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Review Article

Clinical Outcomes of root canal retreatment in Patients with malocclusion

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Abstract

Background: Nonsurgical root canal retreatment carries a lower and more variable prognosis than primary treatment, governed principally by preoperative periapical status, persistence of intracanal infection, and coronal seal. How malocclusion and orthodontic tooth movement interact with retreatment outcomes is addressed only indirectly by the endodontic and orthodontic literatures considered separately.

Objective: To synthesize retreatment outcomes together with the orthodontic-endodontic interaction literature, characterizing retreatment prognosis specifically in patients with malocclusion.

Methods: Narrative synthesis of cohort studies, randomized trials, systematic reviews, and controlled comparative studies identified through PubMed/MEDLINE, Scopus, and Google Scholar, spanning endodontic retreatment-outcome and orthodontic root-resorption research.

Findings: Retreatment healing tracks tightly with preoperative periapical status and coronal restoration quality rather than with malocclusion severity; controlled comparisons find root-filled teeth tolerate orthodontic force at least as well as vital teeth, with no consistent excess resorption; occlusal trauma remains a plausible but poorly quantified contributor to periapical pathology.

Conclusions: Malocclusion is best treated as a modifying rather than a determining factor in retreatment prognosis; coordinated planning, retreating first when prognosis allows and correcting traumatic occlusion where identified, is supported by the comparative literature even where cohort-scale outcome data specific to this population remain limited.

Keywords: root canal retreatment; malocclusion; occlusal trauma; orthodontic-endodontic interactions; apical periodontitis

1. Introduction

Nonsurgical root canal retreatment is, by most measures, the least predictable of the routine procedures in endodontic practice. Where primary root canal treatment in a tooth without preoperative apical periodontitis succeeds at rates approaching 95% in well-conducted cohorts, retreatment of a tooth that has already failed carries a materially lower and more variable prognosis, shaped as much by what is found on reopening the canal system, residual infection, missed anatomy, an inadequate coronal seal, as by the technical steps of the procedure itself [1]. Two large prospective cohorts from the same UK group established the framework that most of the subsequent retreatment literature still uses: outcome tracks tightly with preoperative periapical status and with the quality of the coronal restoration placed afterward, more so than with the specific retreatment technique chosen [2,3]. Gulabivala and Ng's recent reframing of these principles argues that treatment and retreatment outcomes are best understood as the product of a small number of interacting biological and technical variables rather than a single "success rate" attached to the procedure as a whole [3].

Malocclusion complicates that picture in ways the mainstream retreatment literature rarely addresses directly. Teeth that are rotated, tipped, crowded, or positioned outside the arch form are harder to isolate and access, and more likely to carry an occlusal load the periodontal ligament and periapical tissues were not built to absorb evenly. Occlusal trauma has been documented, in case reports and clinical series, as a contributing or even sufficient cause of periapical breakdown in teeth with intact, seemingly healthy pulps, a mechanism distinct from bacterial apical periodontitis but capable of producing a radiographically similar lesion [4]. At the same time, a substantial minority of patients presenting for endodontic retreatment are already under, or about to begin, orthodontic care, raising questions neither literature answers alone: does a root-filled tooth resorb

differently under orthodontic load, does it tolerate the same force magnitudes, and how should treatment sequence extraction, retreatment, and tooth movement when a malpositioned, endodontically compromised tooth is central to the case [5,6,7]. This review synthesizes the endodontic retreatment-outcome literature alongside the orthodontic-endodontic interaction literature to characterize clinical outcomes of retreatment specifically in patients with malocclusion, and to identify where the evidence supports confident treatment planning and where it does not.

2. Methods

This is a narrative synthesis rather than a registered systematic review, reflecting the fact that no single body of literature addresses "retreatment outcomes in malocclusion" as a defined clinical question; the evidence sits at the intersection of two separately developed fields, endodontic retreatment-outcome research and orthodontic-endodontic interaction research, and had to be assembled and cross-read accordingly. PubMed/MEDLINE, Scopus, and Google Scholar were searched using combinations of "root canal retreatment," "endodontic retreatment outcome," "apical periodontitis," "malocclusion," "occlusal trauma," "orthodontic tooth movement," "root resorption," and "orthodontic-endodontic interactions," with no date restriction given how much of the foundational evidence in both fields predates 2010. Priority was given to prospective and retrospective cohort studies and systematic reviews reporting retreatment healing or tooth-survival endpoints, and to controlled and split-mouth studies comparing root-filled and vital teeth under orthodontic load. Case reports were retained selectively where they illustrated a mechanism not well captured by cohort data. Twenty-two sources meeting these criteria were synthesized below.

