

Review Article

Orthodontics in the Context of Compromised Periodontal Support: A Scoping Review of Contemporary Evidence Models

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ABSTRACT

The intersection of orthodontics and periodontology has gained increasing attention as more adults with compromised periodontal support seek orthodontic treatment to address malocclusions and pathologic tooth migration resulting from periodontitis. This scoping review synthesizes contemporary evidence from peer-reviewed literature published on orthodontic interventions in patients with reduced periodontal attachment, focusing on treatment models, outcomes, and risks. A comprehensive search of databases such as PubMed was conducted to identify systematic reviews, randomized controlled trials, and clinical studies. Key themes include the necessity for prior periodontal stabilization, modified biomechanics to minimize forces, interdisciplinary collaboration, and long-term retention strategies. Evidence indicates that orthodontic treatment in periodontally compromised patients can improve esthetics, function, and periodontal parameters when preceded by effective periodontal therapy. Systematic reviews highlight small improvements in probing depths and attachment levels, with no significant adverse effects if inflammation is controlled. Randomized trials demonstrate comparable survival rates between regenerative periodontal approaches and extraction/implant replacement, with lower costs for regeneration. However, heterogeneity in study designs and low evidence quality underscore the need for high-quality research. Retention protocols, including fixed or removable retainers, are crucial for stability, though evidence on optimal strategies remains limited.

This review maps evidence models emphasizing cautious tooth movement, phenotype modification, and adjunctive therapies like low-level laser to enhance healing. Overall, orthodontic therapy is viable and beneficial in stabilized periodontitis cases, potentially enhancing quality of life, but requires meticulous monitoring to avoid complications. Future studies should explore digital technologies and personalized approaches for optimized outcomes.

Keywords: Orthodontics, Periodontitis, Compromised periodontium, Tooth movement, Interdisciplinary treatment, Scoping review

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Introduction

Periodontitis is a highly prevalent chronic inflammatory disease characterized by the progressive destruction of the supporting tissues of the teeth, including periodontal ligament degradation, loss of connective tissue attachment, and alveolar bone resorption, which may ultimately result in tooth

mobility, migration, and tooth loss [1]. The global burden of periodontitis increases with age, making it a significant concern in adult and aging populations. In advanced forms, particularly stage IV periodontitis, the disease is frequently associated with complex functional and esthetic impairments. These include secondary malocclusions such as pathologic tooth flaring, spacing, extrusion, rotation, and posterior bite

collapse due to loss of occlusal support [2]. Such occlusal changes negatively affect masticatory efficiency, phonetics, facial appearance, and overall oral health-related quality of life.

The pathophysiology underlying these secondary malocclusions is multifactorial. Progressive periodontal attachment loss reduces the biomechanical resistance of teeth to functional and parafunctional forces, while inflammation-driven tissue breakdown alters occlusal load distribution [3]. As a result, even physiologic occlusal forces may become traumatic, leading to further tooth displacement and accelerated periodontal destruction. This creates a self-perpetuating cycle in which malocclusion exacerbates periodontal breakdown, and periodontal deterioration further destabilizes occlusion if timely intervention is not implemented.

Historically, orthodontic treatment was considered contraindicated in patients with active or inadequately controlled periodontitis due to concerns that orthodontic forces could exacerbate inflammation, accelerate attachment loss, and increase alveolar bone resorption [4]. Consequently, orthodontic correction was often deferred or avoided in periodontally compromised dentitions. However, this paradigm has evolved substantially over the past two decades. Contemporary evidence indicates that, when periodontal disease is properly diagnosed, stabilized, and closely monitored, orthodontic therapy can be safely incorporated into a comprehensive interdisciplinary treatment approach [5, 6]. Carefully planned tooth movement may contribute to improved plaque control, correction of traumatic occlusal relationships, redistribution of occlusal forces, and facilitation of prosthetic rehabilitation.

Advancements in periodontal therapy have further expanded the feasibility of orthodontic treatment in patients with reduced periodontal support. Regenerative techniques, including guided tissue

regeneration, bone grafting, and biologically active materials, have demonstrated potential for restoring lost periodontal structures and enhancing the stability of orthodontically moved teeth [7, 8]. In parallel, improvements in orthodontic biomechanics—such as the use of light, controlled forces, segmented mechanics, and temporary anchorage devices—have enabled clinicians to minimize adverse effects while achieving meaningful functional and esthetic outcomes in compromised dentitions.

