

Survival and Success Rate of Restoration Post Endodontic Treatment

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Introduction: Dental restoration following endodontic treatment aims to restore tooth function, aesthetics, and strength compromised by caries or trauma. Loss of tooth structure post-treatment can reduce strength by up to 60%, increasing fracture risk. Restoration choice depends on remaining tooth structure, coronal sealing, retention, and occlusal factors. Direct restorations suit minimal damage, while indirect options like crowns or endocrowns address significant structural loss.

Objective: To evaluate the durability and success of post-endodontic restorations through a scoping review focused on remaining tooth structure, restoration techniques, materials, and post use.

Methods: A scoping review was conducted using PubMed, ScienceDirect, and Scopus, following PRISMA-ScR guidelines. Included studies were randomized controlled trials, cross-sectional studies, and case-control studies published in English within the last five years. In vitro studies, non-randomized clinical trials, and literature reviews were excluded.

Results: From 353 articles, 14 met inclusion criteria. The studies found that indirect restorations exhibited higher success rates (63% to 91.61%) than direct restorations (43.2% to 86.7%). This finding attributed to the inherent advantages of indirect approach. Indirect restorations demonstrated higher 3-year survival rates (82.7 to 99.1%) than direct restorations (75 to 97.6%). Among these, full-coverage crowns were superior, due to their enhanced fracture resistance, ferrule effect, and stress distribution while direct resin composites suffice when adequate tooth structure remains. Direct restorations are recommended for endodontically treated teeth that still have two or more intact coronal walls, as their prognosis and success rates are quite good for both anterior and posterior teeth. Glass-fiber posts reduce root fracture risk compared to metal posts; however, outcomes depend on post design and occlusal load.

Conclusion: The long-term success of post-endodontic restorations depends on multiple factors, with remaining tooth structure being paramount. Evidence shows a clear hierarchy: indirect restorations, particularly full-coverage crowns (FCCs), demonstrate superior success and survival rates due to their fracture resistance and effective stress distribution. Direct composites are only viable with substantial remaining tooth structure (≥ 2 intact walls). Glass-fiber posts are preferred over metal posts to reduce fracture risk. Ultimately, a ferrule-effect-based, tailored approach that matches biomechanical demands to clinical conditions is essential for optimal outcomes.

Keywords: survival rate, success rate, restoration, endodontically treated teeth

Introduction

Post-endodontic dental restoration is a critical phase aimed at restoring the function, aesthetics, and structural strength of teeth that have been compromised due to caries, trauma, or treatment procedures. The loss of tooth structure following endodontic treatment can reduce tooth strength by up to 60%,¹ thereby increasing the risk of fracture and restoration failure.²⁻⁴ Changes in the sensory characteristics of non-vital teeth may lead to increased occlusal forces, which must be considered during restorative planning, particularly in abutment teeth.⁵ The success of endodontic treatment is highly influenced by the quality of the definitive restoration, which should provide a tight coronal seal and preserve as much of the remaining tooth structure as possible.^{2,6,7} Post-endodontic tooth conditions vary widely, ranging from minimal to significant loss of coronal tissue; therefore, the choice of restorative techniques and materials must be tailored to the

specific clinical situation.^{8,9} Direct restorations are generally used for minor damage, whereas indirect restorations such as crowns, onlays, or endocrowns are preferred in cases with extensive structural loss.^{2,10}

Several factors, such as the amount of remaining tooth structure, the presence of a ferrule, the use of posts, and occlusal conditions, play significant roles in the prognosis of restorations.^{4,11}

The prognosis is critically influenced by the choice of restorative approach, including the use of intracanal posts for additional retention. Studies have demonstrated that fiber-reinforced composite posts effectively distribute stress and reinforce endodontically treated teeth, thereby improving their overall strength and clinical survival, especially when ferrule is limited.¹² Other complications that may lead to failure of post-endodontic restorations include coronal leakage and loss of retention.^{7,8} Despite numerous studies, variations in outcomes persist, and there is still no clear consensus regarding the key factors that determine the durability and success of such restorations. Modern dentistry defines success in a more comprehensive manner, as opposed to traditional studies, which have primarily concentrated on the survival of restorations—that is, whether a tooth or restoration remains in place. As Zanza et al emphasizes, real clinical success is a concept that contains several parts. It goes beyond just keeping teeth in place to include how well they work, how healthy the surrounding tissues are, and how well they fit in with the natural teeth.¹³ Therefore, this study employs a scoping review methodology to summarize the scientific evidence related to the longevity and success of restorations following endodontic treatment. The findings of this review are expected to serve as a clinical guide for making appropriate restorative decisions to improve the long-term prognosis of endodontically treated teeth.^{14,15}

