar—is used as the pulp source due to its rich content of regenerative stem cells and growth factors [11]. The recipient tooth, typically a damaged single-rooted permanent tooth in need of regenerative treatment, is prepared by thoroughly disinfecting and shaping the root canal [12]. The harvested donor pulp is then carefully placed into this prepared canal, followed by the application of biocompatible material to cover the transplanted pulp tissue and restorative procedures, often using resin-based materials [10,11]. This process aims to restore pulp vitality and encourage the formation of new, functional pulp tissue [10,11,12]. While allogenic pulp transplantation offers the advantage of utilizing readily available donor tissue rich in regenerative properties, its main drawbacks include the risk of immune rejection, limited donor availability, and potential cross-contamination, which require stringent clinical protocols to mitigate [10,11,12]. Feitosa et al. investigated allogenic pulp transplantation in three patient cases involving pulp from a child's extracted teeth placed into a parent's root canal. Two years of follow-up with imaging, pulp vitality tests, and Doppler ultrasound showed that all treated teeth eventually revascularized and exhibited no endodontic or periodontal radiolucency [10]. Although only a small number of cases were examined, the findings suggest that this technique could be a viable option for pulp revitalization. Notably, the protocol did not include apical bleeding or preventive antibiotic coverage [10].

Regenerative endodontics represents a shift in the treatment of pulpitis by focusing on restoring the pulp–dentin complex through biologically driven approaches rather than conventional root canal therapy. This review highlights promising techniques such as autogenic and allogenic pulp transplantation, PRF, human amniotic membrane scaffolds, cell-homing strategies, and nanofibrous and bioceramic scaffolds, all of which leverage stem cells, growth factors, and biocompatible materials to promote tissue regeneration, vascularization, and functional recovery. These advancements offer significant potential for preserving tooth vitality and structural integrity while reducing long-term complications. However, key challenges remain, including the need for standardized protocols, consistent clinical outcomes, and further validation through robust, long-term clinical studies to address biological variability and ensure safety, efficacy, and cost-effectiveness. By overcoming these limitations and refining these techniques, regenerative endodontics has the potential to establish itself as the gold standard for managing pulpitis, ultimately improving patient outcomes and redefining the future of endodontic care.

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Conifilct of Interest

None.

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