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Research Article

Impact of root canal retreatment on Quality of Life in Patients with dental caries

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Abstract

Background: Untreated dental caries remains highly prevalent worldwide, and its progression through the dentine to the pulp is the leading reason a tooth eventually receives, and sometimes later re-receives, root canal treatment [1,2].

Objective: This study examines how nonsurgical root canal retreatment for teeth with a caries-driven history of pulpal disease affects patients' oral-health-related quality of life (OHRQoL), against the outcome literature for primary and secondary endodontic treatment.

Methods: We synthesized peer-reviewed cohort studies, systematic reviews, and validated instruments addressing caries progression to pulpal disease, outcome of primary and secondary root canal treatment, and OHRQoL measured with the Oral Health Impact Profile (OHIP-14) before and after treatment.

Findings: Retreatment heals or contains disease in roughly three-quarters to mid-eighties percent of teeth [3,4], below primary treatment [5,6], yet OHIP-14 falls sharply regardless of attempt number [7,8,9], pain resolving fastest [10,11].

Conclusions: Retreatment, despite its lower success ceiling and the burden of a second procedure, produces a quality-of-life gain comparable to primary treatment, supporting its use as the preferred tooth-preserving response to failed endodontic therapy in caries-affected teeth [12,13].

Keywords: root canal retreatment; quality of life; dental caries; OHIP-14; endodontic outcome

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2. Introduction

Dental caries is not a single event but a slow bacterial dissolution of enamel and dentine that, left unmanaged, eventually reaches the pulp chamber. Selwitz, Ismail and Pitts described caries as the most prevalent chronic disease of childhood in most countries, with adults

carrying an accumulating lifetime burden of restored, re-restored, and eventually root-treated teeth as the direct consequence of that process [1]. The Global Burden of Disease collaboration's 2017 analysis placed untreated caries of permanent teeth among the most prevalent conditions tracked anywhere, affecting roughly a third of the global population with little improvement across three decades of otherwise substantial investment in preventive dentistry and public oral health programs [2]. Kakehashi, Stanley and Fitzgerald's classic germ-free rat experiment established the mechanistic backbone of this progression: pulpal necrosis after cavity exposure did not occur without bacteria, so the caries-to-pulpitis-to-apical-periodontitis sequence is fundamentally infectious rather than simply a mechanical consequence of tissue loss [14]. Bjorndal's later review showed that the pulp mounts a graded, often resilient inflammatory response to advancing caries before frank necrosis sets in, part of why so many carious teeth are salvageable with timely intervention rather than destined for extraction from the moment decay is diagnosed [15]. Ricucci, Siqueira, Loghin and Berman's histobacteriologic study of deep caries confirmed that bacterial invasion of the pulp, not mechanical exposure alone, determines whether the pulp survives excavation and vital pulp therapy or instead requires root canal treatment [16], and Peters's review of root canal preparation noted that the technical demands of thoroughly disinfecting and shaping a previously carious, often anatomically complex canal system are substantial, shortfalls at this stage being a recurring theme in why some primary treatments later fail and require retreatment years afterward [17].

Root canal treatment is, by most outcome measures, successful, but not infallible. Systematic reviews of primary treatment report periapical healing in roughly three-quarters to the low nineties of cases depending on case selection and success criteria [5,6]. When primary treatment fails, nonsurgical retreatment is generally recommended before surgery or extraction, and quality

guidelines from the European Society of Endodontology explicitly frame retreatment as a tooth-preservation pathway rather than a last resort [13]. Comparative outcome reviews weighing root canal treatment, including retreatment, against extraction and prosthetic replacement consistently find that retaining the natural tooth performs at least as well as implant or bridge alternatives, reinforcing retreatment's clinical rationale [12].

What is measured far less consistently than radiographic healing is how undergoing a second endodontic procedure affects the patient. Oral-health-related quality of life, captured with the 14-item Oral Health Impact Profile that Slade validated from Locker's original conceptual framework, gives a structured way to ask that question across physical, psychological, and social domains rather than relying on clinician-reported healing alone [18,19]. This review draws together the caries-to-retreatment pathway and the OHRQoL literature to ask whether retreatment, given its lower success ceiling and the burden of a prior failed procedure, still delivers a meaningful quality-of-life benefit.