Method

The method used in this study is a scoping review, which is an ideal approach to determine the scope of research and to identify and map the available evidence from the past five years. This study was conducted from January to March 2025 at the Library of the Faculty of Dentistry, Padjadjaran University. The scoping review follows the PRISMA-ScR framework (Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews) to enhance the transparency, consistency, and completeness of the research findings.¹⁶

The data sources for this study were obtained from the PubMed, ScienceDirect, and Scopus databases to identify articles discussing the longevity and success of restorations following endodontic treatment. The article search was conducted using Boolean operators with the following keywords: (endodontically treated teeth) AND (crown) OR (endo crown) OR (post and crown) OR (inlay) OR (onlay) OR (direct restoration) AND (survival rate) OR (success rate) OR (complication).¹⁷

Results

The aim of this scoping review is to examine the longevity and success of post-endodontic restorations based on an evaluation of the remaining tooth structure, restorative techniques, types of materials, and the use of posts. Article searches were conducted using predetermined keywords across databases as well as through manual searching. A total of 166 articles were identified from PubMed, 44 articles from ScienceDirect, and 143 articles from Scopus, resulting in a total of 353 articles. The initial screening process involved removing duplicates using the Mendeley reference manager; 348 articles were retained, and 5 duplicates were removed. The next screening step involved reviewing titles and abstracts; 42 articles were selected, while 306 were excluded due to irrelevance to the research topic. The subsequent step involved applying eligibility criteria through full-text reading, which resulted in 14 articles being included and 28 articles excluded for not meeting the inclusion criteria. Thus, 14 articles were ultimately reviewed in this study. The selection process is illustrated in the PRISMA-ScR flow diagram (Figure 1).

Discussion

Research on the durability and success of post-endodontic restorations shows that the selection of post type, restoration type and material, and the condition of the tooth structure before restoration significantly affect the longevity and success of endodontically treated teeth. The goal of post-endodontic restoration is to restore the function, aesthetics, and strength of teeth that have lost vitality. Major changes following root canal treatment include alterations in the physical properties of tooth tissues, potential discoloration due to inadequate canal debridement,

