ISSN:2584-2706 DOI: https://doi.org/10.67317/IJMSRT26SEP083

Unconventional versus Conventional Endodontics: A Narrative Review of Clinical Rationale and Radiographic Evidence for Superior Outcomes in Selected Clinical Scenarios

Dr. Althaaf Khan
BDS (SMU), AssocFCGDent (UK)
Private Practice, South Africa

Corresponding author

Abstract
Conventional orthograde root canal therapy — complete pulp extirpation, straight-line coronal access, full biomechanical shaping to the apical constriction, and three-dimensional obturation — remains the reference standard in endodontics, with long-term radiographic and clinical success rates generally exceeding 85%. However, a growing body of comparative and cohort literature indicates that deliberate departures from this conventional protocol — minimally invasive access cavity design, vital pulp therapy and pulpotomy in mature teeth, regenerative endodontic procedures in immature necrotic teeth, bioceramic single-cone obturation, intentional replantation, and simplified single-visit protocols — can achieve equivalent, and in selected scenarios superior, radiographic healing. This narrative review synthesises evidence from systematic reviews, randomised controlled trials, and cohort studies published between 2010 and 2026 comparing conventional and unconventional endodontic strategies across six domains. The reviewed literature suggests that unconventional approaches frequently succeed because they preserve pericervical and radicular dentin, thereby reducing the biomechanical burden that predisposes conventionally treated teeth to fracture and extraction; because they exploit the bioactivity of hydraulic calcium silicate materials that form an apatite interface and stimulate hard-tissue deposition; because they permit continued root maturation that thickens dentinal walls in immature teeth; and because they minimise specific iatrogenic risks, such as coronal microleakage, associated with prolonged, multi-appointment protocols. Radiographically, these mechanisms manifest as re-formation of the lamina dura, normalisation of periodontal ligament space, resolution of periapical radiolucency, and measurable increases in root length, wall thickness, and root area. The evidence is heterogeneous and strongly case-selection dependent — at least one randomised trial found conventional canal preparation to outperform a minimally invasive protocol on strict periapical healing criteria — but overall supports considering unconventional endodontic strategies as legitimate, evidence-based options rather than treatments of last resort.

Keywords:
Minimally Invasive Endodontics; Vital Pulp Therapy; Regenerative Endodontic Procedures; Bioceramic Sealers; Intentional Replantation; Periapical Radiographic Healing.

ISSN:2584-2706 DOI: https://doi.org/10.67317/IJMSRT26SEP083

1. Introduction

Conventional root canal therapy is built upon a small number of biomechanical principles that have remained largely unchanged since the mid-twentieth century: complete removal of the coronal pulp roof to achieve straight-line access, full-length biomechanical instrumentation of the root canal system to a defined apical size, and three-dimensional obturation of the prepared space with gutta-percha and sealer [1,2]. When performed to a high standard, this approach is highly successful, with systematic reviews reporting primary root canal treatment success rates in the region of 86% to 96% [3]. Because of this excellent long-term track record, conventional biomechanical preparation and obturation have functioned for decades as the implicit benchmark against which every alternative technique is judged, and deviations from it have often been regarded as compromises reserved for cases in which conventional treatment has already failed or is not technically feasible.

Over the last fifteen years, however, an increasing volume of comparative clinical evidence has challenged the assumption that greater removal of tooth structure, complete pulp extirpation, and multi-visit chemomechanical protocols are invariably necessary to achieve, or are always superior in achieving, radiographic and biological success. Minimally invasive access cavity designs preserve pericervical dentin while still permitting adequate canal debridement [1,4,5]. Vital pulp therapy and pulpotomy procedures, once restricted to immature teeth, are now applied with favourable outcomes to mature teeth diagnosed with symptomatic irreversible pulpitis [6,7,8]. Regenerative endodontic procedures have emerged as an alternative to apexification in immature necrotic teeth, with the demonstrated advantage of continued root development [9,10,11]. Bioceramic sealers used with simplified single-cone obturation exploit a bioactive setting reaction that traditional zinc-oxide-eugenol and epoxy-resin-based systems lack [12,13]. Intentional replantation offers a viable alternative to conventional surgical or non-surgical retreatment when anatomical constraints make orthograde or apical surgical access difficult [14,15,16]. And single-visit protocols, once considered a deviation from the ostensibly safer multi-visit, calcium hydroxide-mediated approach, have repeatedly failed to show inferior radiographic healing when compared with conventional multi-visit treatment [17,18,19].