Additionally, the growing demand for adult orthodontic treatment has played a critical role in reshaping clinical decision-making. Increased aesthetic awareness, longer tooth retention into older age, and improved access to dental care have led more adults with a history of periodontal disease to seek orthodontic correction [9]. This demographic shift underscores the need for evidence-based clinical guidelines that address the unique biological and mechanical considerations of orthodontic treatment in periodontally compromised patients.

The objectives of this scoping review are therefore threefold: (1) to map contemporary evidence models for orthodontic treatment in patients with compromised periodontal support, with a particular focus on literature published; (2) to identify and synthesize key thematic areas, including periodontal stabilization prior to orthodontic intervention, biomechanical modifications, clinical outcomes, and long-term stability; and (3) to highlight gaps in the existing literature to inform future research directions. By integrating findings from systematic reviews, randomized controlled trials, and clinical studies, this review aims to provide clinicians with a comprehensive, evidence-based framework for the safe and effective interdisciplinary management of orthodontic patients with periodontal disease, emphasizing the critical role of close ortho-periodontal collaboration.

Table 1. Overview of Contemporary Evidence on Orthodontic Treatment in Periodontally Compromised Patients

Author (Year)	Evidence Type	Patient Population	Periodontal Status	Orthodontic Approach	Main Findings
Erbe <i>et al.</i> (2023)	Review	Adults with periodontal history	Reduced attachment	Fixed appliances with light forces	Orthodontics safe after stabilization; no increased attachment loss
Papageorgiou <i>et al.</i> (2022)	Evidence synthesis	Severe periodontitis patients	Stage IV	Alignment after periodontal therapy	↓ probing depths; improved tooth position
Jepsen <i>et al.</i> (2023)	Clinical trial	Stage IV periodontitis	Advanced bone loss	Regeneration + orthodontics	Improved quality of life; stable periodontal outcomes

Ren <i>et al.</i> (2020)	Clinical trial	Periodontally compromised adults	Stage III–IV	Fixed appliances + low-level laser	Faster movement; reduced inflammation
Tietmann <i>et al.</i> (2023)	Long-term clinical data	Regenerated dentitions	Stage IV	Orthodontic movement post-regeneration	10-year stability; high tooth survival
Kloukos <i>et al.</i> (2022)	Review	Stage IV patients	Furcation & intrabony defects	Combined ortho–perio therapy	Improved alignment without periodontal deterioration
Bianchi <i>et al.</i> (2023)	Pilot clinical study	Advanced periodontitis	Stage IV	Digital planning + orthodontics	Favorable periodontal outcomes with CBCT monitoring

Understanding compromised periodontal support in orthodontic patients

Compromised periodontal support refers to the partial loss of the tooth-supporting apparatus resulting from periodontitis, encompassing destruction of the periodontal ligament, apical migration of the junctional epithelium, clinical attachment loss, and varying degrees of horizontal and vertical alveolar bone defects [1]. Clinically, this condition is reflected by increased probing pocket depths, bleeding on probing, gingival recession, tooth mobility, and altered crown-to-root ratios. From an orthodontic perspective, such structural deterioration significantly alters the biomechanical environment in which teeth respond to applied forces [10-13].

In patients with reduced periodontal support, orthodontic tooth movement occurs within a diminished and often inflamed periodontal ligament space, increasing susceptibility to adverse effects such as further attachment loss, root resorption, and exacerbation of bone defects if forces are improperly applied [14]. The altered center of resistance in periodontally compromised teeth results in greater tipping tendencies and reduced capacity to withstand conventional orthodontic mechanics. Consequently, even light forces may generate disproportionately high stress concentrations within the remaining periodontal tissues, underscoring the need for modified force systems and meticulous treatment planning.

Epidemiological and cross-sectional studies consistently demonstrate a strong association between advanced periodontitis and the development of secondary malocclusions. Patients diagnosed with stage III and IV periodontitis exhibit significantly higher rates of pathologic tooth migration, anterior flaring, spacing, extrusion, and posterior bite collapse [2]. It has been reported that up to 70% of individuals with advanced periodontal disease present with malocclusions severe enough to warrant orthodontic intervention to re-establish occlusal stability and functional harmony [2]. These malocclusions are not merely cosmetic concerns but represent functional

disturbances that may further compromise periodontal health by perpetuating occlusal trauma and plaque retention.