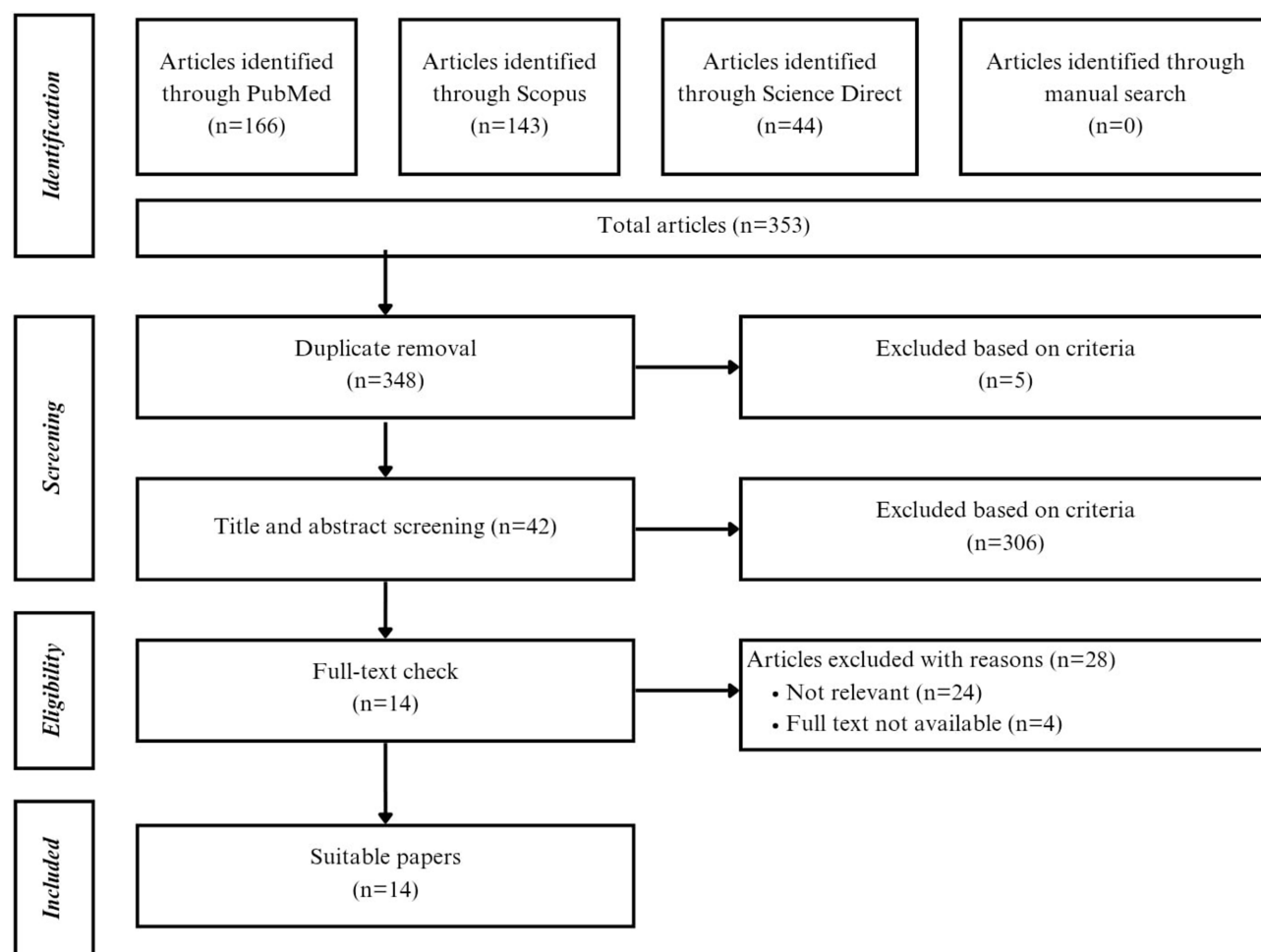


Figure 1 PRISMA-ScR Flow Diagram.

biochemical changes in dentin caused by hemoglobin degradation, and external pigment penetration resulting from the loss of pulpal pressure. In addition, thin gingival biotypes can accentuate color changes in the teeth. An understanding of the changes in tooth composition, microstructure, and macrostructure is essential, as these factors significantly influence the restorative approach and techniques selected. The choices of materials and restoration techniques vary widely, ranging from direct restorations such as composite resin to indirect restorations such as crowns, endocrowns, and the use of posts. Based on the results of a scoping review of 14 studies, variations in restorations, survival rates, success rates, and influencing factors were identified according to extraction data from multiple studies.

Table 1 summarizes the key characteristics of the studies included in this scoping review following the application of the latest inclusion criteria. **Table 2** presents the data extraction and presentation derived from the articles included in this scoping review. The extracted data encompass key variables such as sample size, tooth type, type of restoration, average survival and/or success rate, complications, and conclusions. By organizing these details, this table provides a clear and concise summary of the essential findings from the selected studies, enabling a thorough understanding of the outcomes and trends identified within the reviewed literature.

Several studies in this scoping review show variations in restoration durability based on the type of tooth. Restorations on posterior teeth such as molars and premolars tend to exhibit high survival rates when using CAD/CAM-based endocrowns. Research articles by Jalali et al and El-Ma'aïta et al indicate that endocrowns made from monolithic ceramics like lithium disilicate provide excellent results on molars, with survival rates up to 100%.¹⁸ This is attributed to the strength of the material as well as good occlusal morphological adaptation in posterior teeth. Conversely, in anterior teeth (incisors and canines), direct composite resin restorations are still widely used, as demonstrated in studies by

Table 1 Study Characteristic

No	Authors	Year	Country	Title	Study Design
1	Phengudom, P; Banomyong, D; Jirathanyanatt, T; Ngoenwiwatkul, Y; Suksaphar, W	2021	Thailand	Survival rates of unrestorable fracture of endodontically treated anterior teeth restored with resin composites or crowns: A retrospective cohort study	Retrospective Cohort Study
2	Keskin, S C; Sakar, A; Bolay, S	2024	Turkey	A 3-year clinical evaluation of endocrown restorations with two different materials using the computer-aided design/ computer-aided manufacture system	Prospective Clinical Study
3	Intaraprasong, N; Banomyong, D; Chotvorarak, K; Ngoenwiwatkul, Y; Pittayachawan, P	2024	Thailand	Influence of Different Post-endodontic Restorations on the Survival Rate Against Fracture of Endodontically Treated Anterior Teeth Affected by Cervical Lesions with Pulpal Involvement: A Retrospective Clinical Study	Retrospective Clinical Study
4	Jalali, S; Asgari, N; Pirooz, P; Younespour, S; Atri, F	2024	Iran	Comparison of clinical efficacy of CAD CAM Endocrowns made of feldspathic ceramic, zirconia lithium silicate, and lithium disilicate: A two-year mixed cohort study	Cohort
5	Patel, S S; Sethuraman, R	2022	India	A randomized controlled twelve month clinical study on the evaluation of success rate of endodontically treated teeth restored with metal poly-fiber posts and dentin posts	Randomized Controlled Trial (RCT)
6	Sarkis-Onofre, R; Amaral Pinheiro, H; Poletto-Neto, V; Bergoli, C D; Cenci, 8M S; Pereira-Cenci, T	2020	Brazil	Randomized controlled trial comparing glass fiber posts and cast metal posts	RCT prospektif double-blind
7	Vatankhah, M; Ashraf, H; Jamalian, F; Talebi, S; Akbarzadeh Baghban, A; Khosravi, K; Zargar, N	2024	Iran	Success of Nonsurgical Endodontically Treated Posterior Teeth with Complex Restorative/ Prosthodontic Treatments: A Retrospective Study	Observasional retrospektif
8	Xiang, F; Shi, K; Hua, H; Zhao, J; Zheng, Y	2024	China	Restoration of teeth lacking complete ferrules using cast precious metal alloy post-and-cores and knife-edged crowns: A retrospective clinical study	Restrospektif Klinis
9	Linnemann, T; Kramer, E J; Schwendicke, F; Wolf, T G; Meyer-Lueckel, H; Wierichs, R J	2021	Germany	Longevity and Risk Factors of Post Restorations after up to 15 Years: A Practice-based Study	Cohort multi-center
10	Poletto-Neto, Victório; Chisini, Luiz Alexandre; Fokkinga, Wietske; Kreulen, Cees; Loomans, Bas; Cenci, Maximiliano Sérgio; Pereira-Cenci, Tatiana	2024	Netherlands	Single crown vs composite for glass fiber post-retained restorations: An 8-year randomized clinical trial.	Randomized Controlled Trial (RCT)
11	Bergoli, César Dalmolin; Machry, Renan Vaz; Schwantz, Julia Kaster; Brondani, Lucas Pradebon; Pereira-Cenci, Tatiana; Pereira, Gabriel Kalil Rocha; Valandro, Luiz Felipe	2023	Germany	Survival rate and treatment success of glass fiber posts cemented with two adhesive cementation strategies after up to 106 months: a randomized clinical trial.	Randomized Controlled Trial (RCT)

