Natural Resources for Human Health
eISSN: 2583-1194

Original Research

Received 18 July 2026
Revised 17 Aug 2026
Accepted 01 Sep 2026

Natural Resources for Human Health 2026, Vol.6(21s):1522–1538

KEYWORDS:
endocrown, fiber post, remaining tooth structure, restoration survival, clinical success, aggregate data.

Association between Remaining Tooth Structure, Restoration Type, and Clinical Outcomes of Endocrown and Fiber Post-Supported Crowns in Endodontically Treated Teeth

Shaimaa F K Habib[1], Ahmed M. Elmarakby[2], Hend Mohamed Elsayed[3], Wael Mohamed Gamal[4], Ala'a Kamal[5], Khaled Beshr[6]

[1]Department of Restorative and Prosthodontic Dental Sciences, College of Dentistry, Dar Al Uloom University, Riyadh, Saudi Arabia
Email: s.habib@dau.edu.sa, ORCID: 0009-0008-4754-8360
[2]Associate Professor, Department of Restorative and Prosthetic Dental Sciences, College of Dentistry, Dar Al Uloom University, Riyadh 13313, Saudi Arabia.
Assistant Professor, Department of Operative Dentistry, Faculty of Dental Medicine, Al-Azhar University, Assiut Branch, Assiut 71524, Egypt. Consultant in Conservative Dentistry, SCFHS.
Email: Ahmed.e@dau.edu.sa, ORCID: 0000-0002-9950-5900
[3]Assistant Professor of Restorative Dentistry, Department of Restorative and Prosthetic Dental Sciences, College of Dentistry, Dar Al Uloom University, Riyadh, Saudi Arabia.
Assistant Professor of Conservative Dentistry, Conservative Dentistry Department, Faculty of Dentistry, Cairo University, Egypt.
Email: hend.e@dau.edu.sa, hend.elsayed@dentistry.cu.edu.eg, ORCID: 0009-0008-6816-653X
[4]Associate Professor of Conservative Dentistry, Department of Preventive and Restorative Dentistry, Applied Science Private University, Amman, Jordan.
Email: W_abdelwahab@asu.edu.jo, ORCID: 0000-0002-7057-5200
[5]Lecturer, Department of Restorative and Prosthetic Dental Sciences, College of Dentistry, Dar Al Uloom University, Riyadh 13313, Saudi Arabia.
Department of Operative Dentistry, Faculty of Dental Medicine, MSA University, Egypt. Registrar in Conservative Dentistry, SCFHS
Email: a.Kamal@dau.edu.sa, ORCID: 0009-0005-4709-3093
[6]Associate Professor, Department of Endodontics, Faculty of Dentistry, Beni-Suef University, Egypt.
Associate Professor, Department of Restorative and Prosthetic Dental Sciences, College of Dentistry, Dar Al Uloom University, Riyadh, Saudi Arabia.
Email: khbeshr@dent.bsu.edu.eg, ORCID: 0000-0003-1786-9020

ABSTRACT:

Objective: To examine the associations that can be evaluated between remaining tooth structure, restoration type, and clinical outcomes using aggregate data gathered from eight reports on endocrowns and fiber post-supported crowns.

Methods: Aggregate data from eight clinical reports, assigned to seven conservative cohort identifiers, were examined in a retrospective clinical cohort study. Endocrowns versus fiber post-supported full crowns formed the strict restoration comparison.

Natural Resources for Human Health
eISSN: 2583-1194

Structural associations within fiber crowns were analyzed separately using verified subgroup counts, conditional odds ratios, exact 95% confidence intervals, and Fisher tests. Three secondary structural tests received Holm adjustment; no meta-analysis was performed.

Results: The dataset comprised 75 outcome records, including repeated visits and overlapping endpoints. In the sole strict direct trial, complete loss occurred in 4/12 endocrowns versus 0/12 fiber crowns at 12 months (p = .093). Within fiber crowns, the odds ratios for failure with less structure were 3.77 (95% CI 0.81–24.36) with Gradia Core, 1.88 (0.54–6.96) with GCem Automix, and 4.88 (1.16–29.52) for a ferrule <2 versus ≥2 mm. Holm-adjusted p values were .208, .399, and .056, respectively.

Conclusions: The direct restoration comparison remained imprecise. Structural contrasts within fiber crowns were estimable and directionally favored more retained tissue, but did not meet the adjusted significance threshold. Nonrandomized structural groups and incompatible definitions limit causal interpretation. No shared structural strata supported a structure-by-restoration interaction.

1. INTRODUCTION

Treatment of endodontically treated teeth involves consideration of the canal system treated as well as the tissues which might be used for definitive restoration of the treated tooth. Clinical evidence reviews show that the residual coronal structure, tooth location, proximity to adjacent teeth, tooth fractures and the type of restoration are relevant to the subsequent survival of the tooth and the restoration. These factors make post-endodontic restoration a part of a larger clinical decision, and not the end of the treatment for the completion of the root canal (Bhuva et al., 2021). The European Society of Endodontology (2021) therefore suggests the choice of a restoration to be related to the remaining tooth and its functional needs.

Endocrowns and fiber post-supported crowns are two different ways of retaining. An endocrown is a combination of an adhesively retained coronal restoration plus an extension into the pulp chamber whereas a fiber post is used to retain a core onto which a crown has to be cemented (Govare & Contrepois, 2020). However, a post should not be interpreted as a substitute for lost sound tooth structure and is not necessarily an automatic increase of root strength (ESO, 2021), but is primarily indicated when there is not enough coronal retention. Thus, there is a need to focus on both their materials and clinical indications when comparing them.

The only universal measurement is not adequate to describe remaining tooth structure. The number and configuration of the remaining walls, the height and continuity of the ferrule, and the proportion of the remaining coronal tissue are all different types of structural conditions that are related (Juloski et al., 2012). Teeth have been classified in the clinical investigation either by wall based classification or percentage based residual structure and assessed at different stages of preparation (Ferrari et al., 2012; Juloski et al., 2014). These differences are important as a threshold that is used to accept patients will not necessarily give the variation that is needed to estimate an association with outcome.

Although endocrowns are identified as clinically relevant alternative treatment modality for extensively damaged teeth, there is also a paucity of evidence in systematic reviews to support this, and the evidence includes a variety of endocrown designs, materials, comparators, and follow-up durations (Al-Dabbagh, 2021; Sedrez-Porto et al., 2016). Comparing with a conventional crown without post is not the same as a comparison with a fiber post supported crown. Likewise, a fibre post-supported partial-coverage restoration is not necessarily considered a full crown (Morimoto et al., 2022). These differences may be the basis for deciding which reported comparisons will directly answer the restoration aspect of the question at hand.

Aggregated data gathered from eight reports can be made available for re-analysis, if each result is associated with its study, the treatment arm, the endpoint, and the time of observation. This type of data is unable to restore unreported patient-level relationships and discrepancies between study averages do not reflect relationships within individual teeth or patients (Riley et al., 2010). The explicit statement of the lack of comparability and transparency of grouping, therefore, are critical, especially

when a numerical meta-analysis would suggest that there is more comparability than the evidence can support (Campbell et al., 2020).

The goal was to review relationships between the remaining tooth structure, type of restoration and clinical outcomes based on aggregate data gathered from eight reports. The main question was restoration loss at 12 months, in terms of complete loss, in a direct endocrown versus a fiber post-supported full-crown. The secondary question was about clinical failure in the various structural classes in fibre crowns with the cement as constant as possible. The associated null hypotheses were that of complete loss (no restoration-type association) and clinical failure (no within-study structural association). A subsequent exploratory question was whether or not there were common structural strata that allowed for estimation of a structure-by-restoration interaction. All analyses were carried out in an exploratory fashion, and equivalence and interaction were not assumed to be estimable from unreported cells (Riley et al., 2010).

Literature Review

The evidence on endocrowns has accumulated from laboratory and clinical research that provides answers to different questions. In their systematic review, Govare and Contrepois (2020) found 41 publications, eight of which were clinical studies, and 33 were laboratory investigations. Laboratory fracture tests can detect the mechanical differences under specific loading conditions but are not accurate at estimating the chances of debonding, caries, repair or tooth loss in a patient. Sedrez-Porto et al. (2016) also assessed the clinical survival in isolation from laboratory fracture strength. This separation helps to limit the current numerical results to those of human clinical outcomes and to keep the biomechanical literature as background information.