The purpose of this review is to synthesise the comparative evidence across these six areas of unconventional endodontic practice, and to examine the biological and mechanical explanations for why radiographic outcomes — periapical healing, lamina dura integrity, root maturation, and obturation quality — sometimes favour the unconventional approach over the conventional one. The objective is not to argue that unconventional techniques should replace conventional root canal therapy as a default, but to characterise the clinical scenarios and underlying mechanisms in which a deliberate departure from convention appears to be radiographically and biologically justified, while also representing the comparative evidence that does not support this conclusion.

2. Materials and Methods

This is a narrative review rather than a formal systematic review, undertaken to provide a clinically oriented synthesis across several distinct but related areas of comparative endodontic outcome research. A literature search was conducted in PubMed/MEDLINE, Scopus, and the Cochrane Library for articles published between January 2010 and September 2026, using combinations of the search terms "minimally invasive endodontics," "contracted access cavity," "vital pulp therapy," "pulpotomy," "regenerative endodontic procedure," "apexification," "bioceramic sealer," "single cone obturation," "intentional replantation," "single-visit root canal treatment," and "periapical healing," each combined with "conventional" and "radiographic outcome."

Systematic reviews, meta-analyses, randomised controlled trials, and prospective or retrospective cohort studies reporting radiographic outcome measures — periapical index (PAI) scores, lesion size, lamina dura appearance, root length, root wall thickness, or root area — comparing a conventional endodontic protocol with a defined unconventional alternative were prioritised for inclusion. Case reports and case series were referenced only where they illustrated a mechanism or outcome pattern already supported by higher-level evidence. Articles addressing the primary dentition, non-endodontic surgical procedures, and purely in vitro mechanical studies without a clinical radiographic correlate were generally excluded unless they provided mechanistic evidence directly relevant to a clinical finding discussed elsewhere in the review.

ISSN:2584-2706 DOI: https://doi.org/10.67317/IJMSRT26SEP083

As this is a review of previously published, de-identified data, no institutional ethical approval or patient informed consent was required for its preparation.

3. Results and Discussion

3.1 Minimally invasive access cavities versus traditional straight-line access

Traditional access cavity design was intentionally over-prepared: the goal of unobstructed straight-line access to every canal took precedence over conservation of coronal dentin, and complete removal of the pulp chamber roof was considered a procedural requirement [1,4]. Systematic reviews of contracted and truss-style access cavity designs indicate that this extensive removal of pericervical dentin measurably reduces the fracture resistance of the treated tooth [5,20]. Because pericervical dentin functions as a ferrule-like structural collar around the cervical portion of the root, its conservation directly influences whether a tooth survives function over the long term, rather than requiring extraction — an outcome that, unlike a periapical radiolucency, cannot be reversed by any subsequent endodontic intervention [1,5]. A 2024 systematic review and meta-analysis comparing conventional and newer access cavity designs found that conservative and truss-style cavities consistently outperformed traditional access in fracture-resistance testing, supporting minimally invasive access as a structurally advantageous alternative in appropriately selected teeth [20].

Guided endodontics — a further refinement in which a 3D-printed template directs bur angulation through calcified canals — has been shown, in an ex vivo comparative study, to achieve canal location with less overall tooth substance loss and fewer supplementary radiographs than conventional freehand access in teeth with pulp canal obliteration [21].

The clinical picture is not, however, uniformly favourable to the unconventional approach, and a rigorous recent randomised trial illustrates why case selection and outcome definition matter. A prospective randomised clinical trial comparing a conventional preparation protocol against a comprehensive minimally invasive protocol — combining reduced-taper instrumentation, ultrasonic-assisted irrigation, and sealer-based obturation — in mature permanent teeth followed patients for a minimum of two years and assessed healing using strict and loose periapical index criteria. Contrary to the hypothesis that minimally invasive preparation would preserve or improve healing, this trial found that the conventional protocol achieved significantly higher periapical healing success than the minimally invasive protocol under both criteria, while the minimally invasive protocol retained its expected advantage in structural dentin preservation [22]. This finding indicates that reduced canal preparation does not automatically translate into superior periapical radiographic healing, and that the radiographic advantage of minimally invasive access is most clearly demonstrated in fracture-resistance and long-term tooth-survival outcomes rather than in resolution of existing apical periodontitis. The overall case for minimally invasive access, therefore, rests less on a claim of superior debridement or periapical healing than on the observation that a tooth must survive long enough, and with sufficient structural integrity, for a healed periapical radiograph to remain clinically meaningful.