(Continued)

Table 1 (Continued).

No	Authors	Year	Country	Title	Study Design
12	Olegário, Isabel Cristina; Bresolin, Carmela Rampazzo; Pássaro, Ana Laura; de Araujo, Mariana Pinheiro; Hesse, Daniela; Mendes, Fausto Medeiros; Raggio, Daniela Prócida	2022	Ireland	Stainless steel crown vs bulk fill composites for the restoration of primary molars post-pulpectomy: 1-year survival and acceptance results of a randomized clinical trial.	Randomized Controlled Trial (RCT)
13	Bijelic-Donova, J; Myyryläinen, T; Karsila, V; Vallittu, P K; Tanner, J	2022	Finland	Direct Short-Fiber Reinforced Composite Resin Restorations and Glass-Ceramic Endocrowns in Endodontically Treated Molars: A 4 -Year Clinical Study.	Clinical study
14	El-Ma'aïta, Ahmad; A Al-Rabab'ah, Mohammad; Abu-Awwad, Motasum; Hattar, Susan; Devlin, Hugh	2022	Jordan	Endocrowns Clinical Performance and Patient Satisfaction: A Randomized Clinical Trial of Three Monolithic Ceramic Restorations.	Randomized Controlled Trial (RCT)

Phengudom et al and Intraprasong et al. Although the survival rates are fairly high, the success of the restorations strongly depends on the condition of the remaining tooth structure.¹⁹ Loss of cervical structure or pulp involvement in anterior teeth has been proven to be a significant prognostic factor for fracture risk.²⁰

The choice of restorative materials is also an important topic discussed in this scoping review. Direct composite resin has advantages in terms of tissue conservation and ease of application; however, its long-term success rate is relatively lower. A research article by Poletto-Neto et al reported that although the survival rate of composite resin reached 97.6%, its success rate was only 43.2%, significantly lower than metal-ceramic crown restorations, which achieved 85%.²¹ On

Table 2 Data Presentation

No.	Sample Size	Tooth Type	Type of Restoration	Average Survival and/or Success Rate (%)	Complication	Conclusion
1	263 anterior teeth	Incisors and canines	Direct resin composite (DRC): 157, and full coverage crown (FCC): 106, with fiber-reinforced posts (58), cast metal posts (45), and no post used (3).	Survival DRC: 90.4% Survival FCC: 99.1% (P<0.05)	-	FCC demonstrated superior survival rates. DRC can be successfully used as a permanent restoration if no negative predisposing factors are present.
2	90 teeth	Premolars and molars	Endocrown (indirect) CAD/CAM: • Lava Ultimate (LU): resin nanoceramic (n = 52) • Celtra Duo (CD): zirconia-reinforced lithium silicate (n = 38)	LU: 82.7% survival (3 years) CD: 86.8% survival (3 years)	LU: 8 failures (2 debondings, 1 ceramic restoration fracture, 4 tooth fractures, 1 secondary caries) CD: 4 failures (2 debondings, 1 ceramic restoration fracture, 1 tooth fracture)	Both materials demonstrated good and comparable clinical performance for endocrowns in endodontically treated teeth (ETT) using the CAD/CAM system in clinical settings.

(Continued)

Table 2 (Continued).

