

Bridging the Gap: Evaluating Awareness and Readiness for Regenerative Endodontics among Endodontists and General Practitioners: A Survey

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Abstract—

Background: Regenerative endodontic procedures (REPs) represent a fundamental shift in contemporary endodontic practice by prioritizing the biological regeneration of the pulp–dentin complex over traditional approaches centered on canal disinfection and obturation. Despite their potential to improve long-term clinical outcomes, the integration of REPs into routine practice remains limited.

Aim: To evaluate the level of awareness and perceptions of dental practitioners regarding regenerative endodontic procedures (REPs), and to identify the perceived barriers and key factors influencing their adoption in clinical practice.

Materials and Methods: A descriptive cross-sectional study design was employed among 50 dental professionals, utilizing a structured, 26-item online questionnaire for data collection. The collected data were subjected to descriptive statistical analysis, and associations between participants' professional backgrounds and levels of awareness were subsequently evaluated.

Results: Endodontists exhibited significantly higher levels of awareness of regenerative endodontic procedures compared with general dental practitioners. The principal barriers identified by respondents included inadequate educational exposure, high procedural costs, and uncertainty surrounding regulatory guidelines.

Conclusion: Although dental practitioners generally express a favourable attitude toward regenerative endodontic procedures, their integration into routine clinical practice remains constrained by systemic barriers. The implementation of structured educational programs, appropriate economic support mechanisms, and well-defined clinical and regulatory guidelines is essential.

Index Terms—Regenerative endodontics, Regenerative endodontic procedures, Dental practitioners, Awareness, Survey.

I. INTRODUCTION

1.1 Regenerative Endodontics

Regenerative endodontics is an evolving and promising field in dentistry that has demonstrated

highly favourable clinical outcomes. It comprises biologically based procedures designed to replace damaged or necrotic pulp tissues, offering a conservative and effective alternative to conventional root canal therapy and more invasive surgical endodontic procedures.(1) The success of regenerative endodontic procedures is largely dependent on the clinician's knowledge, technical expertise, and adherence to established treatment protocols. Over the past two decades, regenerative endodontics has gained significant attention among clinicians and researchers, particularly for the management of necrotic immature permanent teeth. Unlike traditional endodontic treatments that result in a non-vital tooth, regenerative approaches aim to restore pulp vitality, allowing continued root development and strengthening of surrounding dental structures.(2)

1.2 Limitations of Conventional Endodontic Therapy

Conventional endodontic treatments, including root canal therapy and apexification, have demonstrated high success rates in controlling infection. However, these approaches result in devitalization of the tooth. Loss of pulp vitality leads to reduced moisture content within the dentin, causing compromised biomechanical properties and increased susceptibility to fracture. Consequently, ideal endodontic therapy should focus on biological regeneration, wherein diseased or necrotic pulp tissue is replaced with healthy, functional pulp to revitalize the tooth.(2)

1.3 Historical Perspective of Regenerative Endodontic Procedures

The foundation of regenerative endodontics can be traced back to the pioneering work of Nygaard-Ostby in the 1960s, who demonstrated that inducing bleeding into the root canal space could promote tissue ingrowth. This concept laid the groundwork for modern regenerative endodontic procedures (REPs). Subsequent clinical applications introduced

revascularization techniques, where the formation of an apical blood clot acted as a natural scaffold for cell migration and differentiation. These biologically driven methods shifted the focus of endodontic treatment from disease elimination to true tissue restoration.(3)

1.4 Biological Basis of Regenerative Endodontics

The success of regenerative endodontic procedures relies on the fundamental triad of tissue engineering: stem cells, scaffolds, and signalling molecules. Stem cells such as dental pulp stem cells (DPSCs) and stem cells from the apical papilla (SCAP) exhibit high proliferative capacity and odontogenic potential. Scaffolds provide a three-dimensional framework that supports cell attachment, proliferation, and differentiation. Growth factors such as vascular endothelial growth factor (VEGF), bone morphogenetic proteins (BMPs), and transforming growth factor-beta play crucial roles in angiogenesis, cellular differentiation, and tissue maturation.(3)