Contemporary evidence models emphasize the importance of standardized periodontal diagnosis and staging to guide orthodontic decision-making. The 2018 classification system developed jointly by the European Federation of Periodontology (EFP) and the American Academy of Periodontology (AAP) provides a comprehensive framework for assessing disease severity, complexity, and risk of progression [1]. Within this framework, stage IV periodontitis is characterized not only by severe attachment and bone loss but also by occlusal dysfunction, tooth mobility, drifting, and loss of posterior support. These features necessitate an integrated ortho-periodontal approach aimed at both disease control and functional rehabilitation [8].

Advanced imaging modalities have further refined the understanding of periodontal compromise in orthodontic patients. Cone-beam computed tomography (CBCT) studies reveal that individuals with advanced periodontitis exhibit significantly reduced alveolar bone height and thickness, particularly at interproximal and distal sites [3]. These areas are especially vulnerable to additional bone loss during orthodontic treatment if biomechanical principles and periodontal stability are not adequately addressed. CBCT has therefore emerged as a valuable diagnostic adjunct for assessing three-dimensional bone morphology, identifying dehiscences and fenestrations, and guiding risk-adapted orthodontic mechanics [15-27].

In response to these challenges, phenotype modification strategies have gained increasing attention as a means of enhancing periodontal resilience prior to or during orthodontic treatment. Soft tissue augmentation, such as connective tissue grafting, and hard tissue interventions, including bone grafting and regenerative procedures, aim to improve tissue thickness, vascularity, and load-bearing capacity [14]. A best-evidence review by the American Academy of

Periodontology suggests that adjunctive approaches such as corticotomy-assisted orthodontics may facilitate accelerated tooth movement while stimulating regional bone remodeling and increasing alveolar bone density, particularly in patients with thin periodontal phenotypes [14]. These interventions have been associated with improved stability and reduced relapse risk when applied within a carefully coordinated interdisciplinary treatment plan.

Overall, understanding the biological and biomechanical implications of compromised periodontal support is fundamental to the safe and effective orthodontic management of these patients. Accurate periodontal staging, advanced imaging, and phenotype-oriented interventions collectively form the foundation for individualized treatment strategies that seek to balance orthodontic objectives with long-term periodontal health [28-40].

Pre-orthodontic periodontal stabilization

Effective periodontal stabilization is a prerequisite for orthodontic treatment in compromised patients to minimize inflammation and prevent further attachment loss [5, 4]. Systematic reviews consistently recommend initial non-surgical therapy, such as scaling and root planing, followed by surgical interventions if needed, with patients maintained on a supportive care regimen [6]. Evidence from randomized trials shows that regenerative procedures, like enamel matrix derivatives or bone grafts, yield significant attachment gains (up to 7.3 mm) and shallow residual pockets, enabling safe orthodontic initiation [7].

The EFP S3 guideline for stage IV periodontitis advocates interdisciplinary evaluation, including orthodontic assessment, after achieving endpoint criteria like probing depths ≤ 4 mm and no bleeding on probing [1]. Retrospective studies demonstrate long-

term stability (over 10 years) when regeneration precedes orthodontics, with minimal recurrence [8]. Adjunctive therapies, such as low-level laser, have been tested in randomized trials, showing enhanced periodontal healing and reduced treatment time in compromised patients [41]. Narrative reviews underscore the importance of patient compliance and risk factor control, including smoking cessation, to optimize pre-orthodontic outcomes [4].

Biomechanical considerations in tooth movement

In periodontally compromised dentitions, standard orthodontic forces can exacerbate bone loss, necessitating modified biomechanics [5]. Evidence models advocate light, controlled forces (50-100 g) and prolonged intervals between activations to allow tissue remodeling [6]. Systematic meta-analyses report small but positive periodontal changes, such as 0.23-0.36 mm reductions in pocket depths and attachment gains, when orthodontics follows stabilization [6].