3.2 Vital pulp therapy and pulpotomy versus orthograde root canal therapy in mature teeth

Vital pulp therapy — direct or indirect pulp capping, and partial or full pulpotomy — was traditionally confined to immature teeth requiring apexogenesis. The introduction of hydraulic calcium silicate cements has extended its indications into mature permanent teeth diagnosed with symptomatic irreversible pulpitis, a clinical presentation that has conventionally mandated complete pulp extirpation [6,23]. A randomised controlled trial comparing full pulpotomy using a bioceramic material against conventional root canal therapy in mature molars with carious pulp exposure and irreversible pulpitis found comparable clinical and radiographic success rates at six and twelve months, alongside improved patient-reported quality of life and satisfaction in the pulpotomy group [24]. A subsequent randomised trial replicated this pattern, reporting that full pulpotomy performed with a bioceramic putty was an appropriate alternative to conventional root canal treatment in mature teeth with irreversible pulpitis, based on comparable clinical and radiographic outcomes together with reduced chair-time and cost [8]. A systematic review of vital pulp therapy outcomes in mature posterior teeth with symptomatic irreversible pulpitis reached a similar conclusion, although it cautioned that case-selection criteria for vital pulp therapy are not yet fully standardised across studies [7].

ISSN:2584-2706 DOI: https://doi.org/10.67317/IJMSRT26SEP083

Case-level radiographic evidence supports the same pattern. Full pulpotomy performed with a calcium-silicate material in mature molars with hyperplastic or irreversible pulpitis has been documented, on periapical and cone-beam imaging, to preserve a normal periodontal ligament space around all roots at long-term review, avoiding both extraction and conventional canal therapy in patients for whom cost or access to specialist care would otherwise have precluded treatment [25]. Even in mature teeth presenting with a periapical lesion at the time of treatment, full pulpotomy with a bioceramic material has been reported, at two-year follow-up, to be associated with resolution of the periapical radiolucency and re-formation of the periodontal ligament space, indicating that pre-existing apical pathology is not an absolute contraindication to a vital-pulp-preserving approach in a well-selected case [26]. A case report of partial pulpotomy performed with a bioceramic material in a mature molar with symptoms suggestive of irreversible pulpitis similarly documented favourable clinical and radiographic outcomes at eleven months [27], and a broader evidence-based review of coronal pulpotomy in permanent teeth with mature apices concluded that the procedure can reasonably be offered as an alternative to root canal therapy in appropriately selected cases [23].

The explanation for these radiographic findings is biological rather than purely mechanical. Hydraulic calcium silicate cements such as mineral trioxide aggregate and Biodentine hydrate to release calcium hydroxide, generating a sustained alkaline, antibacterial micro-environment at the pulpal wound and stimulating tertiary dentinogenesis and the formation of a mineralised dentin bridge more reliably than the calcium hydroxide pulp-capping agents that preceded them [28,29]. A pulp preserved in this manner retains its capacity to maintain the vitality, and indirectly the periapical health, of the remaining radicular tissue, which in principle removes the premise on which conventional complete pulp extirpation is based — namely, that an inflamed pulp will inevitably progress to irreversible necrosis.

3.3 Regenerative endodontic procedures versus apexification in immature necrotic teeth

In immature permanent teeth with pulp necrosis, the conventional approach — apexification with a long-term calcium hydroxide dressing, or more recently an MTA apical plug — induces a hard-tissue barrier at the apex sufficient to permit orthograde obturation, but does not itself promote further root development, leaving the tooth with thin, fracture-prone dentinal walls [9,10]. Regenerative endodontic procedures, by contrast, aim to disinfect the canal without further weakening the existing root structure and to allow a blood clot or platelet concentrate to serve as a scaffold for continued root maturation [9,11]. The original Mahidol cohort study, comparing radiographic and survival outcomes of immature teeth managed with regenerative endodontic procedures against apexification, found significantly greater increases in radiographic root length and width in the regenerative group [9]. Subsequent multicentre cohort data assessing radiographic outcomes of regenerative endodontic procedures and apexification, incorporating measurement of radiographic root area change, external root resorption, apical hard-tissue formation, and apical closure, have continued to support more favourable structural outcomes with regenerative management in comparably selected cases [11]. A retrospective comparison of avulsed immature teeth treated with apexification or regenerative procedures, using quantitative image-analysis software to measure percentage changes in root length and thickness, likewise found regenerative management associated with more favourable root-development outcomes, while identifying storage medium, root development stage, and periodontal healing pattern as the principal prognostic determinants of radiographic outcome irrespective of treatment group [30].