No.	Sample Size	Tooth Type	Type of Restoration	Average Survival and/or Success Rate (%)	Complication	Conclusion
3	175 teeth	Incisors and canines	Composite resin (n = 125) Post/core + crown (n = 50)	Composite resin: 85.6% Crown: 88%	Composite resin restorations: crown-root fractures, crown fractures, and root fractures were observed Crown restorations: crown-root fractures and crown fractures occurred.	During the average evaluation period of 33 months, no significant difference was found in fracture survival rates between anterior teeth with cervical lesions and pulpal involvement restored using composite resin or crowns. However, additional loss of tooth structure was identified as a significant prognostic factor that increased the risk of fracture.
4	141 teeth	Molars and premolars	CAD/CAM endocrowns made of: • Feldspathic ceramic • Zirconia lithium silicate • Lithium disilicate	89.36% of restorations: "clinically excellent/good" 7.09%: "acceptable/satisfactory" 3.54%: "poor/unsatisfactory" (replacement needed)	Secondary caries, fracture, marginal staining (aesthetic)	Endocrowns made from various types of ceramics have shown high short-term success rates and can be recommended for the restoration of endodontically treated posterior teeth.
5	36 teeth	Incisors, canines, premolars, molars	Metal fiber post + composite core Dentin post + composite core	100% survival over 12 months, with no tooth loss.	One case of de-cementation occurred in each group; no secondary caries, post/core/root fractures, or signs of periapical pathology were observed.	Both demonstrated similar clinical outcomes in terms of survival and success over 12 months; both metal fiber and dentin posts were effective.
6	183 teeth	Incisors, canines, premolars, molars (maxilla and mandible)	Cast metal post + metal-ceramic crown Glass fiber post + metal-ceramic crown	Total 5-year AFR: 1.5% AFR for cast metal posts: 1.2% AFR for glass fiber posts: 1.7% (p = 0.63 for survival, p = 0.26 for success)	Root fractures (7 glass fiber posts and 3 cast metal posts), post debonding (3 glass fiber posts and 2 cast metal posts), endodontic failure, secondary caries, restoration debonding, and combined post and restoration debonding.	Glass fiber posts and cast metal posts demonstrated good and comparable clinical performance in teeth without a ferrule.

(Continued)

Table 2 (Continued).

No.	Sample Size	Tooth Type	Type of Restoration	Average Survival and/or Success Rate (%)	Complication	Conclusion
7	190 teeth	Premolars and molars	Indirect: crown, post and core crown, amalgam build-up with post, amalgam build-up without post, post and core crown with crown lengthening Direct: composite build-up	Survival rate: 89.4% Success rate: 70.5%	-	Endodontically treated teeth with minimal mobility, no voids in the obturation, and restorations such as crowns, post and core crowns, or amalgam with posts, along with the presence of proximal contact, demonstrate a high success rate.
8	130 teeth	Not specified	Cast precious metal alloy post-and-core + knife-edged crown (indirect)	Success rate of 93.85% (mean follow-up 48.3 ± 26.1 months); estimated 5-year success rate of 91.61%.	Post debonding, root fracture, apical periodontitis	Cast post-and-core and knife-edged crowns on teeth with a ferrule of ≤2 walls showed good clinical outcomes without increasing the risk of periodontal disease.
9	195 teeth	Incisor, canine, premolar	Post + definitive restoration (various types, not specified)	Success rate: 63% (122 teeth), mean follow-up 110 months Survival rate: 78% (152 teeth), mean follow-up 133 months Annual failure rate (AFR): 6.0% (success), 3.3% (survival) When recemented restorations are excluded, AFR decreases to 3.5% and 2.1%, respectively.	The most frequent failure occurred in cases of recementation of telescopic crowns long after the placement of new posts.	Restorations on endodontically treated teeth with posts show high success and survival rates in general practice, but recementation of old crowns increases the risk of failure.
10	75 teeth	Anterior teeth, premolar, molar	Metal-ceramic crowns (indirect) Direct composite resin restorations (with glass fiber posts)	Success rate: MC: 85% (AFR 1.31%) CR: 43.2% (AFR 6.58%) Survival rate: MC: 93.8% (AFR 0.52%) CR: 97.6% (AFR 0.20%)	Restoration fracture	The success rate of metal-ceramic crown restorations is higher, while the survival rates between the two restorations are similar. Composite resin is more conservative but requires reintervention more frequently.

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Table 2 (Continued).