1.5 Current Clinical Protocols

Standard regenerative endodontic protocols emphasize minimal mechanical instrumentation, thorough disinfection of the root canal system, and intracanal medicaments such as calcium hydroxide or triple antibiotic paste. Apical bleeding is then induced to create a biological scaffold, followed by coronal sealing with biocompatible materials like mineral trioxide aggregate (MTA). Recent modifications to these protocols incorporate platelet concentrates and advanced scaffold materials to enhance treatment predictability and outcomes.(3)

II. MATERIALS AND METHODS

- **Study Design:** A descriptive cross-sectional questionnaire-based survey was conducted.
- **Study Setting and Duration:** Conducted online across Pune between November 2025 and February 2026.
- **Participants:** Registered dental professionals, including endodontists and general practitioners.
- **Sample Size:** Out of 70 invited participants, 50 valid responses were received.
- **Exclusion Criteria:** Undergraduate students and incomplete survey responses.
- **Survey Instrument:** A structured 26-item questionnaire validated by a panel of two endodontic experts for content validity, covering 6 domains: Demographics; Awareness of regenerative endodontics; Training and clinical exposure; Willingness to perform regenerative endodontics; Clinical practice patterns; and Perceptions and future outlook.

- **Data Collection:** The survey was disseminated via Google Forms. Participation was voluntary.
- **Statistical Analysis:** Data were analyzed using IBM SPSS Statistics version 31.0. Descriptive statistics were used to summarize participant responses and demographic characteristics. Associations between specialty and awareness levels were evaluated using the Chi-square test. Statistical significance was set at $p < 0.05$.

III. RESULTS

3.1 Demographics

Endodontists: 20 (40%); General Practitioners: 20 (40%); Resident/Intern: 9 (18%); Orthodontists: 1 (2%). Mean clinical experience: 2.6–2.8 years. Type of practice: Private practice 16 (32%); Government institution 15 (30%); Academic/teaching institution 12 (24%); Mixed practice 7 (14%). Location of practice: Urban 38 (76%); Semi-urban 12 (24%).

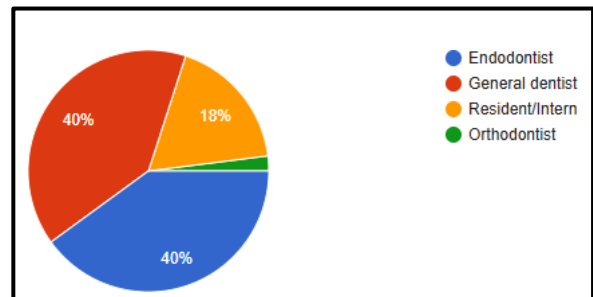


Figure 1: Distribution of study participants by specialty

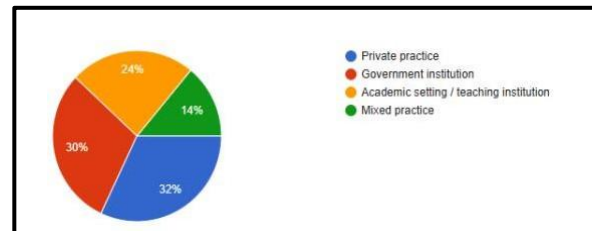


Figure 2: Distribution of participants by type of practice

3.2 Awareness of Regenerative Endodontics (RE)

Awareness of the concept of regenerative endodontics: 94% Yes (47/50), only 3 respondents unaware (6%). Self-rated knowledge level: Fair 58% (29/50); Good 32% (16/50); Excellent 6% (3/50); Poor 4% (2/50).