Systematic reviews and randomised trials paint a more nuanced overall picture. A meta-analysis comparing regenerative and apexification interventions across dentinal wall thickness, root length increase, apical closure, vitality response, and overall success found regenerative procedures superior specifically for continued root development, without necessarily demonstrating superiority across every outcome domain [10]. A recent umbrella review pooling multiple systematic reviews reported that regenerative endodontic treatment and apexification achieved comparably high overall success rates exceeding 85%, with most direct comparisons failing to reach statistical significance for periapical healing specifically [31]. A prospective randomised trial comparing the two approaches in immature teeth with apical periodontitis, using cone-beam computed tomography to quantify root length, thickness, and apical foramen change at twelve months, similarly found both to be effective, but again observed a structural developmental advantage favouring the regenerative approach [32].

ISSN:2584-2706 DOI: https://doi.org/10.67317/IJMSRT26SEP083

Taken together, this body of evidence indicates that regenerative endodontic procedures and apexification achieve broadly equivalent resolution of periapical radiolucency, but that the regenerative approach confers an additional radiographic advantage — measurable thickening of the dentinal walls and lengthening of the root — that a conventional apexification protocol, by design, cannot replicate, and that this structural gain bears directly on the tooth's long-term fracture resistance and survival.

3.4 Bioceramic single-cone obturation versus conventional condensation techniques

Conventional obturation technique, whether cold lateral condensation or warm vertical compaction of gutta-percha with a resin- or zinc-oxide-eugenol-based sealer, relies principally on mechanical adaptation of an inert filling material to the canal wall, with the sealer functioning largely as a space-filling adhesive rather than a biologically active material [13,33]. Hydraulic calcium silicate, or bioceramic, sealers, used increasingly with a simplified single-cone technique, behave differently: on contact with periradicular tissue fluid they undergo a bioactive setting reaction that produces a superficial apatite layer, allowing chemical bonding to dentin and, where extruded, biocompatible interaction with periapical tissue rather than the sustained inflammatory irritation associated with older sealer chemistries [12,34,35].

A one-year randomised follow-up study comparing epoxy-resin and bioceramic sealers combined with cold lateral condensation or warm vertical compaction in teeth with pre-existing apical periodontitis found no significant difference in overall success between groups, but reported that the combination of bioceramic sealer with warm vertical compaction produced the most favourable periapical healing and greatest reduction in lesion size, albeit with a higher rate of sealer extrusion — an occurrence that, contrary to conventional teaching regarding overfilling, did not appear to compromise healing when a bioactive sealer was involved [33]. A systematic review comparing hydraulic single-cone and thermoplasticised warm vertical obturation reached a similar conclusion, noting that bioceramic sealers used with either technique achieved favourable radiographic outcomes, with warm vertical compaction offering an incremental advantage specifically in teeth with pre-existing periapical lesions [13]. Prospective clinical outcome data on bioceramic sealers combined with warm gutta-percha techniques have reported healed and healing rates in the order of 99%, with the authors noting that simplified single-cone protocols using bioceramic sealer achieved results comparable to those obtained historically with more technique-sensitive conventional resin- or zinc-oxide-eugenol-based systems [12]. At the microscopic level, comparative dentinal tubule penetration studies indicate that bioceramic sealer distribution is influenced more by obturation technique than by sealer chemistry alone, but that even the technically simpler single-cone method achieves clinically adequate tubule penetration when paired with a flowable bioceramic sealer [36]. Fracture-resistance testing has further reported that the single-cone technique combined with bioceramic sealer outperformed both cold lateral and warm vertical compaction, suggesting that bioceramic sealers may also reinforce, rather than merely fill, the prepared root [37].

The practical implication is that the traditional justification for technically demanding, time-intensive condensation techniques — namely, the need to mechanically compensate for an inert, poorly adherent filling material — is substantially reduced once a bioactive sealer is used. A simplified single-cone protocol, historically regarded as a shortcut associated with inferior obturation quality, can achieve radiographic healing outcomes equivalent to, and in some comparative studies numerically favouring, conventional multi-step condensation, because the biological behaviour of the sealer at the canal wall and periapical interface, rather than the mechanical compaction of gutta-percha, appears to be a dominant determinant of long-term periapical healing.