No.	Sample Size	Tooth Type	Type of Restoration	Average Survival and/or Success Rate (%)	Complication	Conclusion
11	142 teeth	Premolars and molars	- Fiber post + crown Group CRC: adhesive system + resin cement Group SRC: self-adhesive resin cement	Survival rate: CRC: 88.9% SRC: 90.9% Success rate: CRC: 82% SRC: 77%	Post debonding, root fracture, crown debonding, post fracture, extraction	Both groups used fiber post cementation strategies (conventional and self-adhesive) and showed high and comparable survival and success rates up to 106 months.
12	91 teeth	Primary molars	Bulk-Fill composite (direct) and Stainless Steel Crown (SSC) (indirect)	1-year survival rate: SSC 88%, BF 75% 1-year success rate: SSC 82.6%, BF 86.7%	Endodontic failure (increased pathological radiolucency, restoration fracture accompanied by fistula, restoration fracture accompanied by increased pathological radiolucency, abscess, root resorption of more than two-thirds accompanied by increased pathological radiolucency)	It was not proven that BF is non-inferior to SSC in maintaining endodontic success after 1 year. Both were well accepted by children and their parents.
13	18 teeth	Molar	- SFCR: direct composite restorations with a short fiber-reinforced base (11 teeth) - GCE: indirect glass-ceramic endocrowns (7 teeth)	4 years survival rate: SFCR: 90,9% GCE: 85,7%	Secondary caries occurred on direct restorations; teeth restored with endocrowns were extracted due to periapical infection; two teeth restored with direct restorations experienced chipping and rough surfaces; one tooth restored with an endocrown required occlusal adjustment.	GCE provides smoother surface results and better anatomical shape. SFCR is easier to perform because it requires only one visit but more frequently needs retreatment.
14	60 teeth	Molar	Endocrowns made from three types of monolithic ceramic materials: Lithium disilicate (LD) Monolithic zirconia (Zr) Hybrid ceramic (HC)	Overall 2-year survival: 90.9% LD: 100% Zr: 82.4% (3 debondings) HC: 89.5% (2 fractures/chipping)	Zr: 3 debonded HC: 2 fractures	Endocrowns are a reliable restoration option for endodontically treated molars in the short term. Lithium disilicate demonstrates the best performance with minimal complications.

the other hand, ceramic materials such as lithium disilicate, feldspathic ceramic, and zirconia lithium silicate used in endocrowns demonstrate good clinical performance with high survival rates.^{18,22,23} Specifically, a study by El-Ma'aïta et al showed that lithium disilicate endocrowns have the fewest complications compared to other ceramic materials, making it the recommended material for endodontically treated molars.

Studies compared in this scoping review also highlight the importance of selecting the appropriate restoration technique. Indirect restorations such as crowns and endocrowns have advantages in occlusal load resistance, especially in posterior teeth. A research article by Vatankah et al demonstrated that indirect restorations like crowns and post-and-core crowns, combined with stable clinical conditions—such as good proximal contact and no voids in the obturation—can achieve success rates up to 70.5%.²⁴ Direct restorations tend to require more frequent reinterventions, as shown in the study by Bijelic-Donova et al, which indicated that direct composite restorations are easier to perform but are more prone to complications such as chipping and rough surfaces.²⁵

Glass fiber posts and cast metal posts are both widely used in endodontically treated teeth. A research article by Sarkis-Onofre et al reported that both types of posts showed similar failure rates over a five-year period, with an annual failure rate (AFR) of 1.2% for cast metal and 1.7% for glass fiber posts.²⁶ Root fractures and debonding were the most common complications observed in both groups. A study by Bergoli et al compared the cementation methods of fiber posts using conventional resin cement (CRC) and self-adhesive resin cement (SRC), with nearly identical survival rates of 88.9% (CRC) and 90.9% (SRC). This indicates that restoration success depends not only on the type of post but also on the cementation technique and materials used.²⁷

The success of restorations on endodontically treated teeth is measured by the absence of clinical and radiographic signs of failure, such as loss of retention, root fracture, or caries around the restoration.²⁸ The importance of proper coronal restoration, including the use of posts and cores as well as the presence of a ferrule, is a key factor in improving the long-term prognosis of endodontically treated teeth. Good restorations prevent micro-leakage and reinforce the tooth structure, thereby reducing the risk of failure.² Evaluation of tooth structure, selection of restoration techniques and materials, and the use of posts are important factors in determining the durability and success of post-endodontic restorations.

Full coverage crown (FCC) restorations, generally on anterior teeth, demonstrate a very high survival rate of 99.1%, outperforming direct resin composite (DRC) restorations, which have a survival rate of 90.4%. Direct resin composite (DRC) can still be a permanent option in cases without negative predisposing factors. This finding aligns with existing theories that anterior teeth can be effectively restored using direct composite, provided certain structural and functional conditions are met.²⁹ These conditions include the presence of 3–4 remaining cavity walls, bilateral posterior support, a favorable cervical root dentin thickness ratio ($\geq 1:1:1$), and the absence of parafunctional habits such as bruxism.¹⁹ Direct restorations are recommended for endodontically treated teeth that still have two or more intact coronal walls, as their prognosis and success rates are quite good for both anterior and posterior teeth.³⁰ When these criteria are fulfilled, direct composite restorations can be an effective long-term option, especially for anterior teeth that require aesthetic and conservative results.