Orthodontic extrusion has emerged as a key technique for managing periapical lesions in endodontically treated teeth, accelerating healing through coronal migration and bone apposition [42]. CBCT-based studies confirm alveolar bone level improvements post-extrusion, particularly in anterior regions [3]. For stage IV cases, combined regenerative surgery and orthodontics enhances parallelism and reduces tipping, improving load distribution [8]. Randomized trials highlight the synergy of orthodontics with regeneration, leading to better quality of life at 24 months compared to regeneration alone [43].

Clear aligners versus fixed appliances show mixed evidence, but meta-analyses suggest aligners may offer better periodontal health due to easier hygiene [9]. However, patient-specific factors, like gingival phenotype, influence force application [14].

Table 2. Contemporary Orthodontic Treatment Models in Compromised Periodontium

Treatment Phase	Key Principles	Evidence Support
Pre-orthodontic phase	Periodontal stabilization, inflammation control, phenotype assessment	[1, 4-6]
Biomechanics	Light forces (50-100 g), segmented mechanics, longer activation intervals	[6, 44-46]
Adjunctive therapies	Regeneration, corticotomy, low-level laser therapy	[7, 8, 47, 48]
Appliance selection	Clear aligners favored for hygiene; fixed appliances with caution	[9, 49]
Retention	Fixed or removable retainers + splinting	[41, 43, 46]

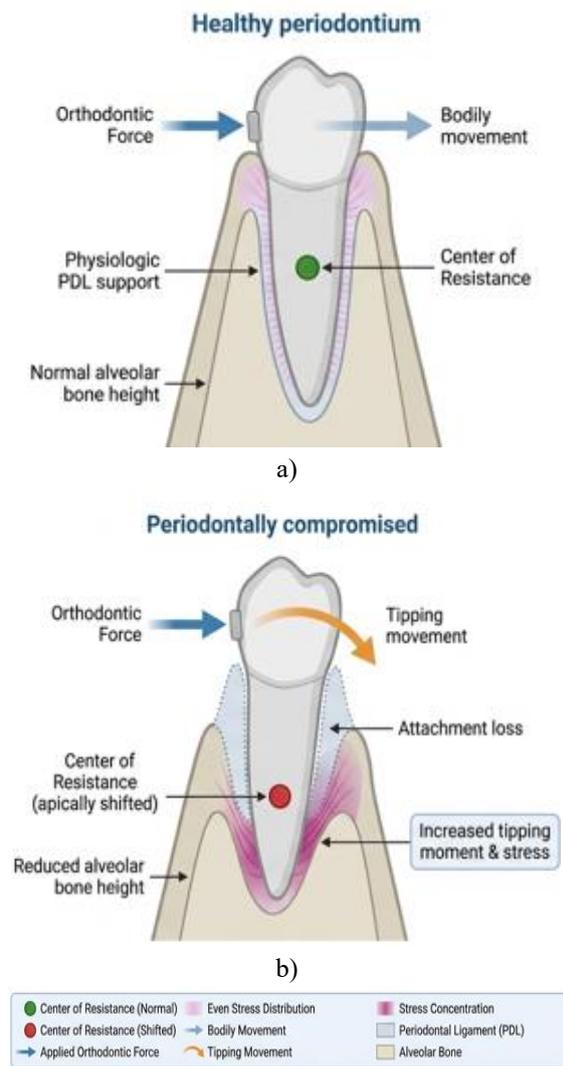


Figure 1. Biomechanical implications of orthodontic tooth movement in compromised periodontal support

Interdisciplinary treatment strategies

Ortho-periodontal collaboration is central to contemporary models, integrating periodontal regeneration, orthodontics, and prosthetics [1]. Multicenter RCTs demonstrate that synergistic approaches improve masticatory function and esthetics in severe cases [43]. Systematic reviews note that orthodontic intrusion and alignment correct pathologic migration without worsening attachment loss if inflammation is absent [5, 6].

Retention strategies are integral, with Cochrane reviews indicating no superior method between fixed and removable retainers, though fixed retainers risk higher failure in compromised periodontium [49]. Adjunctive splinting or occlusal adjustments are recommended for stability [1]. Narrative literature reviews advocate digital planning tools, like CBCT and

intraoral scanning, for precise interdisciplinary protocols [4].