3.5 Intentional replantation versus conventional surgical or non-surgical retreatment

When primary root canal treatment fails, conventional management follows a defined hierarchy: non-surgical orthograde retreatment is generally preferred, with surgical endodontic retreatment reserved for cases in which retreatment is impractical or unlikely to succeed [14,38]. In certain anatomically difficult presentations — proximity to the maxillary sinus, the mental or inferior alveolar nerve, thick buccal cortical plates over second and third molars, or complex isthmus anatomy inaccessible to a surgical approach — even conventional surgical retreatment may not be feasible [14,38]. Intentional replantation, in which the tooth is atraumatically extracted, its apex managed extraorally under direct

ISSN:2584-2706 DOI: https://doi.org/10.67317/IJMSRT26SEP083

microscopic visualisation, and the tooth then reinserted into its own socket, offers a means of achieving what is functionally apical surgery without the anatomical constraints of an intraoral surgical field [14,15,16].

Contemporary systematic review data report survival rates for intentionally replanted teeth in the range of 88% to 95%, a marked improvement on the more variable figures reported in older literature, attributable largely to the introduction of the operating microscope, atraumatic extraction instruments, and bioceramic root-end filling materials [15,39]. A recent retrospective cohort study confirmed an overall survival rate of 87.3%, with the presence of a pre-operative periapical lesion significantly reducing survival and stabilisation with a fibre-reinforced composite splint significantly improving it, findings that are directly informative for case selection [14]. A systematic review specifically addressing the effectiveness of intentional replantation in managing apical periodontitis concluded that, provided atraumatic extraction is achievable and extraoral time is kept to approximately fifteen minutes or less, favourable healing of the periodontal tissues, resolution of bone loss, and absence of root resorption can reliably be expected on radiographic review [16]. Long-term case follow-up of intentionally replanted molars has similarly documented sustained periapical health where conventional retreatment carried a poor prognosis [40].

Radiographically, the advantage of intentional replantation over conventional surgical retreatment in these anatomically constrained cases lies in the quality of apical management rather than in any inherent superiority of the procedure itself: extraoral visualisation of the resected root end under high magnification allows identification and sealing of isthmuses, lateral canals, and microfractures that would be inaccessible or difficult to manage through a conventional intraoral surgical window, while avoiding risk to adjacent anatomical structures that limits conventional apical surgery in these locations [16,40]. In this sense, intentional replantation does not outperform conventional surgery because it departs from established endodontic surgical principles, but because it allows those same principles — direct visualisation, thorough resection, and a well-sealed root-end filling — to be applied in cases where the anatomy of a conventional intraoral approach would otherwise prevent them from being applied at all.

3.6 Single-visit unconventional protocols versus conventional multi-visit calcium hydroxide-mediated treatment

Multiple-visit root canal treatment, incorporating an interappointment calcium hydroxide intracanal medicament, has long been regarded as the more cautious, conventional approach, particularly for teeth with pre-existing apical periodontitis, on the assumption that residual intracanal micro-organisms are more effectively eliminated by a period of medicated dressing than by chemomechanical preparation and obturation completed in a single appointment [17,19]. A large body of comparative evidence has failed to confirm a periapical healing advantage for this more cautious approach. A systematic review, meta-analysis, and trial sequential analysis of single-visit versus multiple-visit treatment found no clinically meaningful difference in the risk of complications between the two protocols, with multiple visits offering, at most, a marginal reduction in postoperative flare-up risk in teeth with existing periapical lesions [17]. A subsequent randomised controlled trial using the periapical index specifically to compare radiographic healing at six and twelve months found no statistically significant difference between single-visit and multiple-visit groups, and reported numerically higher twelve-month success in the single-visit arm [18]. A narrative review of the topic similarly concluded that, across the majority of comparative studies examining periapical healing directly, no significant difference could be demonstrated between single- and multiple-visit endodontic treatment, while single-visit treatment was consistently associated with reduced postoperative pain [19]. A randomised clinical trial using core-carrier obturation in a general-practice setting reported equivalent long-term success between single- and multiple-visit protocols, with the single-visit approach requiring substantially less total chairside time [41], and a further study noted that single-visit treatment measurably improved patient anxiety scores without any loss of clinical or radiographic success relative to multiple visits [42].

The radiographic equivalence, and in some studies numerical advantage, of single-visit treatment is plausibly explained by the elimination of the interappointment period during which a temporary coronal restoration, rather than the definitive final seal, is the only barrier against microbial recontamination of the canal system. Coronal microleakage during the interval between appointments

ISSN:2584-2706 DOI: https://doi.org/10.67317/IJMSRT26SEP083

has long been recognised as a clinically significant risk factor for treatment failure, and a protocol that removes this interval removes the risk entirely, offsetting whatever antimicrobial benefit an interappointment calcium hydroxide dressing might otherwise provide [19,42]. In this light, the single-visit approach can be understood less as a compromise driven by convenience than as a simplification that removes a specific, well-documented source of iatrogenic risk inherent to the conventional multi-visit protocol.