Endocrowns are considered an appropriate option for restoring teeth that have undergone endodontic treatment, especially in cases with significant loss of tooth structure, limited interocclusal space, or short clinical crowns.³¹ Restorations on posterior teeth using resin nanoceramic and zirconia-reinforced lithium silicate endocrowns fabricated through CAD/CAM systems have also demonstrated survival rates above 80% over three years, with primary complications including debonding, restoration fractures, tooth fractures, and secondary caries.^{21,22} The durability levels observed in this research fall within a similar range as reported in a systematic review and meta-analysis, which documented that endocrowns exhibit excellent survival rates ranging from 86.9% to 99%.³² Indications for indirect restorations in endodontically treated teeth arise in cases with significant coronal structure loss where the remaining coronal walls are insufficient to support direct restorations. Under such conditions, indirect restorations such as full coverage crowns (FCC) or onlays are often required, sometimes necessitating the fabrication of a core build-up first to support the final restoration.³³

Loss of additional tooth structure has been shown to increase the risk of fracture in both composite resin restorations and crowns.¹⁹ The prognosis of post and core restorations following endodontic treatment is highly influenced by the

remaining tooth structure, with the presence of a ferrule being a key factor that provides stability and helps distribute stress evenly.³⁴ This aligns with the general consensus that a ferrule design, which provides coronal dentin above the preparation margin, can enhance fracture resistance in endodontically treated teeth. The ferrule effect is defined as a band of tooth structure measuring 1.5 to 2 mm in height that circumferentially surrounds the cervical portion of the tooth.³⁵ Therefore, a systematic method is required to evaluate the remaining tooth structure prior to restoration. The Tooth Restorability Index (TRI) was developed to assess the strategic value of the remaining dentin, using a scoring system from 0 to 3 across six sextants, with a maximum score of 18 per tooth.³⁶ Evaluation of post-endodontic tooth restorations is not limited to the Tooth Restorability Index (TRI) but can also be performed using the Restorative Difficulty Evaluation System of Endodontically Treated Teeth (RDES), which includes eight parameters. Each parameter is rated according to difficulty levels ranging from minor to moderate to high, and the scores for each parameter are visualized in a functional diagram arranged from the innermost to outermost sections. A comprehensive evaluation of this diagram allows for more individualized treatment planning and can assist in determining the prognosis of restorations on endodontically treated teeth.³⁷

Cases requiring posts have been studied, with research indicating that glass-fiber posts tend to provide better survival and success rates compared to metal posts, as well as reducing the risk of root fracture, although the differences are not always statistically significant.³⁸ Another study reported that, after five years, the Annual Failure Rate (AFR) for both types of posts was 1.5%. More specifically, cast metal posts showed an AFR of 1.2%, while glass fiber posts had an AFR of 1.7%. Although this difference was not statistically significant, these results suggest that cast metal posts have a slightly lower failure rate compared to glass fiber posts, with failures more commonly occurring in posterior teeth.²⁶ Fiber posts have a modulus of elasticity close to that of dentin, allowing for a more even stress distribution along the root and helping to reduce the risk of catastrophic root fractures.³⁹ This biomechanical compatibility also causes fiber posts to fail in more tolerable ways, such as fractures of the post or core restoration, rather than root fractures that could result in complete tooth loss.⁴⁰ Meta-analyses have also reported that fiber posts demonstrate higher medium-term survival rates (3 to 7 years) compared to metal posts, along with a lower risk of root fracture and debonding in many cases.⁴¹ Metal posts, particularly cast metal posts, have higher fracture resistance and tensile strength compared to fiber posts, making them very strong under load. However, the modulus of elasticity of metal posts is much higher than dentin's, which can cause stress concentration at the post-dentin interface, thus increasing the risk of root fractures. Metal posts also show higher rates of debonding due to this mismatch in elasticity.⁴² Clinical outcomes depend on various factors such as the remaining tooth structure, post design, cementation technique, occlusal load, and follow-up duration. Some studies emphasize the superior strength of metal posts in withstanding high occlusal loads,⁴³ while others highlight the biomechanical advantages of fiber posts in reducing root fractures and improving treatment longevity. However, the maximum stress levels on roots with glass fiber posts appear to be higher than those with metal posts, suggesting that fiber posts experiencing excessively high stress fail early, whereas those surviving the initial years exhibit clinically acceptable stress levels.⁴⁴ Several studies indicate that restoration failure in endodontically treated teeth with posts is influenced by the type and position of the tooth due to differences in the posts' modulus of elasticity, stress distribution, and direction of occlusal forces—anterior teeth, which experience non-axial forces, are more prone to fracture from stress concentration in the root, whereas posterior teeth, subjected to axial forces, have more evenly distributed stress.^{20,34,43} The primary use of posts is to retain the core buildup when the remaining tooth structure is insufficient to provide adequate structural support for the crown; posts do not reinforce the tooth itself.⁴⁵