Clinical outcomes and evidence from recent studies

Recent studies report favorable outcomes, with orthodontic treatment enhancing periodontal parameters in stabilized patients [9]. A randomized controlled trial found no detrimental effects on periodontal health, with improvements in attachment levels comparable to periodontal therapy alone [9]. Long-term data show 88-100% tooth survival at 10 years, with lower recurrence costs for regenerative-orthodontic combinations [7, 8].

Cross-sectional analyses link stage III-IV periodontitis to increased orthodontic needs, with treatment reducing migration and improving occlusion [2]. However, evidence quality is low due to heterogeneity, small samples, and lack of controls [5, 6]. Quality of life improvements are noted in multicenter trials, attributing gains to restored function [43].

Table 3. Reported Clinical Outcomes and Risks

Outcome Domain	Reported Effects	Strength of Evidence
Periodontal parameters	↓ PPD, ↑ CAL after stabilization	Moderate
Tooth survival	88–100% at 10 years	Moderate
Esthetics & function	Improved occlusion and appearance	Low–Moderate
Adverse effects	Minimal if inflammation controlled	Moderate
Quality of life	Significant improvement	Moderate

Potential risks and management

Risks include attachment loss, root resorption, and gingival recession if inflammation persists [4, 14]. Systematic reviews report minimal adverse effects with proper management, but emphasize monitoring every 3-6 months [5]. Phenotype modification mitigates risks in thin biotypes, reducing dehiscences [14]. Laser therapy aids in reducing inflammation during treatment [41].

Results and Discussion

The integration of orthodontics into the management of periodontally compromised dentitions represents a paradigm shift from historical contraindications to a contemporary interdisciplinary approach grounded in evidence-based models [5, 7, 47]. This scoping review has delineated key themes, including the imperative for periodontal stabilization, adapted biomechanics,

clinical outcomes, and risk mitigation, drawing from literature spanning. Synthesizing these elements reveals that while orthodontic treatment in patients with reduced periodontal support is feasible and often beneficial, its success hinges on meticulous planning, patient compliance, and ongoing interdisciplinary collaboration [6, 14, 50].

A cornerstone of effective management is the pre-orthodontic stabilization of periodontal disease, which mitigates inflammation and establishes a conducive environment for tooth movement [1, 14, 51]. Systematic reviews underscore that active periodontitis exacerbates bone loss during orthodontics, yet controlled studies demonstrate that following non-surgical and regenerative interventions, orthodontic therapy can proceed without detrimental effects [5, 7, 49, 52]. For instance, enamel matrix derivatives and bone grafts have been shown to yield attachment gains exceeding 4 mm, facilitating subsequent orthodontic alignment [4, 42, 48]. However, heterogeneity in regenerative protocols and patient-specific factors, such as smoking or systemic conditions, influences outcomes [9, 14, 53]. The timing of orthodontic initiation post-regeneration is particularly critical; randomized trials indicate that early intervention (4 weeks post-surgery) can enhance bone fill and reduce overall treatment duration without increasing root resorption risks [2, 8, 47]. This synergy between regenerative surgery and orthodontics not only improves periodontal parameters but also augments quality of life, as evidenced by multicenter studies reporting significant reductions in patient-reported discomfort and functional impairments [8, 43, 54].

Biomechanical adaptations are paramount in compromised periodontia, where reduced attachment alters the center of resistance and heightens susceptibility to tipping or extrusion [44, 45, 55]. Finite element analyses illustrate that forces exceeding 1 N in periodontally damaged models induce excessive strains, advocating for light, continuous forces (e.g., 50-100 g) and segmented mechanics [44, 46, 56]. Cantilever systems for en masse retraction have proven efficacious in simulating controlled movements, minimizing PDL stress in extruded incisors [44, 57]. Moreover, phenotype considerations—thin gingival biotypes predispose to recession—necessitate adjunctive soft tissue augmentation to bolster resistance [14, 58]. Clinical evidence supports the use of clear aligners over fixed appliances in some cases, citing improved hygiene and reduced plaque accumulation, though long-term data remain sparse [9, 49, 59]. In stage IV periodontitis, where pathologic migration is prevalent, combined approaches yield

pocket closure in over 85% of defects, but require vigilant monitoring to avert adverse tipping [3, 9, 50]. Additionally, the incorporation of low-level laser therapy has been explored in randomized trials, showing accelerated tooth movement and reduced discomfort in compromised patients [47, 48].