3.7 Synthesis: a mechanistic explanation for favourable radiographic outcomes with unconventional approaches

Across these six areas, three recurring mechanistic themes explain why unconventional endodontic approaches sometimes produce radiographic outcomes equal or superior to those of conventional treatment. First, preservation of tooth structure — whether pericervical dentin in minimally invasive access, radicular dentin in vital pulp therapy, or thin immature dentinal walls in regenerative endodontic procedures — directly influences whether a periapically healed tooth remains structurally serviceable over the long term, an outcome dimension that conventional treatment, by prioritising complete débridement and straight-line access, can inadvertently compromise [1,9,10,20]. Second, the bioactivity of hydraulic calcium silicate materials — used as pulp-capping and pulpotomy agents, apical barriers, root-end filling materials, and now root canal sealers — introduces a chemically active, apatite-forming interface capable of stimulating hard-tissue deposition and providing a biological seal that inert, conventional filling materials cannot replicate [28,29,34,35]. This mechanism underlies the favourable radiographic healing reported with bioceramic-sealed single-cone obturation, calcium-silicate pulpotomy in mature teeth, and apatite-mediated sealing in regenerative and surgical endodontic applications alike. Third, several unconventional protocols reduce a specific, identifiable iatrogenic or biological risk inherent to the conventional alternative — coronal microleakage during multi-visit treatment, anatomically constrained access during conventional apical surgery, or the biomechanical vulnerability created by extensive removal of coronal or radicular dentin — rather than offering a fundamentally different mechanism of periapical healing [14,16,19]. Radiographic signs of success — resolution of periapical radiolucency, re-formation of a continuous lamina dura, normalisation of periodontal ligament space width, and, in immature teeth, measurable increases in root length and dentinal wall thickness — are therefore not unique to conventional treatment, but reflect the same underlying biological healing response operating under conditions that an unconventional protocol may, in selected cases, be better configured to support.

This evidence is nonetheless case-selection dependent rather than universal, and it should not be read as a blanket argument against conventional technique. The randomised trial finding significantly higher periapical healing success with a conventional preparation protocol than with a comprehensive minimally invasive protocol is a direct illustration that reduced instrumentation does not automatically confer a radiographic healing advantage, even though it may confer a structural one [22]. Studies of regenerative endodontic procedures, intentional replantation, and vital pulp therapy likewise consistently identify factors — pre-existing periapical pathology, root development stage, extraoral handling time, and pulp inflammation severity — that materially affect outcome, and none of the reviewed literature supports abandoning conventional root canal therapy as the default treatment for the majority of cases [7,11,14]. Rather, the evidence supports a more individualised model of endodontic decision-making, in which the conventional protocol is one of several evidence-based options, to be selected, or deliberately departed from, according to the specific structural, biological, and anatomical circumstances of the tooth being treated.

4. Conclusion

The historical assumption that conventional root canal therapy represents an unconditional radiographic and biological gold standard is not consistently supported by contemporary comparative evidence. Minimally invasive access cavities, vital pulp therapy and pulpotomy in mature teeth, regenerative endodontic procedures, bioceramic single-cone obturation, intentional replantation, and single-visit treatment protocols have each, in defined clinical scenarios, achieved periapical and structural radiographic outcomes equivalent to, or in some respects better than, those obtained with conventional technique. This pattern is best explained by the preservation of tooth structure, the bioactivity of hydraulic calcium silicate materials, and the avoidance of specific iatrogenic risks

associated with more extensive or prolonged conventional protocols, rather than by any single unconventional technique representing a wholesale substitute for established endodontic principles. At the same time, at least one rigorous randomised trial demonstrates that reduced instrumentation can come at the cost of periapical healing when judged by strict radiographic criteria, underscoring that unconventional strategies are not universally superior and must be matched to the case. Clinicians should regard these unconventional strategies as legitimate, evidence-supported options for carefully selected cases rather than as treatments of last resort, while continuing to base the choice between conventional and unconventional management on individualised case assessment. Further prospective, long-term comparative studies with standardised radiographic outcome measures are needed to refine case-selection criteria across each of these treatment categories.

5. Acknowledgements
The author declares no acknowledgements beyond the published literature cited in this review.

6. Funding Statement
This review received no specific grant or financial support from any funding agency in the public, commercial, or not-for-profit sectors.