Evaluation of the durability and clinical success of post use in endodontically treated teeth, both in initial restorations and in teeth that were previously restored, had the post removed, and received a new post before re-restoration, shows higher failure rates in the group undergoing post removal and re-cementation compared to teeth restored for the first time. When re-cementation failures are excluded, the Annual Failure Rate (AFR) decreases to 3.5% and 2.1%, respectively.⁴⁴ Loss of retention is the most common cause of failure in post decementation procedures, and repeated decementation and recementation processes can progressively weaken the tooth structure and reduce the long-term durability of the restoration.⁴⁶ Studies conducted on primary molars indicate that stainless steel crowns (SSC), bulk-fill composite, 3D-fabricated endocrowns, and prefabricated zirconia crowns are all generally well accepted, although SSCs show a slightly higher survival rate after one year.⁴⁷

Complications in restorations following endodontic treatment, as reported in the literature, are divided into two categories: biological and mechanical complications. Biological complications include secondary caries, periapical abnormalities such as periapical lesions and fistulas, periodontitis, endodontic failure, and even tooth extraction as the final outcome of treatment failure.³⁸ The individual patient factors that often predispose to these complications (eg, heavy occlusal load, parafunctional habits, periodontal status, and patient compliance) are frequently underreported or inconsistently documented in the available studies. The absence of this granular data prevents a more detailed analysis. More importantly, it casts doubt on whether the findings apply to everyday clinical practice, as we cannot predict how these restorations will perform under specific, real-world conditions.

Mechanical complications encompass restoration fractures, post debonding, and restoration decementation. Post-endodontic restorations are heavily influenced by the choice of post type, restorative material, and the condition of the remaining tooth structure prior to restoration. A study by Phengudom et al found that full coverage crowns exhibit the highest durability, particularly in anterior teeth, while direct resin composite can be an effective option when structural conditions are favorable.¹⁹ Endocrowns can be an excellent short-term restoration option for posterior teeth with significant structural loss, as stated in studies by Jalali et al²³ and El-Ma'aita et al.¹⁸ The presence of a ferrule and evaluation of tooth structure using indices such as the Tooth Restorability Index (TRI) and the Restorative Difficulty Evaluation System of Endodontically Treated Teeth (RDES) are critical in restoration planning. However, a retrospective clinical study by Xiang et al³⁴ investigating restorations on teeth without a complete ferrule showed that clinical outcomes for teeth with two or fewer ferrule walls restored with cast noble metal posts and cores, along with knife-edged crowns, can still yield good results with a high cumulative success probability over five years. Glass fiber posts generally offer advantages in reducing the risk of root fractures compared to metal posts, although the differences in failure rates are not always statistically significant, as reported by Sarkis-Onofre et al.²⁶ This is supported by the theory that glass fiber posts possess a modulus of elasticity similar to dentin, allowing for more even stress distribution laterally and to the root tissues, whereas metal posts have a higher modulus of elasticity, which tends to transfer stress directly to the apical end of the root.²⁹

The limitations of this scoping review include heterogeneity in study designs and sample populations used in the analyzed studies, which may lead to variation in results and diverse conclusions. The lack of long-term data and the absence of standardized criteria for evaluating restoration success also limit the generalizability of the findings. Variations in the remaining tooth structure, restoration techniques, materials used, as well as individual patient factors, further challenge the formulation of universal recommendations.

A significant drawback of the synthesis evidence is the short-term follow-up period in several included research, which undermines the credibility of long-term survival statistics for post-endodontic restorations. Early and mid-term results are useful, but definitive judgments cannot be made about genuine long-term durability because of inability to evaluate performance beyond 5–10 years. This underscores the imperative for forthcoming longitudinal investigations with prolonged monitoring durations to precisely evaluate lifelong restoration success.

Conclusion

The long-term success of post-endodontic restorations is multifactorial, depends on a thorough evaluation of remaining tooth structure and the subsequent selection of appropriate restorative materials and techniques. The combined evidence demonstrates a clear definitive of outcomes: indirect restorations consistently exhibited superior success (63–91.61%) and 3-year survival rates (82.7–99.1%) compared to direct restorations (43.2–86.7% success; 75–97.6% survival). Full-coverage crowns (FCCs) are the most reliable due to their enhanced fracture resistance, effective ferrule effect, and optimal stress distribution. Direct composite restorations remain a viable, conservative option but are primarily indicated only when adequate coronal structure (eg, at least two intact walls) remains, while indirect restorations such as FCCs, are needed with substantial coronal loss. Furthermore, the choice of post system is critical; glass-fiber posts significantly reduce the risk of root fracture compared to metal posts. Ultimately, achieving optimal clinical prognosis requires a personalized approach that focuses on creating ferrule effect and matching the restoration's biomechanical needs to the specific clinical conditions.

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