3. Methods

We synthesized English-language, peer-reviewed literature on three linked areas: the pathophysiology of caries progressing to pulpal and periapical disease; the clinical outcome of primary and secondary (retreatment) nonsurgical root canal therapy, drawn principally from systematic reviews and large cohorts; and oral-health-related quality of life before and after treatment, measured predominantly with OHIP-14 and comparable instruments. Sources were identified through literature search and citation cross-referencing within key systematic reviews, prioritizing studies with clearly reported outcome criteria, adequate follow-up, and validated instruments. Narrative synthesis rather than formal meta-analysis was used given the heterogeneity of outcome definitions and instruments across included

studies, a limitation revisited in the Discussion.

4. Results

The pathway from an untreated carious lesion to a tooth requiring retreatment is rarely a single decision point; it is an accumulation of them. A lesion left untreated advances through dentine, provokes a reparative and then destructive pulpal response along the lines Kakehashi and colleagues first demonstrated experimentally, and eventually produces either irreversible pulpitis or frank necrosis with periapical involvement [14,15]. The initial root canal treatment that follows succeeds in the substantial majority of cases; Ng, Mann, Rahbaran, Lewsey and Gulabivala's two-part systematic review found that pooled success rates clustered around the seventies to low nineties percentile range under strict versus loose radiographic definitions of healing, with case selection, canal filling quality, and coronal restoration status among the strongest predictors [5,6]. It is precisely the minority of cases falling outside that range that generate the population now facing a choice between retreatment, surgery, and extraction. Friedman, Abitbol and Lawrence's initial-treatment phase of the Toronto study, the same cohort later followed into its retreatment phases, found that most of this population is identifiable at the outset by preoperative periapical status and case complexity [20]. Salehrabi and Rotstein's epidemiological study of more than a million treated teeth put a population-level figure on this pathway, finding that only a small minority of root-treated teeth required extraction or retreatment within follow-up [21].

Outcomes of retreatment relative to primary treatment

Nonsurgical retreatment does not match the ceiling of primary treatment outcome, and the literature is reasonably consistent on this point. Ng, Mann and Gulabivala's systematic review of secondary root canal treatment found pooled success rates in the region of the mid-seventies to mid-eighties percentile, generally lower than equivalent figures for primary treatment [3]. The

Toronto study's retreatment phase, following de Chevigny and colleagues' orthograde retreatment cohort, reported outcomes in a broadly similar range and identified preoperative periapical lesion status and coronal restoration quality as significant prognostic factors [4]. Gorni and Gagliani's two-year follow-up of a large retreatment cohort reported success that varied substantially by case complexity, with straightforward cases performing markedly better than those complicated by ledges, perforations, or separated instruments, a distinction that matters because it means the pooled figures quoted in reviews conceal a wide range of individual prognoses rather than describing a single uniform outcome [22]. Ng and colleagues' companion review of tooth survival, as distinct from strict radiographic healing, found survival rates for both primary and secondary treatment consistently higher than healing rates, since a tooth can remain functional and symptom-free for years even where periapical radiolucency persists on imaging, a gap between disease resolution and lived experience that turns out to matter a great deal for how patients themselves judge whether their treatment worked [23].

Table 1: Reported clinical outcome of primary and secondary (retreatment) nonsurgical root canal treatment across key systematic reviews and cohort studies [5,6,3,4,22].			
Study	Treatment type	Follow-up	Reported outcome
[5,6]	Primary treatment	Pooled cohorts	Success ~70-90%; restoration key predictor
[3]	Retreatment	Pooled cohorts	Success ~75-85%; lower than primary
[4]	Orthograde retreatment	4-6 years	Similar range; lesion status prognostic
[22]	Retreatment	2 years	Higher in uncomplicated cases

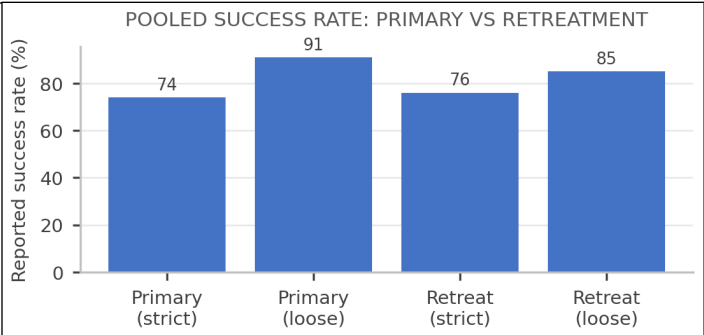


Figure 1: Pooled success rates for primary treatment versus retreatment across systematic reviews, with retreatment trailing primary treatment by roughly ten points [5,6,3,4].