The evidence from clinical studies that fiber post-supported restorations was presented and suggests that the structural substrate should be considered separately. Ferrari et al. (2012) evaluated 345 patients who donated 360 premolars that were divided into six groups based on their tooth structure: No Post, Pre-Fabricated Fiber Post and Customized Fiber Post under the crown. They correlated retained coronal walls and post retention with the clinical prognosis. Endocrown arm was however not included in the study. It can help guide the structural basis for post-endodontic restoration, but it cannot provide a direct effect of the post-endodontic restoration on the structure or prove that the same structural relationship exists with both types of post-endodontic restoration.

The researchers of Juloski et al. (2014) categorised the preparations on the premolars and then randomly allocated the luting material used to structural categories. This allows to make structural comparisons at equal cements, but not at equal amounts of retained tissue, which was not randomized. Mancebo et al. (2010) looked at the different types of ferrule found in a crowned fiber-post restoration. These studies provide structural evidence, but have a different definition of exposure, different outcomes, and different observation periods. Both are devoid of endocrown comparator. Hence, their outcomes cannot be aggregated by combining a structural threshold with those of other studies nor be the basis of an indirect statement regarding which restoration is better.

Endocrown cohorts are used to denote a different portion of the evidence. Belleflamme et al. (2017) performed a retrospective study with 99 registered restorations, damage classification after preparation and FDI criteria for the assessment of clinical success. They achieved a report which differentiated between success and overall survival as well as biological and technical complications. Due to the absence of an endocrown comparison group, results of this study represent endocrown performance within the clinical conditions used. Furthermore, the distribution of residual-damage classes and the percentage of no damage to the structure and the outcomes that occur in these classes is not reported separately, which makes it impossible to reconstruct a structure-outcome association from the overall percentages.

The random study of Abou El-Enein et al., (2021) is more directly comparable to the target restoration. The patients with lithium disilicate endocrowns or crowns supported by fiber-reinforced composite posts and cores were all in the upper anterior area (n = 24). The study defined gross fracture or retention grades and marginal integrity were assessed at follow-up over 12 months, as well as satisfaction. The inclusion criteria included that at least 2–3 mm of tooth structure was present above the cementoenamel junction. Thus, the study provides a within-trial restoration contrast under a limited structural condition; but not a comparison across levels of the remaining structure measured. When reanalyzing the results, its outcome definitions need to be preserved also.

Morimoto et al. (2021) showed procedure times and patients' perceptions in a comparison of endocrowns and fiber post-supported partial-coverage ceramic restorations in 40 patients. Morimoto et al., (2022) have reported the two-year survival for the same named restorative approaches. These reports pertain to conservative post-endodontics treatment; however, partial coverage is different from the comparator (full-crown) as indicated in the primary analysis. Similarities in authorship, interventions, and total sample also indicate this should be verified and is a shared cohort. Riley et al. (2010) correctly pointed out that an aggregate synthesis would be inappropriate until they can be shown to be independent patient samples.

Other clinical comparisons help to elucidate the limits of the evidence. In the study by Skupien et al. (2016) the teeth with the glass fiber posts were divided into two groups: direct composite restoration and metal-ceramic crown. They differentiated reparable failures of restoration from tooth loss and their 57 restorations were divided among 47 patients. It thus offers data on the performance of fibre-crowns and interdependence of the teeth in patients, without being able to offer an endocrown comparator. Intervention is defined here as a direct composite arm, and would result in a clinically invalid contrast if it were treated as an endocrown.

In this trial by de Kuijper et al. (2026), a total of 102 severely compromised molars were treated with either direct resin composite restorations or lithium disilicate endocrowns. It took into account the number of walls left when allocating and recognised the difference between tooth survival, tooth success and restoration survival. Its endocrown results can be extrapolated into a clinical situation with significantly decreased structure; its direct-composite comparator is not a fiber post-supported full crown. By doing so, this distinction ensures that a well-described trial that did not assess a treatment effect is not indirectly used as evidence to support a different treatment effect.

Outcome harmonisation is thus as crucial as the classification of interventions. FDI criteria differentiate between aesthetic, functional and biological properties and offer grades to help clinical decisions to monitor, repair or replace (Hickel et al., 2010). However, the events missing restoration, chipped restoration (which can still function) and extracted tooth are not equivalent. The difference between survival and success in clinical endocrown reports further illustrate that a good retention can occur and complications that necessitate interventions (Belleflamme et al., 2017). These definitions and what associations can be estimated must be retained in a defensible synthesis, prior to the common statistical label (Campbell et al., 2020).

METHODOLOGY

Study design and analytical scope

A retrospective clinical cohort study was performed using aggregated clinical data gathered from eight reports to provide an exploratory analysis. Eligible clinical reports were separated and the data placed in a pre-structured Microsoft Excel spreadsheet and analysed statistically and presented graphically. Each data record was for a treatment arm, follow-up assessment and clinical outcome and not for every patient. Study grouping, endpoint definitions and synthesis decision were made according to the transparency principles of SWiM (Campbell et al., 2020). The study was not a novel cross sectional study nor a thorough systematic review. No a priori protocol existed and the priorities for analysis were determined as part of the data extraction process.

Evidence sources and eligibility

Clinical reports were identified using targeted searches in the literature indexed in PubMed, publisher platforms and institutional repositories, and the records were verified till November 3, 2026. The words used were endocrown, fiber post, crown, remaining tooth structure, ferrule, clinical outcome, survival and clinical trial. Other searches included keywords from the structural studies, full text, subgroup, and Table 2 as well as searching the clinical endocrown reports for structural strata. Publisher and indexed information of bibliographic details were verified. Search combinations, screening of candidates and extraction changes were documented. The retrieval was focussed rather than comprehensive; reviews helped to inform but did not add individual patient observations.

Only numerical evidence from human clinical studies of permanent endodontically treated teeth were eligible. Endocrowns and fiber post-supported full crowns were the only ones that could be included in the strict comparative category. Fiber post-supported partial coverage was kept as a distinct contextual type. Single arm endocrown studies, structural studies of fiber crowns and trials with other restorative comparators were carried forward for evidence mapping and not pooled to the strict

contrast. Comparative numerical inference was based on laboratory experiments, preference surveys, protocols (no clinical results) and case reports.

Extraction and verification

Relationships between records were maintained in terms of publication, cohort, arm and outcome identifiers. Design, restoration coverage, fibre-post use, material, structural definition and timing, follow-up basis, allocated sample, verified outcome denominator, reported count/estimate, and source location were extracted. Eligibility criteria, number of walls, size of ferrule, percentage remaining, and damage class have been kept in their original units. A follow-up denominator was not used to replace an allocated arm size.

A comparison of the Abou El-Enein et al. tables (2021) has been done with the publisher PDF. Explicit numerator, denominator and complete follow-up were present in all four 48-month structural subgroups in Juloski et al. (2014). The primary PDF text, Methods and Table 4 from Mancebo et al. (2010) were checked and verified in PubMed. Other entries did not change from their abstract or indexed-text nature. Extraction was performed with one review process with no independent duplicate extraction. A formal risk of bias assessment was not carried out and source verification and data availability were not considered to be low risk of bias.

Outcomes and dependence

The key estimand was the difference between the two arms for the complete restoration loss at 12 months in the directly comparable trial. Complete loss was considered as its Charlie retention grade which was a complete missing restoration and not a verified root fracture as noted by Abou El-Enein et al. (2021). Previous visit grades, marginal integrity, satisfaction, reported survival, success and complication modes were separate outcomes. The marginal-integrity Alpha counts were kept, but no attempt was made to add the Charlie and Fracture counts from the source table, which overlap.

A second visit for the same tooth was considered to be a repetition of the initial visit. One conservative cohort identifier was assigned to the reports if full-text was not available to confirm that the reported cohort was Morimoto; in this case, samples were not combined. Another potential limitation is the possible clustering of multiple teeth in the patients of other studies. Percentages or estimates of survival were not used to rebuild individual records, event times or patient-level covariates, as is the case for aggregate versus individual-participant evidence (Riley et al., 2010).