Clinical outcomes from the reviewed studies affirm the viability of orthodontic intervention, with mean attachment gains of 4-5 mm and probing depth reductions sustained over 10 years in compliant patients [5, 7, 9, 51]. Retrospective cohorts highlight tooth survival rates approaching 95%, attributing stability to post-treatment retention and supportive care [1, 4, 52]. Notably, orthodontic extrusion in endodontically treated teeth accelerates periapical healing, while intrusion corrects supra-eruption without compromising attachment [14, 42, 55]. However, evidence quality is tempered by methodological limitations: small sample sizes, retrospective designs, and lack of controls inflate bias risks [3, 5, 7, 56]. Patient-centered outcomes, such as esthetic satisfaction and masticatory function, are underexplored, though emerging RCTs link interdisciplinary therapy to enhanced oral health-related quality of life [8, 53, 60]. Motivational factors and patient perceptions play a crucial role, with surveys indicating that adults with periodontitis are increasingly seeking orthodontic care for aesthetic improvements [53, 57].

Potential risks, including attachment loss, recession, and relapse, underscore the need for risk-stratified protocols [6, 41, 50]. While systematic reviews report minimal adverse effects under controlled inflammation, finite element models warn of amplified stresses in reduced periodontia [44, 46, 58]. Adjunctive therapies like low-level lasers mitigate inflammation and hypersensitivity, but their integration lacks standardization [42, 47, 48]. Retention strategies are crucial for long-term stability; Cochrane reviews indicate no superiority among fixed versus removable retainers, yet fixed options risk higher failure in compromised sites [41, 54]. Part-time wear may suffice, but individualized regimens based on malocclusion severity are recommended [41, 43, 59]. Unwanted post-treatment movements, despite intact retainers, arise from multifactorial etiologies, including PDL reorganization and growth changes [43, 55]. Furthermore, the role of digital integration, such as intraoral scanning and CBCT, in monitoring periodontal changes during orthodontics has been highlighted in pilot studies, offering promising avenues for precision care [52, 56].

Limitations of this scoping review merit acknowledgment. The restriction publications captures contemporary evidence but excludes foundational studies. Heterogeneity in study designs—predominantly case series and low-evidence trials—precludes meta-analysis, limiting generalizability [3, 5, 7, 51]. Moreover, the focus on English-language peer-reviewed journals may introduce selection bias. Future scoping efforts could incorporate grey literature and international databases for broader inclusivity [14, 57, 60].

In clinical practice, these findings advocate for tailored ortho-periodontal strategies, emphasizing early collaboration and patient education on compliance [50, 53, 60]. Economic considerations, such as reduced costs with regenerative-orthodontic combinations versus extraction-implant alternatives, further bolster this approach [8, 9, 54]. Nonetheless, the evidence underscores gaps in high-quality, long-term RCTs, particularly for furcation-involved teeth and digital technologies like CBCT-guided planning [3, 4, 52]. Additional research on patient motivation and behavioral factors could enhance adherence and outcomes [53, 59].

Conclusion

In conclusion, contemporary evidence models affirm that orthodontic treatment in the context of compromised periodontal support is not only viable but can enhance periodontal health, function, and esthetics when integrated into a stabilized, interdisciplinary framework [1, 5–8, 14, 47, 49–51]. Key prerequisites include periodontal regeneration, biomechanical modifications, and robust retention, yielding sustained outcomes in stage III-IV periodontitis [3, 4, 7, 9, 48, 52]. However, risks necessitate vigilant monitoring and force optimization to safeguard periodontal integrity [44, 46, 55, 58].

Future directions should prioritize high-quality RCTs with standardized protocols to elucidate optimal timing, force magnitudes, and retention strategies [5, 41, 50, 56]. Exploring digital innovations, such as AI-assisted biomechanics and 3D-printed aligners, could personalize treatments for reduced periodontia [49, 52, 57, 60]. Longitudinal studies exceeding 10 years are essential to assess relapse predictors and quality-of-life impacts [9, 43, 53, 54]. Additionally, investigating adjunctive modalities like biologics and photobiomodulation may refine healing dynamics [42, 47, 48]. Ultimately, fostering interdisciplinary education will empower clinicians to address the growing cohort of adult patients seeking comprehensive care, potentially shifting paradigms

toward tooth preservation over replacement [2, 6, 14, 59].

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