3. Results

Baseline outcomes of nonsurgical root canal

retreatment

Table 1: Factors most consistently associated with nonsurgical root canal retreatment outcome across cohort and randomized outcome studies [1,2,3,13,14].		
Factor	Direction of effect	Representative evidence
Preoperative apical periodontitis	Absence associated with higher healing rate	[1,10]
Persistent intracanal infection	Presence at obturation predicts failure	[13,14]
Quality of coronal restoration	Adequate seal associated with better survival	[2,3]
Biofilm-organized persistent infection	Reduces responsiveness to retreatment	[16,15]
Number of treatment visits	No significant effect when disinfection is thorough	[12]

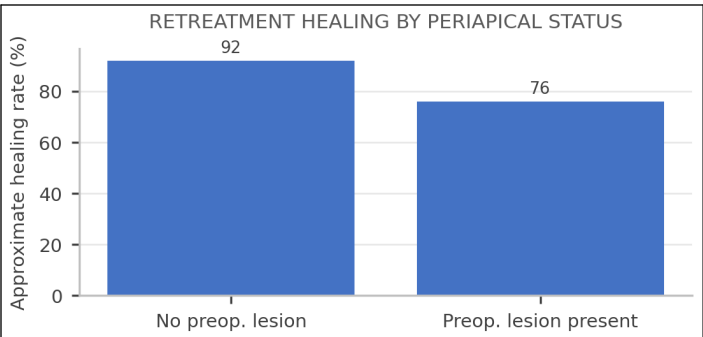


Figure 1: Approximate nonsurgical retreatment healing rate by preoperative periapical status, drawn from prospective cohort and randomized retreatment outcome data, illustrating the consistent prognostic advantage of retreating teeth without an established periapical lesion [10,2,11].

Pooled and cohort-level estimates of nonsurgical retreatment success vary by how "success" is defined and by case mix, but converge on a consistent ordering of prognosis. Torabinejad and colleagues' systematic review comparing nonsurgical retreatment with endodontic surgery found weighted success rates broadly comparable over the first two to four years, with retreatment showing a modest advantage in longer-term tooth retention once initial healing was achieved [8]. Salehrabi and Rotstein's large epidemiologic evaluation of orthograde retreatment outcomes in an insurance-claims population found the great majority of retreated teeth remained functional at extended follow-up, reinforcing that tooth survival, as distinct from strict radiographic healing, is high even

when apical healing is incomplete [9]. Gorni and Gagliani's two-year follow-up of orthograde retreatment identified preoperative periapical status as the single strongest predictor of outcome, echoed independently by Kvist and Reit's randomized comparison of surgical and nonsurgical retreatment, which found nonsurgical retreatment performed at least as well as surgery when the lesion was amenable to nonsurgical access [10,11]. Paredes-Vieyra and Enriquez's randomized trial comparing single- and two-visit retreatment protocols found no significant difference in healing, suggesting that, once thorough disinfection is achieved, appointment number matters less than the completeness of the chemomechanical and obturation steps within them [12].

The microbiological basis for this preoperative-status effect is well characterized. Sundqvist and colleagues' classic analysis of teeth with failed endodontic treatment found persistent intracanal infection, often dominated by *Enterococcus faecalis* and other organisms tolerant of the retreatment environment, in the great majority of failed cases, and showed conservative retreatment could resolve this infection and achieve healing in most instances [13]. Sjögren and colleagues' earlier work on primary treatment established the same principle from the other direction, that culturable bacteria at obturation is the strongest single predictor of subsequent failure, a finding retreatment research has since confirmed applies with comparable force to the second attempt [14]. Siqueira's review of why well-treated teeth fail catalogued the mechanisms, intraradicular persistence in isolated canal spaces, extraradicular infection, foreign-body reactions, and true cystic lesions unresponsive to nonsurgical intervention, that collectively explain why a subset of cases will not heal regardless of technique [15]. Ricucci and Siqueira's histopathologic study of biofilms in post-treatment apical periodontitis found biofilm-organized bacterial communities in a substantial proportion of failed cases, a structural feature that plausibly explains why some persistent infections resist

protocols highly effective against planktonic bacteria [16]. Where nonsurgical retreatment fails or is not feasible, Setzer and colleagues' meta-analysis found modern endodontic microsurgery achieves materially better outcomes than traditional periapical surgery, narrowing though not eliminating the gap with nonsurgical retreatment [17], and Cohn's comparative framework for choosing between nonsurgical retreatment, surgical retreatment, and implant placement remains a widely cited starting point once nonsurgical options have been exhausted [7].