Statistical analysis

Arm-specific risks were based on actual counts and denominators and two-sided 95% confidence intervals (Clopper–Pearson, 1934) were used for the primary comparison. Probability ordered, two sided Fisher exact test was used for association analysis. Comparative uncertainty was described as a conditional maximum-likelihood odds ratio and central exact 95% confidence limits and the observed risk difference was reported as a descriptive percentage-point difference. Exact methods were chosen as counts in the table were sparse and the table had a zero-event arm (Agresti, 1992). No continuity correction was taken to make the ratio finite.

The level of significance used was .05 (primarily). Hypergeometric enumeration was used to check independently its probability. No tests were included in repeated visits or retention grades, satisfaction or overlapping survival endpoints. There were three secondary Fisher tests that analyzed any clinical failure; two structural comparisons between the two groups of cement and one ferrule comparison. Holm's step-down procedure (Holm, 1979) was used to adjust their p values. Pointwise, but not multiplicity adjusted, exact odds-ratio intervals were calculated. Analyses were exploratory, with questions being sharpened after looking at the evidence and nonsignificance not interpreted as equivalence or acceptance of a null hypothesis.

Remaining structure and synthesis decisions

For structural comparisons, the number of months in the complete 48-month subgroup reported by Juloski et al. (2014) were used (≤50% remaining coronal structure versus >50% remaining coronal structure) for each luting used. All failures were complementary to directly reported clinical success and loss of teeth was complementary to directly reported survival. Rounded percentages were not used to make counts. The conditional odds ratios and the central exact 95% intervals were calculated as were the primary comparison. The Mancebo ferrule contrast directly reported the number of any-failure counts as opposed to a fixed follow-up of 36 months. Both reports were nonrandomized and had a structural exposure. No causal or

aggregation over definitions of these associations was performed. No interaction model was fitted as the common structural categories and outcomes were not found in both of the restoration groups.

A pooled treatment effect, network meta-analysis or meta-regression was not fitted. Estimation of between-study heterogeneity was not possible and publication-bias diagnostics could not be carried out in the single strict direct trial. The mean follow-up was not considered a common survival horizon and reported estimates of Kaplan–Meier were not converted into number of events. The method of combining clinically different outcomes and/or comparators (Campbell et al., 2020) was not used, rather study-specific summaries and structured evidence mapping were used.

Missing data and reproducibility

No imputations were made for missing numbers. The initial number of retentions of Bravo and Charlie were determined as complements of an all-Alpha report. Verified counts were kept in addition to reported subgroup percentages which were also retained, but could be slightly different due to rounding of the sources. Availability matrix, exact-interval plots, retention grades, satisfaction, complications, survival versus success and separate structural associations were figures included. No nesting of tooth loss with any failure was applied, nor was tooth loss added to failure. No reconstruction of the denominators for satisfaction or the Kaplan–Meier risk sets for late was performed. No times of individual events and no records of covariate data were created.

Analyses used Python 3.12.14, NumPy 2.5.4, SciPy 1.18.1, and Matplotlib 3.11.2. Data analysis code and outputs were kept, as were study-level tables to aid in reproducibility. No patients were recruited, contacted or identified for analysis, only aggregate information gathered from eight reports was analyzed.

RESULTS

Evidence available for the research question

The data obtained included eight reports allocated to seven conservative cohort identifiers, 17 arm records and 75 outcome records. 55 outcome records had both a count and a denominator; there were no outcome rows that did not have both a count and a numerical estimate. These counts encompassed multiple visits, multiple endpoints, and were not necessarily independent samples, nor did they completely report all clinically relevant outcomes. All four structural cells were provided by the full-text verification (Juloski et al., 2014) and an additional ferrule comparison was provided by Mancebo et al. (2010). Table 1 makes a distinction between the strict direct trial and contextual evidence. The potentially related Morimoto reports were kept together conservatively.

Table 1*:* Clinical reports and their analytical roles

Report	Reported sample	Comparison	Analytical role
Abou El-Enein et al. (2021)	24 patients; 24 teeth	Endocrown vs fiber post-supported full crown	Direct comparison
Morimoto et al. (2021)	40 patients	Endocrown vs partial coverage with fiber post	Procedure context
Morimoto et al. (2022)	40 participants reported	Endocrown vs partial coverage with fiber post	Survival context
Juloski et al. (2014)	120 patients; 120 teeth	Fiber crowns by structure and cement	Structural associations
Belleflamme et al. (2017)	99 restorations	Single-arm endocrown cohort	Complications and outcomes

Report	Reported sample	Comparison	Analytical role
Skupien et al. (2016)	47 patients; 57 teeth	Fiber post + crown vs fiber post + composite	No endocrown arm
de Kuijper et al. (2026)	102 molars	Endocrown vs direct composite	No fiber-crown arm
Mancebo et al. (2010)	87 patients; 87 teeth	Fiber crowns by ferrule	Structural association

Note. Eight reports represent seven conservative cohort identifiers. Morimoto cohort overlap remains unconfirmed. Samples are not summed; repeated outcomes are not independent patients.

Only Abou El-Enein et al. (2021) provided an established rigorous comparison between endocrown and fiber post-supported full crown. Two fiber-crown reports provided structural subgroup results, while no report was able to give both common structural and both target restoration types (Figure 1). Availability does not mean that the study is of good quality or that there is no bias.

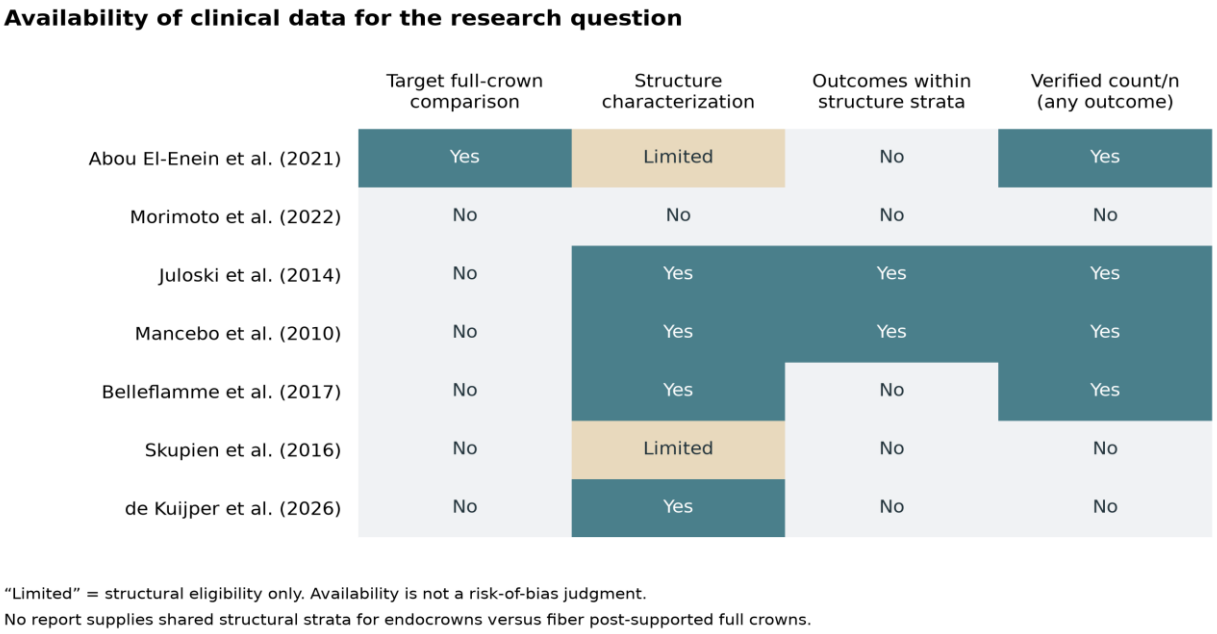


Figure 1*:* Availability of data relevant to the research question

Note. Availability in the extracted evidence, not a formal quality assessment. Limited denotes structural eligibility information without analyzed structural variation. The Morimoto procedure-time companion report is omitted. Sources: clinical-outcome reports in Table 1.