Table 1: Awareness of REPs by Specialty

Specialty	Aware of REPs (%)	Not Aware (%)
Endodontists (n=20)	95.5%	4.5%

Specialty	Aware of REPs (%)	Not Aware (%)
General Practitioners (n=20)	90%	10%
Others (n=10)	100%	—

Opinion on RE effectiveness compared to traditional apexification: Equally effective 70% (35/50); More effective 20% (10/50); Less effective 6% (3/50); Not sure 4% (2/50). Received formal training in RE: Yes 60% (30/50), No 40% (20/50). Observed or assisted in an RE procedure: Yes 76% (38/50), No 24% (12/50). Awareness of current AAE/international guidelines for REP: Yes 52% (26/50), Maybe 16% (8/50), No 32% (16/50). Most familiar RE component: Blood clot-induced regeneration (32% of respondents); Scaffold-based approaches (18%); PRP/PRF-based regeneration, stem cell-based therapies, triple antibiotic paste (16% each).

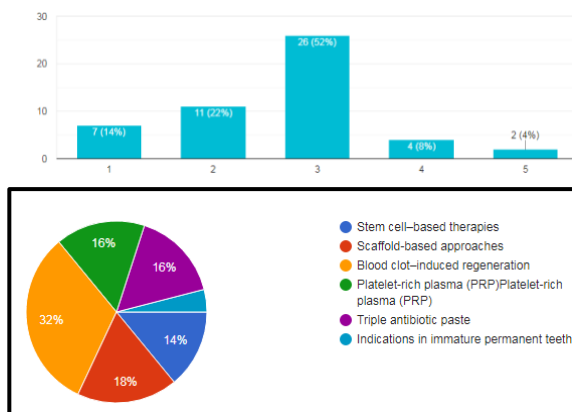


Figure 3: Most familiar RE component

3.3 Willingness and Adoption Intent

Willing to perform RE in their practice: Yes 72% (36/50), Maybe 10% (5/50), No 18% (9/50). Already performed at least one RE procedure: Yes 76% (38/50), No 24% (12/50). Likelihood to incorporate RE into routine practice: Somewhat likely 64%; Very likely 18%; Already practicing 8%; Not likely 10%. Belief that RE will become standard of care in future: Yes 88% (44/50), No 12% (6/50). Would recommend RE to eligible patients if adequate resources available: Yes 90%+.

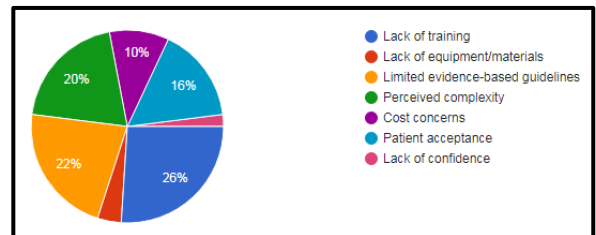


Figure 4: Factors affecting willingness to perform RE

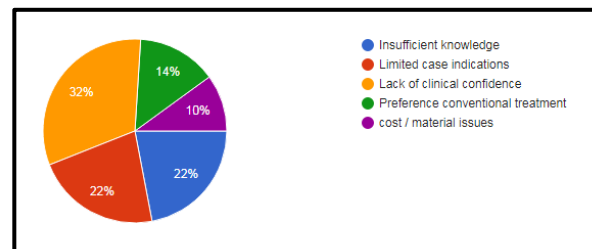


Figure 5: Primary reason for not willing to perform RE

Barriers: Difficulty achieving bleeding/clot formation (26%); Unpredictable outcomes (40%); Material availability/cost (12%); Time consumption (10%); Patient cooperation (8%); Lack of support/guidelines (4%).