Malocclusion, occlusal trauma, and periapical health

Occlusal trauma occupies an unusual position in this literature: mechanistically plausible, clinically documented in case material, but rarely quantified at cohort scale. Case reports describing periapical radiolucency developing around teeth under sustained heavy occlusal contact, absent caries, restorative breach, or any other identifiable route of pulpal infection, support a biologically coherent pathway in which chronic compressive and shearing load on the periodontal ligament disrupts apical vascular supply and produces pulpal and periapical changes that mimic, and sometimes coexist with, infection-driven apical periodontitis [4]. Malocclusion is the structural substrate for much of this loading: crowded, rotated, or supra-erupted teeth concentrate occlusal contact unevenly, and teeth in premature contact bear force outside their long axis, a pattern the periodontal ligament tolerates poorly compared with axial load. This bears directly on retreatment, because a tooth retreated for apparent apical periodontitis but left in a traumatic occlusal relationship is being asked to heal under the same mechanical insult that plausibly contributed to the original lesion; while robust cohort-level data quantifying this specific interaction in retreatment populations are not yet available, the mechanistic and orthodontic-endodontic interface literature converge on occlusal adjustment as a reasonable adjunct where traumatic occlusion is

identified [6].

Parashos's review of the orthodontic-endodontic interface situates this within the wider set of considerations that arise whenever a malpositioned tooth also has a compromised or previously treated pulp, including sequencing of orthodontic force relative to endodontic intervention, anchorage choice when adjacent teeth include endodontically treated abutments, and the special case of the traumatized or previously avulsed tooth requiring both orthodontic realignment and endodontic monitoring [6]. Parashos's earlier treatment-recommendations paper on endodontic-orthodontic interactions similarly argues for a coordinated, rather than sequential-and-siloed, treatment plan whenever both specialties are indicated, since decisions made by one discipline materially change the risk profile faced by the other [5].

Root canal-treated teeth under orthodontic load: root resorption and pulp status

The question of whether a root-filled tooth behaves differently from a vital tooth once it is moved orthodontically has been studied directly, and the accumulated evidence is more reassuring than clinical intuition might suggest. Spurrier and colleagues' comparison of apical root resorption in endodontically treated and vital teeth undergoing comparable orthodontic force found no meaningful excess resorption in the root-filled group; if anything, root-filled teeth in their sample showed slightly less resorption than their vital contralateral counterparts, a finding attributed to reduced pulpal and periodontal inflammatory signalling in a tooth without a vital, responsive pulp [18]. Weltman and colleagues' systematic review of root resorption during orthodontic tooth movement, while not restricted to root-filled teeth, situates this within the broader determinants of resorption risk, force magnitude and duration, treatment duration, and root morphology, that matter considerably more than pulp status [19].

Table 2: Controlled comparisons of endodontically treated and vital teeth under orthodontic force, by design and key finding [18,20,21,22,19].		
Study	Comparison	Key finding
[18]	Root-filled vs vital contralateral teeth	No excess resorption in root-filled teeth; slightly less in some cases
[20]	Pulp/periapical status under orthodontic force	No adverse periapical effect in well-treated teeth
[21]	Pulp histology, moderate vs severe intrusive force	Severe force alone can injure vital pulp regardless of tooth
[22]	Review, force magnitude vs pulp status	Moderate conventional force unlikely to injure vital or treated pulp
[19]	Systematic review, resorption determinants	Force magnitude, duration and root morphology dominate over pulp status

Where root canal-treated teeth do differ from vital teeth under orthodontic load, the evidence points to force magnitude tolerance rather than resorption susceptibility as the more relevant variable. Mattison and colleagues' comparison of pulp status in endodontically treated versus non-endodontically treated teeth found no adverse effect of movement on the periapical status of well-obtured, asymptomatic root-filled teeth, supporting the conclusion that a properly treated tooth can be moved with conventional force protocols without special modification [20]. Han and colleagues' histologic study of human dental pulp exposed to moderate versus severe intrusive force in vital premolars is relevant by contrast: it demonstrated that severe intrusive force can produce localized inflammation and altered vascularity in previously healthy vital pulps, a reminder that force magnitude control matters most for teeth still capable of a pulpal response and correspondingly less for a tooth already root-filled and periapically stable [21]. Alattas's review of pulp changes secondary to orthodontic force concludes that moderate, conventional force levels are unlikely to produce clinically significant pulpal injury regardless of pulp status, with adverse effects concentrated at the high end of the force spectrum [22].

Combined treatment planning: sequencing retreatment and orthodontics

Cases in which a malpositioned tooth also requires endodontic retreatment raise sequencing questions the outcome literature, built mostly around endodontics or orthodontics considered separately, does not directly resolve. Practical experience and the case-report literature on orthodontic extrusion of fractured or periapically compromised teeth support a general pattern: where the tooth is retreatable with a reasonable periapical prognosis, retreatment before or concurrent with early orthodontic mechanics is preferred over deferring endodontic intervention, because a persistently infected or symptomatic tooth is a poor anchorage unit and a poor candidate for sustained orthodontic load regardless of malocclusion severity [7,6]. Where the prognosis after retreatment is guarded, orthodontic extrusion has itself been used as an adjunct that improves the restorative and sometimes periodontal position of a compromised tooth, effectively buying additional function from a tooth that might otherwise be extracted [5]. Malocclusion correction, in turn, can improve the long-term prognosis of a retreated tooth indirectly, by relieving traumatic occlusal contact, improving hygiene access, and distributing functional load more evenly, benefits intuitive and supported by the occlusal-trauma mechanism above even where direct outcome trials in retreated populations remain scarce [4,3].