Direct comparison of complete restoration loss

Four endocrowns (12 months) and none (12 months) of the fiber post-supported full crowns had complete restoration loss (Table 2). The corresponding risks were 33.3% (exact 95% CI 9.9–65.1%) and 0.0% (95% CI 0.0–26.5%). The difference observed was +33.3 percentage points. Two-sided Fisher exact p = .093, with estimated conditional odds-ratio infinite, exact 95% limits 0.75 to infinity. The large arm-specific uncertainty is shown in figure 2. No continuity correction or treatment estimate pooling was done.

Table 2: Complete restoration loss at 12 months in the direct trial

Restoration	Losses / assessed	Risk (%)	Exact 95% CI (%)
Endocrown	4 / 12	33.3	9.9–65.1
Fiber post-supported full crown	0 / 12	0.0	0.0–26.5

Note. Source: Abou El-Enein et al. (2021), Table III. Arm intervals are Clopper–Pearson. Fisher exact p = .093; conditional odds ratio ∞ (exact 95% CI 0.75–∞); descriptive risk difference +33.3 percentage points. No continuity correction.

This endpoint was the missing restoration endpoint (defined by the authors as Charlie) and did not indicate a root fracture (Abou El-Enein et al., 2021). This is an exploratory test as the endpoint was prioritized following the dataset audit. Small sample and large intervals do not imply superiority or equivalence.

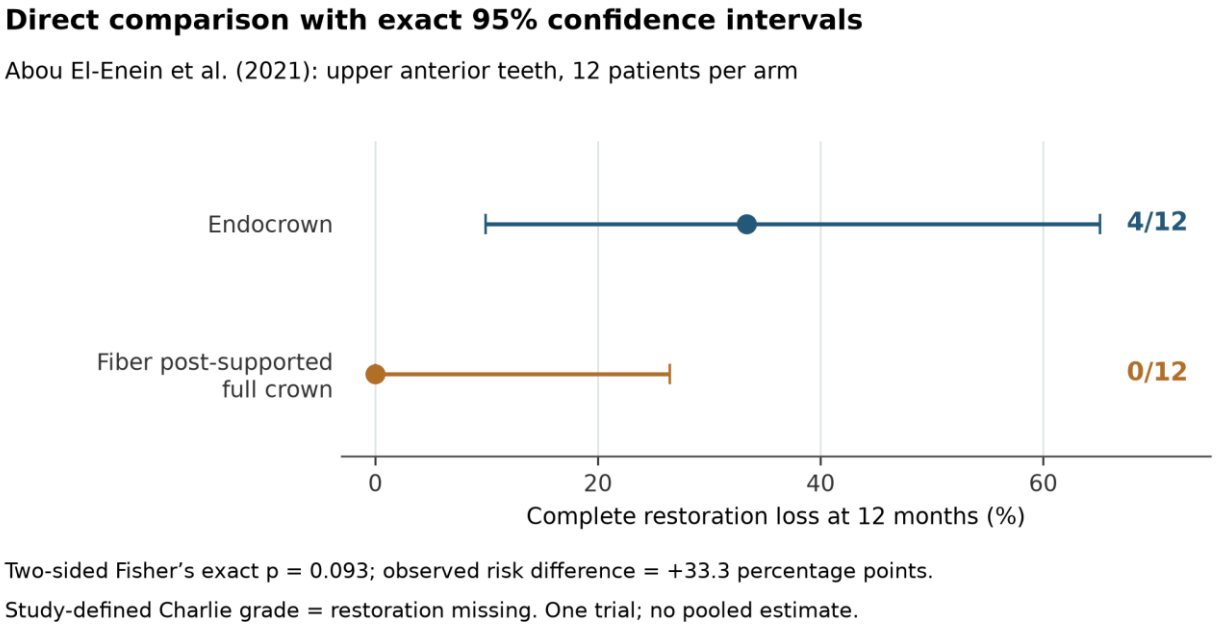


Figure 2: Complete restoration loss with exact arm-specific confidence intervals

Note. One randomized anterior-tooth trial, with 12 patients per arm. Charlie grade denotes a missing restoration. The figure is not a pooled estimate. Source: Abou El-Enein et al. (2021), Table III.

Retention status and patient satisfaction over follow-up

The numbers classified as Alpha at the 3-, 6-, 9- and 12-month visits in the endocrown arm were 12, 11, 9 and 8 respectively. The corresponding Bravo counts were 0, 1, 2, 0; and Charlie counts were 0, 0, 1, 4. At all visits each of the 12 fiber-crown restorations was rated as Alpha. Figure 3 maintains these mutually exclusive grades instead of transforming them to a time-to-event curve. The teeth were not treated as independent observations as the same set of teeth was observed at each visit.

Natural Resources for Human Health
eISSN: 2583-1194

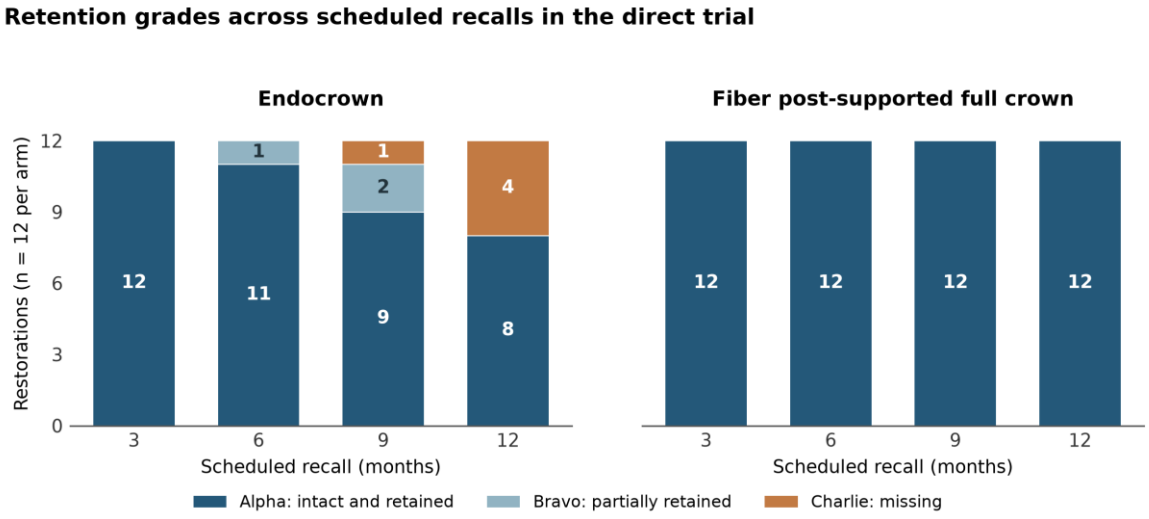


Figure 3*:* Retention-grade distributions across scheduled recalls

Note. Repeated descriptions of the same 12 teeth per arm. Alpha: intact and retained; Bravo: partially retained; Charlie: missing. Initial Bravo and Charlie zeros follow from all restorations being Alpha. Counts must not be summed across visits. Source: Abou El-Enein et al. (2021), Table III.

Patient satisfaction was a separate reported outcome, which was not included here. The percentages in the endocrown arm were 100.0%, 91.7%, 75.0%, and 66.7% at each of the scheduled recalls, while the fiber-crown arm was at 100.0% at all recalls (Figure 4). These percentages were kept as reported, as denominators for outcomes were not verified. No statistical comparisons or additional statistics were made. The numerical equivalent scores on satisfaction and Alpha retention were not considered to be independent confirmation of a treatment effect.