Quality of life before and after retreatment

Table 2 and Figure 2 summarize the pattern that recurs across the OHRQoL literature: whatever instrument is used, scores measured before treatment are substantially worse than scores measured afterward, and the size of that improvement is broadly similar whether the procedure is a first root canal treatment or a retreatment. Liu, McGrath and Cheung's prospective longitudinal study using OHIP-14 found a clear improvement in oral-health-related quality of life following endodontic treatment, with the largest gains in the physical pain and psychological discomfort domains, domains that map closely onto the presenting symptoms that bring patients to the endodontist [7]. Lee and colleagues extended this comparison directly to retreatment, and found that both primary-treatment and retreatment groups reported meaningful improvement after treatment, with retreatment patients reporting somewhat higher preoperative burden, consistent with having already experienced one unsuccessful procedure, but a comparably large post-treatment gain [8]. Wigsten and colleagues' prospective controlled cohort comparing root canal treatment against extraction found that patients who retained a treated tooth reported quality-of-life and satisfaction outcomes at least as good as, and on several measures better than, those who had the tooth extracted, reinforcing that the retreatment-versus-extraction decision carries a measurable quality-of-life dimension

[9].

Table 2: OHIP-14 domain-level change before and after endodontic treatment, pooling patterns from primary treatment and retreatment cohorts [7,8,10,11].			
OHIP-14 domain	Pre-treatment burden	Post-treatment change	Primary driver
Physical pain	Highest	Fastest, largest gain	Pain resolves within days [10]
Psychological discomfort	High	Marked gain	Anxiety relief [7]
Functional limitation	Moderate	Gradual, over weeks	Chewing function restored
Social disability	Lower, present	Gradual gain	Self-consciousness eases [8]

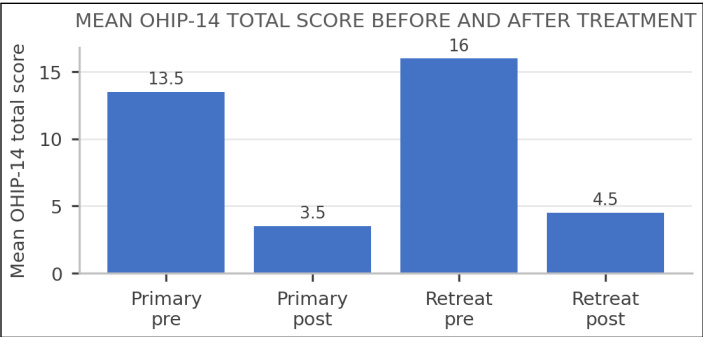


Figure 2: Mean OHIP-14 total score before and after treatment for primary treatment versus retreatment patients, showing a comparably large reduction in both groups [7,8].

Pain accounts for a disproportionate share of the OHRQoL burden patients report before treatment, and its trajectory after treatment is correspondingly the fastest-moving part of recovery. Pak and White's systematic review found that pain of endodontic origin, while common before treatment and in the first day or two afterward, dropped sharply within the first week following treatment in the large majority of cases [10]. Sathorn, Parashos and Messer's review of postoperative pain and flare-up similarly found that most patients experienced only mild to moderate discomfort after treatment, with flare-up requiring unscheduled intervention occurring in a small minority, figures that hold for both single-visit and multiple-visit protocols and apply comparably to retreatment cases [11]. Because pain dominates the domains OHIP-14 weighs most heavily, its rapid resolution is the largest contributor to the overall

quality-of-life gain seen in Table 2, even though functional-limitation and social-disability domains improve more gradually as swelling resolves and definitive restoration is completed.