4. Discussion

Three conclusions follow from synthesizing these two literatures together. First, nonsurgical retreatment outcome is governed overwhelmingly by factors internal to the endodontic system, preoperative periapical status, persistence or elimination of intracanal infection, and coronal restoration quality, rather than by whether the tooth is also malaligned or under active orthodontic force [1,2,3]. A clinician planning retreatment in a patient with malocclusion should weigh these same prognostic variables first, and treat the malocclusion as a modifying rather than a determining factor.

Second, the specific concern that orthodontic movement is unusually hazardous for a root-filled tooth, whether through accelerated resorption or destabilized periapical healing, is not well supported by the controlled comparisons available. Spurrier and colleagues found root-filled teeth tolerated orthodontic force at least as well as vital comparators, and Mattison and colleagues found no adverse periapical effect of movement in well-treated teeth [18,20]. The resorption risk that does exist during orthodontic treatment is driven predominantly by force magnitude, duration, and root morphology, variables that apply equally to vital and root-filled teeth, as Weltman and colleagues identify [19]. This is genuinely reassuring for combined treatment planning: a retreated tooth with a favourable periapical prognosis does not need to be excluded from orthodontic mechanics, or moved with unusually conservative force, purely because it has been endodontically treated. Clinicians accustomed to treating a root-filled tooth as inherently fragile under load will find little support for that caution in the comparative literature summarized here; the biologically meaningful variable is force delivered to the periodontal ligament, not the vitality status of the pulp chamber behind it.

Third, the mechanistic link between malocclusion, occlusal trauma, and periapical pathology, while biologically plausible and supported by case-level observation, remains the least quantified part of this synthesis [4]. The absence of cohort-scale data tracking retreatment outcomes specifically in patients with untreated occlusal trauma is a genuine gap, and it means the recommendation to correct traumatic occlusion alongside retreatment rests more on mechanistic reasoning and the broader orthodontic-endodontic interface literature than on outcome trials designed for that specific question [5,6]. Where retreatment fails despite adequate technique, the microbiological and histopathologic literature on persistent, biofilm-organized infection and true cystic lesions offers a more secure explanation than occlusal factors alone, and clinicians

should not attribute failure to malocclusion without first excluding the infection-driven causes that account for the majority of documented failures [15,16,13]. When nonsurgical retreatment is judged unlikely to succeed, the comparative frameworks offered by Setzer and colleagues' microsurgery meta-analysis and by Cohn's decision framework for retreatment versus surgery versus implant placement remain the most direct evidence-based guides available, and neither requires modification on the basis of malocclusion status alone [17,7].

5. Conclusion

Clinical outcomes of root canal retreatment in patients with malocclusion are shaped first and most powerfully by the same variables that govern retreatment outcomes generally, preoperative periapical status, achievable disinfection, and coronal seal, and only secondarily, and less predictably, by occlusal and orthodontic factors specific to the malocclusion itself [1,2,3,8]. The controlled evidence comparing root-filled and vital teeth under orthodontic load is reassuring: resorption risk and periapical stability during tooth movement do not appear meaningfully worse in properly retreated teeth than in vital comparators, provided conventional force protocols are used [18,19,20]. What remains underdeveloped is direct outcome evidence for the occlusal-trauma pathway and for optimal sequencing of retreatment and orthodontic mechanics in genuinely combined cases; until cohort-scale studies close that gap, coordinated treatment planning grounded in the mechanistic and case-level literature, retreat first when prognosis allows, correct traumatic occlusion where identified, and sequence orthodontic force to avoid loading an unstable periapex, represents the most defensible approach available to clinicians managing this patient population [5,6,7]. Prospective registries that track retreatment outcome alongside malocclusion severity and occlusal status, rather than treating the two as separate research questions, would do more than any single additional case series to close the gap this review has had to bridge with

mechanistic reasoning.

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8. Conflict of Interest

The authors declare no conflict of interest.

9. Author Contributions

K.O. conceived the review and drafted the manuscript. A.O. conducted the literature search and prepared the tables and figures. A.O. critically revised the manuscript for intellectual content. All authors read and approved the final version.

10. Ethics Statement

This article is a narrative literature synthesis and did not involve human participants, patient data, or animal subjects requiring institutional ethics approval.

11. Data Availability

No new datasets were generated for this review. All data discussed are drawn from the cited published sources, listed in the references.

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