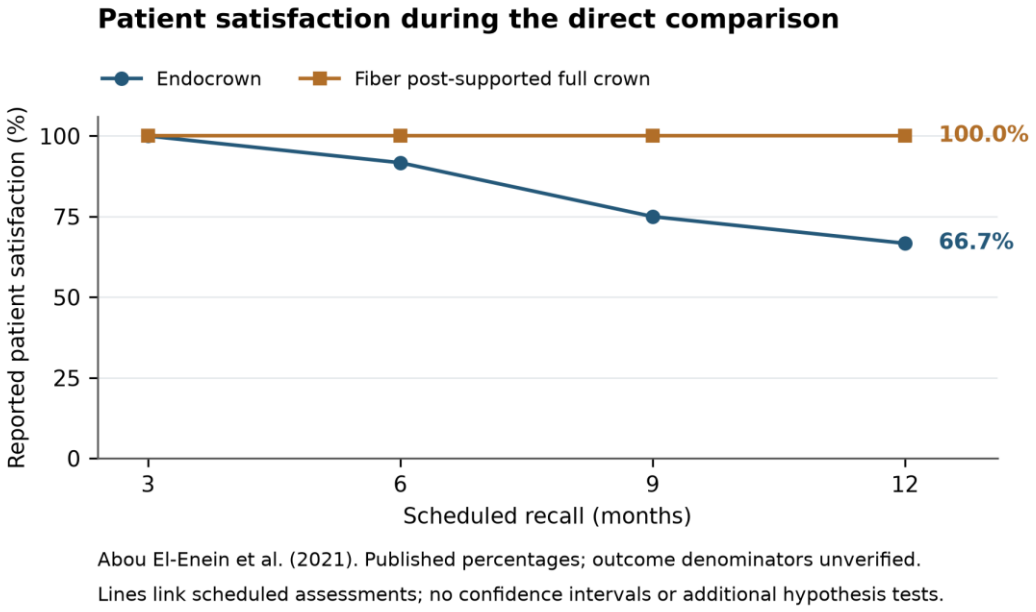


Figure 4: Reported patient satisfaction over follow-up

Note. Percentages as reported; outcome-specific denominators were not verified. No counts, confidence intervals, or hypothesis tests were reconstructed. Lines connect arm-level assessments rather than individual trajectories. Source: Abou El-Enein et al. (2021), patient-satisfaction text and Figure 6.

Remaining tooth structure and clinical failure within fiber crowns

All four of the 48-month structural subgroups (based on Juloski et al., 2014) had 30 teeth assessed and no loss to follow-up. In the teeth of the Gradia Core, clinical failures were seen in 9/30 (with ≤50% structure) and 3/30 (with >50% structure), whilst the corresponding number of GCem were 11/30 and 7/30. The count of tooth-loss in the Gradia Core group was 3/30 compared to 0/30 and in the GCem group was 4/30 compared to 2/30. A clinical failure is differentiated from the nested tooth-loss endpoint in Figure 5. Percentages of reported successes and recalculated fractions are slightly different due to rounding in the source.

Table 3: Verified structural subgroup outcomes at 48 months

Remaining coronal structure	Luting material	Assessed n	Success n (%)	Tooth survival n (%)
>50%	Gradia Core	30	27 (90.0)	30 (100.0)
>50%	GCem Automix	30	23 (76.7)	28 (93.3)
≤50%	Gradia Core	30	21 (70.0)	27 (90.0)
≤50%	GCem Automix	30	19 (63.3)	26 (86.7)

Note. Source: Juloski et al. (2014), Table 2. Complete follow-up in all cells. Percentages use verified counts. Success excludes any failure; survival excludes extraction-producing root fractures. Structural categories also incorporate wall and ferrule requirements.

At a common cement, the conditional odds ratios for any failure with ≤50% versus >50% structure were 3.77 (exact 95% CI 0.81–24.36; Fisher p = .104; Holm p = .208) for Gradia Core and 1.88 (0.54–6.96; p = .399; Holm p = .399) for GCem. Mancebo et al. (2010) reported 11/42 failures with a ferrule <2 mm and 3/45 with a circumferential ferrule ≥2 mm: OR 4.88 (1.16–29.52; p = .019; Holm p = .056). The counts included variable follow-up with a mean of 1027 days (range 377-1585). The three separate associations are shown in Table 4 and Figure 6. All failed to achieve the family adjusted .05 significance criterion, and the structural null hypotheses were not accepted, but rather rejected. An interaction test was not supported by the presence of any common endocrown and fiber-crown structural cells.

Table 4: Exploratory structural associations with any clinical failure

Structural comparison	Failures: less vs more	OR (95% CI)	Fisher p	Holm p
Juloski: Gradia Core	9/30 vs 3/30	3.77 (0.81–24.36)	.104	.208
Juloski: GCem Automix	11/30 vs 7/30	1.88 (0.54–6.96)	.399	.399
Mancebo: ferrule <2 vs ≥2 mm	11/42 vs 3/45	4.88 (1.16–29.52)	.019	.056

Note. Sources: Juloski et al. (2014), Table 2; Mancebo et al. (2010), Table 4. Odds ratios are conditional estimates with central exact pointwise intervals. The two Juloski contrasts compare ≤50% with >50% residual structure at 48 months within the stated cement. Mancebo compares ferrule <2 with ≥2 mm over variable follow-up. Holm adjustment covers these three secondary tests; no pooled estimate is calculated.

Natural Resources for Human Health
eISSN: 2583-1194

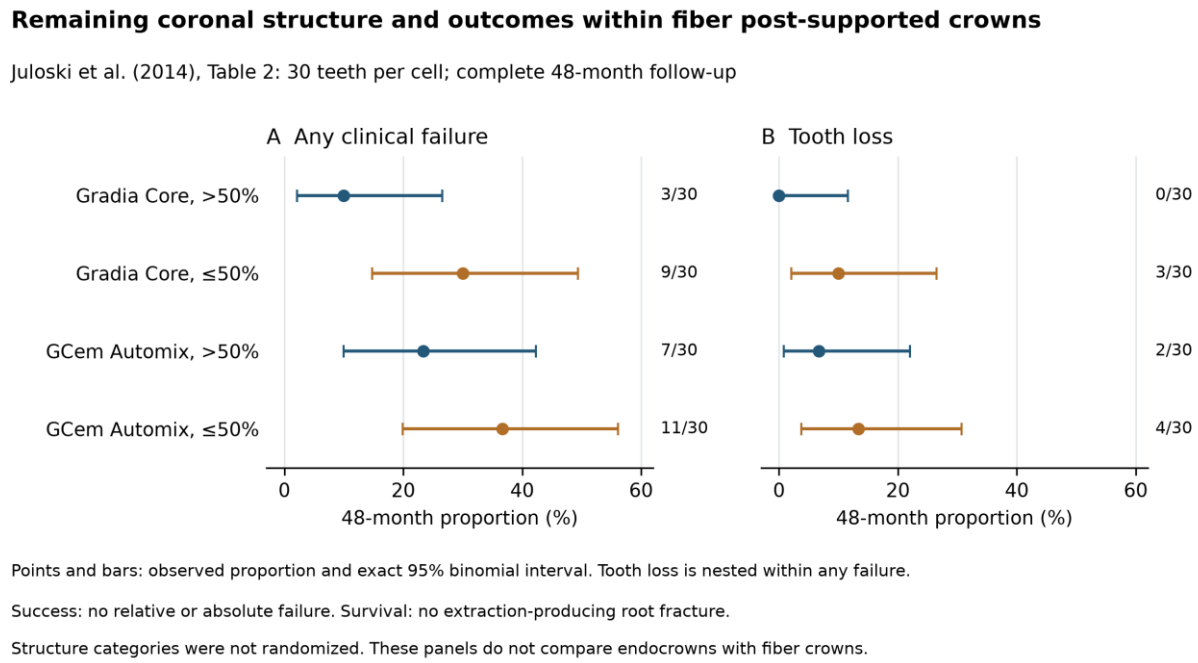


Figure 5: Structural subgroup outcomes within fiber post-supported crowns

Note. Points show observed proportions and exact 95% binomial intervals from verified counts. Any failure and tooth loss are nested endpoints. The structural categories were not randomized. Source: Juloski et al. (2014), Table 2.