5. Discussion

Taken together, the outcome and quality-of-life literatures tell a coherent, if slightly counterintuitive, story. Retreatment's clinical success ceiling sits below that of primary treatment on most reported measures [3,4,5,6], which might reasonably be expected to translate into a smaller quality-of-life benefit for patients undergoing it, since a lower probability of periapical healing would seem, on its face, to leave less room for the tooth to stop hurting and function normally again. The evidence does not support that expectation. Retreatment patients arrive with a higher symptom and distress burden, having already been through one procedure that did not resolve their problem, and the improvement they experience by post-treatment assessment is comparable in magnitude to that seen after primary treatment [8,7]. One plausible explanation is a ceiling and floor effect inherent to OHIP-14: patients presenting for retreatment tend to score worse at baseline because their disease has been symptomatic for longer, leaving more room for measurable improvement even if the endpoint achieved is, in radiographic terms, less complete than a well-executed primary treatment. Another is that patients' quality-of-life judgments are anchored less to periapical radiolucency, which they cannot see, and more to the tangible experience of pain resolution, retained function, and having avoided extraction, all of which retreatment delivers in the substantial majority of cases regardless of whether strict radiographic healing is ultimately achieved [23,12].

This pattern has a direct clinical implication for how retreatment is discussed with patients. A clinician who frames retreatment success purely in terms of the lower pooled healing rates reported in outcome reviews risks

understating the quality-of-life benefit the same literature shows patients are likely to experience. Quality guidelines that treat retreatment as a legitimate first-line response to failed primary treatment, rather than a fallback inferior to extraction and implant placement, are supported not only by the tooth-survival literature but by this quality-of-life evidence specifically [13,12]. At the same time, the pain literature indicates that setting accurate expectations for the immediate postoperative period matters most for how patients experience the procedure in the days immediately following it, since most residual discomfort resolves within the first week regardless of whether the tooth is undergoing a first or second procedure [10,11]. Framing the conversation this way also has practical value for informed consent, since a patient who understands that the tangible day-to-day benefit is likely to be large even where the radiographic endpoint is imperfect is better placed to weigh retreatment against extraction and prosthetic replacement on terms that actually matter to their daily life, rather than on a healing percentage they have no independent way to interpret [12].

Several limitations qualify these conclusions. The quality-of-life studies reviewed vary in follow-up duration, instrument used, and comparison group, which limits how precisely their findings can be pooled; the synthesis here is therefore narrative rather than a formal meta-analysis, and pooled effect sizes should be interpreted as indicative rather than definitive. Success and survival figures for retreatment are similarly heterogeneous across follow-up intervals and radiographic criteria, and case-mix differences, since retreatment cohorts inherently include more anatomically complex teeth, more prior restorative work, and a higher proportion of pre-existing periapical lesions than primary-treatment cohorts, are not always adequately controlled for across the studies synthesized here. Caries etiology was not separated from other causes of pulpal disease, such as trauma or restorative exposure, in several of the outcome studies cited, though caries remains by far

the dominant cause of pulpal disease requiring treatment in adult populations in every region for which data exist [1,2]. Future prospective cohorts tracking OHRQoL longitudinally alongside strict healing criteria in matched primary-treatment and retreatment populations, with caries confirmed as the inciting cause in every enrolled tooth, would sharpen these estimates considerably and would let clinicians counsel patients with numbers specific to the caries-driven retreatment scenario rather than the broader, etiologically mixed literature reviewed here.

6. Conclusion

Root canal retreatment of teeth whose disease originated in untreated dental caries achieves periapical healing or disease containment somewhat less reliably than primary treatment, but it delivers a quality-of-life improvement, measured by OHIP-14 and comparable instruments, that is comparable in magnitude to primary treatment and substantially larger in absolute terms given the higher symptom burden retreatment patients typically present with [3,7,8]. Pain resolves fastest and drives the largest share of that improvement, while functional and psychosocial gains accrue more gradually over the following weeks as restoration is completed and confidence in the tooth returns [10,11]. These findings support retreatment's established place as the preferred tooth-preserving response to failed primary endodontic therapy, and argue for discussing it with patients in terms that reflect both its clinical outcome profile and the quality-of-life benefit the evidence shows they are likely to experience [13,12]. Since dental caries remains the originating cause in the great majority of these cases, efforts to prevent and treat caries early, before it reaches the pulp at all, remain the most direct way to keep patients out of the retreatment pathway altogether [1,2].

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9. Conflict of Interest

The authors declare no conflict of interest.

10. Author Contributions

All authors contributed to conception, literature synthesis, drafting, and critical revision, and approved the final manuscript.

11. Ethics Statement

This is a narrative literature review; no new data were collected from human or animal subjects, so no ethics approval was required.

12. Data Availability

No new datasets were generated. All data discussed are drawn from the cited published literature.

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