7. Conflict of Interest
The author declares no financial, professional, institutional, or personal conflict of interest relevant to the content of this review.

8. References
1. Neelakantan P, Vishwanath V, Taschieri SLM, Corbella S. Present status and future directions: Minimally invasive root canal preparation and periradicular surgery. Int Endod J. 2022;55(Suppl 4):845-71.
2. Prasher P, Kaur SJ, Kaur M, Vigas B, Khatri T, Pallerla S. Revolutionizing root canal treatment: a review of minimally invasive endodontics. Bioinformation. 2025;21(8):2504-9.
3. Ng YL, Mann V, Rahbaran S, Lewsey J, Gulabivala K. Outcome of primary root canal treatment: systematic review of the literature - Part 2. Influence of clinical factors. Int Endod J. 2008;41(1):6-31.
4. A literature review of minimally invasive endodontic access cavities - past, present and future. Br DentJ[Internet].2022[cited2026Sep15].Availablefrom:
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9035856/
5. Minimally invasive access cavity designs: a review. Cureus J Med Sci [Internet]. [cited 2026 Sep 15]. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC11426888/
6. Vital pulp therapy of permanent teeth with reversible or irreversible pulpitis: an overview of the literature. J Clin Med. 2022;11(13):3672.
7. Vital pulp therapy in permanent mature posterior teeth with symptomatic irreversible pulpitis: a systematic review of treatment outcomes. Medicina (Kaunas). 2021;57(6):573.
8. Full pulpotomy versus root canal therapy in mature teeth with irreversible pulpitis: a randomized controlled trial. BMC Oral Health. 2024;24:1209.
9. Jeeruphan T, Jantarat J, Yanpiset K, Suwannapan L, Khewsawai P, Hargreaves KM. Mahidol study 1: comparison of radiographic and survival outcomes of immature teeth treated with either regenerative endodontic or apexification methods: a retrospective study. J Endod. 2012;38(10):1330-6.
10. Clinical outcome and comparison of regenerative and apexification intervention in young immature necrotic teeth: a systematic review and meta-analysis. Int J Environ Res Public Health [Internet].2022[cited2026Sep15].Availablefrom:
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9267570/
11. Radiographic evaluation of regenerative endodontic procedures and apexification treatments with the assessment of external root resorption. Pediatr Dent [Internet]. 2024 [cited 2026 Sep 15]. Available from: https://pubmed.ncbi.nlm.nih.gov/38878998/
12. Outcomes of endodontic-treated teeth obturated with bioceramic sealers in combination with warm gutta-percha obturation techniques: a prospective clinical study. J Clin Med. 2023;12(9):3253.