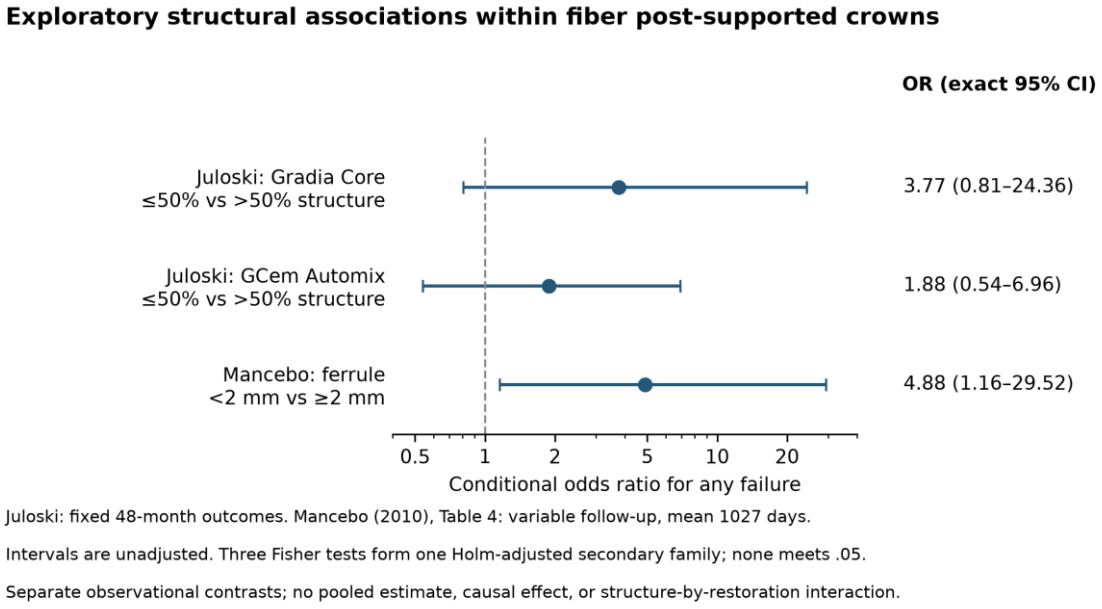


Figure 6: Separate within-study structural associations with clinical failure

Note. Conditional odds ratios with unadjusted exact 95% intervals; the secondary tests are Holm-adjusted in Table 4. Exposures and follow-up differ between reports. No pooled estimate or interaction between restoration type and structure is shown. Sources: Juloski et al. (2014), Table 2; Mancebo et al. (2010), Table 4.

Natural Resources for Human Health
eISSN: 2583-1194

Clinical complication profile in the endocrown cohort

Belleflamme et al. (2017) reported on 99 endocrowns over a single arm and found three periodontal complications, two debondings, two minor chipping events, two caries recurrences and one major fracture. The corresponding descriptive proportions per 99 restorations were 3.0%, 2.0%, 2.0%, 2.0%, and 1.0% (Figure 7). Average observation was 44.7 months and SD of observation was 34.6 months.

These numbers refer only to complications which were reported in one group. These were not totalled to give the number of different teeth affected due to the overlap between modes that was not resolved during the extraction. They were also not interpreted as annualized incidence, a comparison with fiber crowns or a complication rate per fiber structure.

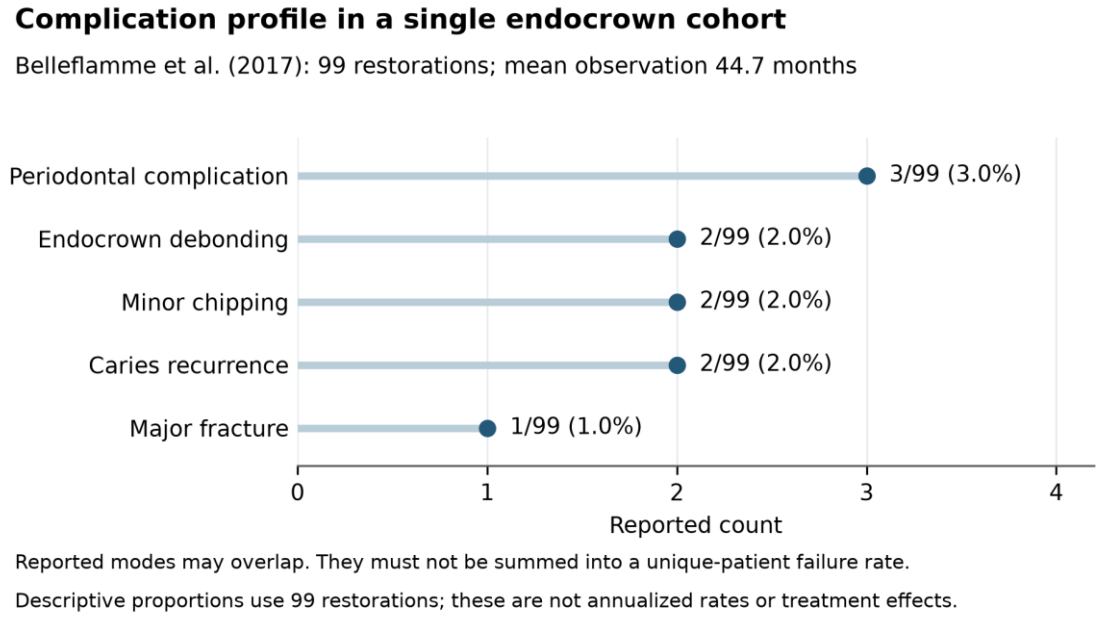


Figure 7: Reported complication modes in a single endocrown cohort

Note. Descriptive counts per 99 documented restorations. Complication modes may overlap and were not summed to estimate unique affected teeth. Variable observation precludes annualized rates. Source: Belleflamme et al. (2017).

Restoration survival and clinical success

Belleflamme et al. (2017) have reported overall survival in restoration of 99.0% and clinical success of 89.9%. Their ten-year Kaplan–Meier estimates were 98.8% and 54.9%, respectively. Figure 8 shows a breakdown of the overall observed proportions and a breakdown between survival and success within each reporting basis, for the ten-year estimate. This was not a 44.7-month fixed survival time since 44.7 months was the mean observation time.

The relationship between numerical separation of survival and success is an illustration of why it was decided to separate the two outcomes as separate endpoints. Not all interval estimates were constructed since the risk sets and confidence limits were not available in the extraction. Within the extracted records of this cohort and the contextual trials, despite the available within-fiber structural comparisons, there were not the joint structural and treatment cells to estimate the joint clinical association with a single statistical model.

Natural Resources for Human Health
eISSN: 2583-1194

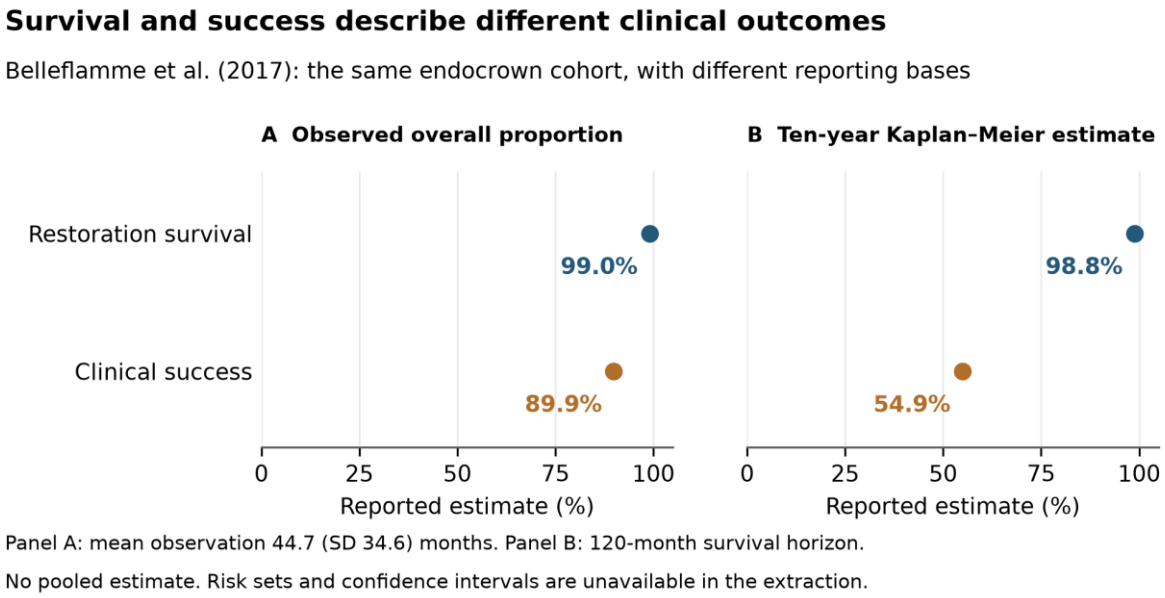


Figure 8: Restoration survival and clinical success under distinct reporting bases

Note. Panel A shows overall observed proportions; mean observation was 44.7 (SD 34.6) months. Panel B shows 120-month Kaplan–Meier estimates. Overall proportions and fixed-horizon survival estimates have different time interpretations. Risk sets and confidence intervals were unavailable in the extraction. Source: Belleflamme et al. (2017).