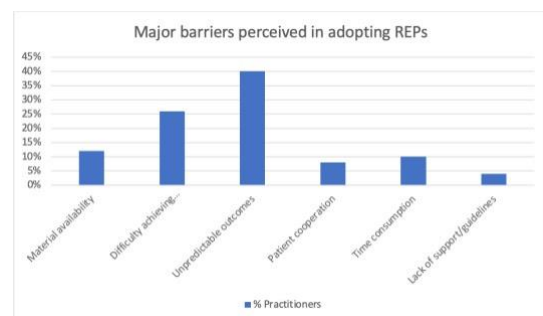


Figure 6: Major barriers perceived in adopting REPs

IV. DISCUSSION

The findings of this study highlight a nuanced interaction between optimism, critical evaluation, and existing knowledge deficiencies among dental practitioners concerning regenerative endodontic therapies. In agreement with previous research by Kim et al., endodontic specialists exhibited markedly higher levels of awareness and conceptual clarity than

general dental practitioners. This variation can largely be explained by enhanced academic exposure, structured postgraduate curricula, and greater clinical involvement with regenerative procedures during specialty training. Comparable patterns have been documented in large-scale surveys from North America and the Middle East, reinforcing the notion that advanced specialization significantly influences knowledge development and preparedness for clinical implementation in regenerative dentistry.(3)

4.1 Educational Implications

A substantial number of respondents identified the lack of organized and comprehensive educational frameworks as a major obstacle to the clinical adoption of regenerative endodontic techniques. This observation supports the conclusions drawn by Saoud et al., emphasizing the urgent need for curricular enhancement. Integrating regenerative dentistry topics into both undergraduate and postgraduate programs, along with focused continuing dental education (CDE) activities, could meaningfully improve theoretical understanding and technical competence. Early exposure within the curriculum may foster conceptual familiarity, promote smoother transition into clinical practice, and encourage sustained professional interest in biologically driven therapeutic approaches.(3)

4.2 Clinical Training and Skill Development

Although participants demonstrated positive attitudes, their limited practical experience highlights a notable disconnect between theoretical knowledge and hands-on application. Incorporating simulation-based exercises, laboratory skill training, and supervised clinical case management into residency curricula may effectively address this gap. Additionally, competency-based evaluations and structured mentorship programs could enhance procedural expertise, improve treatment outcomes, and strengthen clinical confidence.(3)

4.3 Economic and Infrastructural Constraints

Economic limitations and insufficient infrastructure emerged as key barriers to the widespread adoption of regenerative endodontic procedures. These findings are consistent with earlier reports emphasizing the high costs associated with advanced biomaterials, stem cell processing, and specialized clinical equipment. Developing centralized regional stem cell banking centers, investing in laboratory facilities, and promoting the production of affordable biomimetic materials may substantially reduce these financial and logistical challenges.(3)

4.4 Ethical, Legal, and Regulatory Considerations

A significant proportion of participants expressed uncertainty regarding the ethical and legal frameworks

governing regenerative dental treatments. This underscores the need for regulatory bodies and professional dental organizations to establish clear clinical protocols, ethical standards, and legal guidelines. Furthermore, future research should prioritize innovative bioengineering strategies, including gene-editing techniques, nanostructured scaffold development, and artificial intelligence-based diagnostic systems. Collaborative efforts among bioengineers, molecular biologists, and clinicians will be essential to enhance the clinical translation, predictability, and long-term success of regenerative endodontic therapies.(3)

V. CONCLUSION

This cross-sectional survey highlights a substantial level of awareness of regenerative endodontic procedures (REPs) among dental practitioners in Pune, with the majority of respondents demonstrating familiarity with the concept and expressing a generally positive attitude toward its clinical potential. Endodontists showed significantly higher awareness, training exposure, and confidence in performing REPs compared with general practitioners and other dental specialists, underscoring the influence of postgraduate education and specialty training on the adoption of regenerative approaches.

Despite favorable perceptions regarding the effectiveness of REPs, their routine clinical implementation remains limited. Key barriers identified include inadequate formal training, limited hands-on clinical exposure, high procedural costs, and uncertainty regarding standardized clinical and regulatory guidelines. Addressing these gaps through structured undergraduate and postgraduate curricula, continuing dental education programs, clear evidence-based guidelines, and improved access to clinical resources is essential. Such measures will be pivotal in bridging the gap between regenerative research and routine clinical care, ultimately enabling wider and more confident adoption of regenerative endodontic procedures in dental practice.

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