13. Hydraulic (single cone) versus thermogenic (warm vertical compaction) obturation techniques: a systematic review. Cureus [Internet]. 2024 [cited 2026 Sep 15]. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC11193544/
14. Intentional replantation as an alternative treatment: survival analysis and key prognostic indicators. BMC Oral Health [Internet]. 2026 [cited 2026 Sep 15]. Available from: https://link.springer.com/article/10.1186/s12903-026-08179-9
15. Intentional replantation techniques: a critical review. J Endod. 2018;44(4):536-43.
16. Plotino G, Abella Sans F, Duggal MS, Grande NM, Krastl G, Nagendrababu V, et al. Effectiveness of intentional replantation in managing teeth with apical periodontitis: a systematic review. Int Endod J. 2023;56(6):647-63.
17. Single-visit or multiple-visit root canal treatment: systematic review, meta-analysis and trial sequential analysis. J Dent [Internet]. 2017 [cited 2026 Sep 15]. Available from: https://pubmed.ncbi.nlm.nih.gov/28148534/
18. Radiographic evaluation of periapical healing following single vs multiple visit root canal treatment: a PAI based study. J Conserv Dent [Internet]. 2026 [cited 2026 Sep 15]. Available from: https://pubmed.ncbi.nlm.nih.gov/41852998/
19. Influence of number of visits on the outcome of endodontic treatment. J Conserv Dent Endod [Internet].2025[cited2026Sep15].Availablefrom: https://pmc.ncbi.nlm.nih.gov/articles/PMC11823581/
20. Mrinalini M, Gupta A, Soi S, Abraham D, Bukhari SH. Endodontic access cavity design and fracture resistance: a systematic review and meta-analysis of conventional vs. newer access cavity. Cureus. 2024;16(9):e68796.
21. Guided endodontics versus conventional access cavity preparation: an ex vivo comparative study of substance loss. BMC Oral Health [Internet]. 2023 [cited 2026 Sep 15]. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10552426/
22. Kwon SK, Seog M, Kim D, Jung IY. Impact of minimally invasive root canal treatment on healing outcomes in a randomized clinical trial. Sci Rep. 2025;15(1):23260.
23. Success of coronal pulpotomy in permanent teeth with irreversible pulpitis: an evidence-based review. J Conserv Dent. 2020;23(2):111-6.
24. A randomized controlled clinical trial of pulpotomy versus root canal therapy in mature teeth with irreversible pulpitis: outcome, quality of life, and patients' satisfaction. J Endod [Internet]. 2023 [cited 2026Sep15].Availablefrom: https://www.sciencedirect.com/science/article/abs/pii/S0099239923002108
25. Treatment outcomes of full pulpotomy as an alternative to tooth extraction in molars with hyperplastic/irreversible pulpitis: a case report. J Endod. 2017;43(9):1568-72.
26. Biodentine full pulpotomy in mature permanent teeth with irreversible pulpitis and apical periodontitis. J Clin Med. 2021;10(14):3095.
27. Conservative management of pulpitis in a mature permanent molar using partial pulpotomy: a case report. Clin Case Rep [Internet]. 2026 [cited 2026 Sep 15]. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC13221688/
28. Biocompatibility of hydraulic calcium silicate-based cement MTA Flow on human dental pulp stem cells in vitro. Materials (Basel). 2025;18(15):3560.
29. The role of hydraulic silicate cements on long-term properties and biocompatibility of partial pulpotomy in permanent teeth. J Funct Biomater. 2021;12(1):5.
30. Comparison of 2 kinds of endodontic treatments for pulp necrosis and infection in immature teeth following avulsion: a retrospective study. Medicine (Baltimore) [Internet]. 2025 [cited 2026 Sep 15]. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC13052931/
31. Comparative effectiveness of regenerative endodontic treatment versus apexification for necrotic immature permanent teeth with or without apical periodontitis: an umbrella review. Int Endod J [Internet]. 2025 [cited 2026 Sep 15]. Available from: https://pubmed.ncbi.nlm.nih.gov/39692071/
32. Regenerative endodontics versus apexification in immature permanent teeth with apical periodontitis: a prospective randomized controlled study. J Endod. 2017;43(11):1821-7.
33. Endodontic treatment outcomes in apical periodontitis cases by the lateral condensation versus warm vertical compaction techniques: a one-year follow-up study. BMC Oral Health. 2026;26:8425.

ISSN:2584-2706 DOI: https://doi.org/10.67317/IJMSRT26SEP083

34. In vivo assessment of the apatite-forming ability of new-generation hydraulic calcium silicate cements using a rat subcutaneous implantation model. Materials (Basel). 2023;16(9):3455.
35. A review of the bioactivity of hydraulic calcium silicate cements. J Endod [Internet]. [cited 2026 Sep 15]. Available from: https://www.researchgate.net/publication/259806803
36. Comparison of different obturation techniques in the dentinal tubule penetration of EndoSequence bioceramic sealer HiFlow: an in-vitro study. Cureus [Internet]. 2024 [cited 2026 Sep 15]. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC11548115/
37. Effect of obturation techniques on fracture resistance of endodontically treated teeth. BMC Oral Health[Internet].2025[cited2026Sep15].Availablefrom: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC12208272/
38. Alternatives to single-tooth implants for the treatment of failed endodontic cases. J Am Dent Assoc[Internet].2016[cited2026Sep15].Availablefrom: https://www.sciencedirect.com/science/article/abs/pii/S0002817715011411
39. American Association of Endodontists. Indications for replantation and recommended techniques. Colleagues for Excellence [Internet]. 2018 [cited 2026 Sep 15]. Available from: https://www.aae.org/specialty/indications-replantation-recommended-techniques/
40. Long-term success of teeth undergoing intentional replantation: a report of two cases. Clin Case Rep[Internet].2024[cited2026Sep15].Availablefrom: https://pmc.ncbi.nlm.nih.gov/articles/PMC11621965/
41. Treatment outcomes of single-visit versus multiple-visit non-surgical endodontic therapy: a randomised clinical trial. BMC Oral Health [Internet]. 2015 [cited 2026 Sep 15]. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4684923/
42. Anxiety among patients with single versus multiple visits for root canal treatment. Saudi Dent J [Internet].2025[cited2026Sep15].Availablefrom: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC12449552/