DISCUSSION

This exploratory synthesis deals with the two estimable components of the clinical question on their own. Two valid same-cement and ferrule contrasts were tested for restoration type and fiber crowns, respectively. The structural estimates all favored the ones with the more preserved tissue, and were also quite uncertain, none of which crossed the multiplicity-adjusted threshold. There was no evidence of rejection of primary restoration null and secondary structural nulls, and no evidence of structural irrelevance or equivalence. The structure-by-restoration question was not answered given that there was no common structure that spanned the target restoration groups. This lost association can never be reconstructed from the average value of studies (Riley et al., 2010) that do not have contemporary measurements for the same variables.

However, caution is warranted in the direct trial due to four observed losses, and a zero-event comparator, resulting in an unstable comparative estimate. The infinite conditional odds ratio does not mean anything close to an infinitely large clinical effect, but rather is the boundary estimate that the observed table would have. It is definitely between 1 and has no upper bound. On the other hand, if there were no destruction in 12 fiber crowns, it does not mean that their risk is null. Exact methods make the uncertainty apparent without introducing spurious events, but are not able to correct for a small sample (Agresti 1992). It is therefore important to consider the exploratory p value in the context of the event counts and intervals and not to make claims of clinical superiority.

Interpretation is also restricted by the anatomical applicability. The directly comparable study involves the upper anterior teeth and it is specifically the European Society of Endodontology (2021) that indicates the endocrowns as a possibility in the treatment of molar teeth with root fillings, provided the correct adhesive procedure is used. A posterior clinical evidence can thus be used to provide the context, but not automatic validation of the anterior indication. It was not possible to conclude if tooth position affects the relative performance of the two restorations due to the lack of a common assessment for tooth position. If the direct result was extended to all endodontically treated teeth, this distinction/overlap would be blurred, and if the positive posterior cohort results were extrapolated to the anterior trial, it would assume a similarity which was not proven.

A helpful text to help prevent overinterpretation is the literature at large. Al-Dabbagh (2021) concluded endocrowns were a good conservative alternative, but stressed the need for more robust long-term clinical data. More recently, Niakou et al.

(2025) reported pooled success risk ratios of 0.93 (95% CI 0.69–1.27) at seven years and 0.96 (95% CI 0.67–1.39) at five years. Those analyses referred to conventional crowns (with or without posts and cores), which is more inclusive than the category of fiber-post full-crowns considered here. Their results are not valid to import as a 'pooled' answer to the question of this study or be treated as additional independent observations.

The structural results suggest that it is prudent to make a distinction between a prognostic association and a treatment-selection rule. The direction observed is in keeping with the protective argument for the retention of coronal tissue, but is not the deciding factor in the choice of restoration at a specific tissue level. Ferrule reviews separate the contribution of the remaining dentin from that of retention provided by a post and core assembly (Juloski et al., 2012). In the case of guidance, it is recommended to avoid further dentin removal just to provide a room for passive placement of a post (European Society of Endodontology, 2021). Both principles fail to make the leap from these current nonrandomized comparisons of structure to validity for one restorative design in every level of damage.

Structural measure is still a challenge to combine evidence. Percentages based categories also included wall and ferrule requirements while Mancebo et al. (2010) categorized a circumferential ferrule in front of core build-up. As such, they are not equivalent measurements of a single exposure, but are composite clinical conditions. Further, an eligibility threshold in the direct restoration trial doesn't provide a structural gradient. Residual tissue cannot be interpreted without considering other prognostic factors such as tooth position, adjacent tooth contacts (Bhuva et al., 2021). It would require a common measurement protocol that can be reproduced before any attempt at estimating what the impact on selection of endocrowns versus fiber crowns would be with various structural changes.

Same cement comparisons keep the cement the same and nullify the influence of tissue condition from the variables. They are not able to address confounding in nonrandomized structural allocation. But their exact intervals are still large and there is not a great number of events. However, inclusion of the secondary testing family (Holm, 1979) does not keep the nominal association below .05 for the ferrule study. That finding would not be an unequivocal finding of association or the lack of association. Fixed-horizon aggregate odds ratios do not address the same question as the source studies, which were based on time-to-event analyses, and were also refitted without event times.

Exposure definitions have the equal impact as outcome definitions on apparent clinical message. The survival-versus-success display illustrates how a restoration can be "survived" and not be a success. The FDI criteria distinguish between different functional, biological and aesthetic characteristics, and hereby problems with clinical relevance can be described other than just "retained" or "lost" (Hickel et al., 2010). Similarly, debonding, caries and fracture have different management requirements. The complication display does not sum the modes to an assumed number of unique affected teeth, instead it keeps them separate. Only after checking the definitions of events included in a study and how they were treated if repeated interventions were performed, could a common failure endpoint be justified.

There is another constraint that is introduced from the observation time. The descriptive failure fraction from the ferrule study have been combined over varying times of follow-up; the odds ratio is not a three year risk ratio or an adjusted hazard ratio. Similarly, a cohort that is followed for a variable period of time cannot be assigned to the time point that corresponds to its average length of follow-up for measuring an endocrown proportion. A 10-year Kaplan–Meier estimate cannot be simply divided by the baseline sample size. The separate holding of these bases supports the idea of 'maintaining study specific endpoints' and 'maintaining study groups for decisions when quantitative combination is not appropriate' (Campbell et al., 2020). Scheduled retention grades were not then translated into event times, nor added to longer observational retention grades.

The extra patient-satisfaction display provides a patient-centric view, but doesn't boost the amount of independent comparative evidence. The fact that it is similarly patterned to retention status may mean that it is related to aspects of the same clinical experience, but an aggregate extraction cannot rule out a tooth or patient level relationship between the outcomes. If it were possible to reconstruct the satisfaction denominator from an adjacent restoration table this would be an additional assumption and not an additional piece of information. This underscores the importance of recognizing distinct endpoints versus independent samples, and not repeating hypothesis testing among correlated outcomes, when the actual individual outcomes are not available (Riley et al., 2010).

The analysis also features explicit structural comparisons as well as the strict restoration contrast, and maintaing treatment coverage, endpoint definitions, repeated-report grouping and exact uncertainty. However, it is not possible to confirm that all pertinent studies have been retrieved with targeted retrieval. Multiple contextual documents remained reliant on abstracts and/or indexed text, and a single extraction process provides less safeguard against mistakes than independent double checking. While full-text verification helps enhancing data completeness, it does not make for low bias. Formal risk of bias assessment not done. Although it is a retrospective clinical cohort study, the researchers' intent was not to conduct a comprehensive systematic review, a new cross-sectional investigation or a meta-analysis.

The clinical interpretation is thus contingent on the tooth, and the treatment options should be considered. The remaining tissue, restorative coverage, retention criteria and adhesive protocol should be considered in conjunction with each other (Bhuva et al., 2021; Govare & Contrepois, 2020). This data does not provide a blanket preference for a fiber crown or endocrown or a numerical structural threshold for use of either of these. Its usefulness is to demonstrate which of the outcomes reported can be used to compare against each other, and which apparently relevant studies answer a different question. An attention to the definition of comparator is needed with broader conventional-crown reviews (Niakou et al., 2025).

More efforts should be made to secure the rest of the full reports, and to examine the risk of bias independently. It is especially the structural component that requires similar endocrown outcome strata; fiber-crown cohorts alone cannot detect interaction among restoration and structure. Ideally, future comparative studies should document the residual structure at the tooth level at a well-defined stage of preparation, clearly define clinical endpoints, employ a common follow-up and have an adequate number of observations in the structural and restoration categories. When multiple teeth are needed, there is a need for clustering to be handled. A joint model which allows for the retention of study membership and assessment of structural gradients and interaction could be supported by compatible individual-participant data (Riley et al., 2010). This evidence would be more relevant to the question of treatment choice than further unadjusted comparisons of the means of different studies.

CONCLUSION

This retrospective clinical cohort study using clinical data gathered from eight reports offers important quantitative data regarding the interaction of remaining tooth structure with restoration type and clinical outcome of endodontically treated teeth. Compared to fiber post-supported full crowns, there was a higher observed number of complete restoration loss among endocrowns, though not statistically significant. Structural analyses also showed a trend of increased risk of clinical failures in teeth with decreased tooth structure and shorter ferrule height, which suggests that the amount of remaining tooth structure may be important as a prognosis. While none of these structural associations was statistically significant after adjusting for multiple comparisons, they all pointed in the same direction and thus represented a meaningful basis for additional clinical studies. In general, the results highlight the need for all three parameters (remaining tooth structure, ferrule characteristics, and restoration design) to be considered as a whole in the planning of definitive restorations. Future prospective comparative studies using standardized structural measures may further shed light on the cumulative effects they have on long-term clinical outcomes, and help guide more personalized, evidence-based restorative decisions.

Data availability and ethics

All analyzed data were aggregate results gathered from eight reports. No individual-participant records were obtained, and no participants were recruited or contacted.

REFERENCES

[1] Abou El-Enein, Y. H., Elguindy, J. F., & Zaki, A. A. E. L. (2021). One year clinical evaluation of E-max press crowns retained with fiber reinforced composite post versus E-max press endocrowns in anterior endodontically treated teeth (a randomized clinical trial). *Brazilian Dental Science*, *24*(2). https://doi.org/10.14295/bds.2021.v24i2.2413

[2] Agresti, A. (1992). A survey of exact inference for contingency tables. *Statistical Science*, *7*(1), 131–153. https://doi.org/10.1214/ss/1177011454

[3] Al-Dabbagh, R. A. (2021). Survival and success of endocrowns: A systematic review and meta-analysis. *The Journal of Prosthetic Dentistry*, *125*(3), 415.e1–415.e9. https://doi.org/10.1016/j.prosdent.2020.01.011

[4] Belleflamme, M. M., Geerts, S. O., Louwette, M. M., Grenade, C. F., Vanheusden, A. J., & Mainjot, A. K. (2017). No post-no core approach to restore severely damaged posterior teeth: An up to 10-year retrospective study of documented endocrown cases. *Journal of Dentistry*, *63*, 1–7. https://doi.org/10.1016/j.jdent.2017.04.009

[5] Bhuva, B., Giovarruscio, M., Rahim, N., Bitter, K., & Mannocci, F. (2021). The restoration of root filled teeth: A review of the clinical literature. *International Endodontic Journal*, *54*(4), 509–535. https://doi.org/10.1111/iej.13438

[6] Campbell, M., McKenzie, J. E., Sowden, A., Katikireddi, S. V., Brennan, S. E., Ellis, S., Hartmann-Boyce, J., Ryan, R., Shepperd, S., Thomas, J., Welch, V., & Thomson, H. (2020). Synthesis without meta-analysis (SWiM) in systematic reviews: Reporting guideline. *BMJ*, *368*, Article l6890. https://doi.org/10.1136/bmj.l6890

[7] Clopper, C. J., & Pearson, E. S. (1934). The use of confidence or fiducial limits illustrated in the case of the binomial. *Biometrika*, *26*(4), 404–413. https://doi.org/10.1093/biomet/26.4.404

[8] de Kuijper, M. C. F. M., van den Breemer, C. R. G., de Waal, Y. C. M., Lanjouw, L., Özcan, M., Cune, M. S., & Gresnigt, M. M. M. (2026). Direct resin composite and lithium disilicate endocrowns in severely compromised endodontically treated molars: A two-year randomized controlled trial. *International Endodontic Journal*, *59*(11), 2383–2401. https://doi.org/10.1111/iej.70232

[9] European Society of Endodontology. (2021). European Society of Endodontology position statement: The restoration of root filled teeth. *International Endodontic Journal*, *54*(11), 1974–1981. https://doi.org/10.1111/iej.13607

[10] Ferrari, M., Vichi, A., Fadda, G. M., Cagidiaco, M. C., Tay, F. R., Breschi, L., Polimeni, A., & Goracci, C. (2012). A randomized controlled trial of endodontically treated and restored premolars. *Journal of Dental Research*, *91*(7 Suppl.), 72S–78S. https://doi.org/10.1177/0022034512447949

[11] Govare, N., & Contrepois, M. (2020). Endocrowns: A systematic review. *The Journal of Prosthetic Dentistry*, *123*(3), 411–418.e9. https://doi.org/10.1016/j.prosdent.2019.04.009

[12] Hickel, R., Peschke, A., Tyas, M., Mjör, I., Bayne, S., Peters, M., Hiller, K.-A., Randall, R., Vanherle, G., & Heintze, S. D. (2010). FDI World Dental Federation: Clinical criteria for the evaluation of direct and indirect restorations—update and clinical examples. *Clinical Oral Investigations*, *14*(4), 349–366. https://doi.org/10.1007/s00784-010-0432-8

[13] Holm, S. (1979). A simple sequentially rejective multiple test procedure. *Scandinavian Journal of Statistics*, *6*(2), 65–70. https://doi.org/10.2307/4615733

[14] Juloski, J., Fadda, G. M., Monticelli, F., Fajó-Pascual, M., Goracci, C., & Ferrari, M. (2014). Four-year survival of endodontically treated premolars restored with fiber posts. *Journal of Dental Research*, *93*(7 Suppl.), 52S–58S. https://doi.org/10.1177/0022034514527970

[15] Juloski, J., Radovic, I., Goracci, C., Vulicevic, Z. R., & Ferrari, M. (2012). Ferrule effect: A literature review. *Journal of Endodontics*, *38*(1), 11–19. https://doi.org/10.1016/j.joen.2011.09.024

[16] Mancebo, J. C., Jiménez-Castellanos, E., & Cañadas, D. (2010). Effect of tooth type and ferrule on the survival of pulpless teeth restored with fiber posts: A 3-year clinical study. *American Journal of Dentistry*, *23*(6), 351–356. https://pubmed.ncbi.nlm.nih.gov/21344836/

[17] Morimoto, S., Fraga, R. M., Tedesco, T. K., Ozcan, M., Sampaio, F. B. W. R., Moreira, M. S. N. A., Neres Santiago, A. S., & Raggio, D. P. (2021). Procedure time and patient perception for ceramic endocrowns or partial coverage ceramic restorations: A double-blind randomized clinical trial. *Archives of Health Investigation*, *10*(4), 536–541. https://doi.org/10.21270/archi.v10i4.5189

[18] Morimoto, S., Fraga, R. M., Tedesco, T. K., Özcan, M., Sampaio, F. B. W. R., & Raggio, D. P. (2022). Two-year survival of ceramic endocrowns and partial coverage ceramic restorations with fiber post: A 2-year double-blind randomized clinical trial. *European Journal of Prosthodontics and Restorative Dentistry*, *30*(4), 252–261. https://doi.org/10.1922/EJPRD_2374Morimoto10

[19] Niakou, A., Stratos, A., Pissadakis, M., Kamalakidis, S., Michalakis, P., Pissiotis, A., Baba, N. Z., Tsouknidas, A., Vasilaki, D., & Michalakis, K. (2025). Complications and survival rates of endocrowns vs. crowns: A systematic review and meta-analysis. *The International Journal of Prosthodontics*. Advance online publication. https://doi.org/10.11607/ijp.9498

[20] Riley, R. D., Lambert, P. C., & Abo-Zaid, G. (2010). Meta-analysis of individual participant data: Rationale, conduct, and reporting. *BMJ*, *340*, Article c221. https://doi.org/10.1136/bmj.c221

[21] Sedrez-Porto, J. A., da Rosa, W. L. O., da Silva, A. F., Münchow, E. A., & Pereira-Cenci, T. (2016). Endocrown restorations: A systematic review and meta-analysis. *Journal of Dentistry*, *52*, 8–14. https://doi.org/10.1016/j.jdent.2016.07.005

[22] Skupien, J. A., Cenci, M. S., Opdam, N. J., Kreulen, C. M., Huysmans, M.-C., & Pereira-Cenci, T. (2016). Crown vs. composite for post-retained restorations: A randomized clinical trial. *Journal of Dentistry*, *48*, 34–39. https://doi.org/10.1016/j.jdent.2016.03.007