JOURNAL of ENDODONTICS and RESTORATIVE DENTISTRY
E-ISSN: 2980-3748

OPEN ACCESS
creative commons
CC BY NC
This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License

Review Article

Restorative Strategies Following Vital Pulp Therapy: Does the Coronal Restoration Determine Success? A Scoping Review

Esma Nur Güney[1*]

* Corresponding author

[1] Department of Restorative Dentistry, Faculty of Dentistry, Recep Tayyip Erdoğan University, Rize, Türkiye

ARTICLE HISTORY

Received: 07.09.2026
Accepted: 26.09.2026
Published online: 01.09.2026

KEYWORDS

Vital pulp therapy
Coronal restoration
Pulpotomy
Restorative materials
Clinical outcome
Restoration survival

CORRESPONDENCE

Esma Nur Güney
Department of Restorative Dentistry, Faculty of Dentistry, Recep Tayyip Erdoğan University
Rize, Türkiye
Email: esmanur.guney@erdogan.edu.tr

CLINICAL SIGNIFICANCE

Coronal restoration strategy may influence outcomes after vital pulp therapy. Careful selection of restorative materials, techniques, and timing, together with an effective coronal seal, may help support long-term tooth survival and clinical success

ABSTRACT

Background: Vital pulp therapy (VPT) aims to preserve pulp vitality, but long-term success may also depend on the definitive coronal restoration. The influence of restorative strategy on VPT outcomes remains unclear. This scoping review aimed to map randomized controlled clinical evidence on coronal restorative strategies used with VPT, focusing on restoration performance and its relationship with VPT success.

Methods: The final searches of PubMed/MEDLINE, Scopus, and the Web of Science Core Collection were completed on 1 August 2026. Randomized controlled clinical trials involving primary or permanent teeth treated with VPT and reporting at least one coronal restoration-related clinical outcome were included. The review was reported in accordance with the PRISMA Extension for Scoping Reviews (PRISMA-ScR); study selection and data extraction were performed by a single reviewer, and findings were synthesized descriptively.

Results: Thirteen randomized clinical studies met the eligibility criteria. Restorative approaches included stainless steel crowns (SSCs), glass-ionomer-based restorations, composite resin, Cention-N, amalgam, modified open-sandwich restorations, 3D-printed resin crowns, zirconia crowns, and lithium-disilicate endocrowns. SSCs showed favorable restorative performance in several primary molar studies, and some trials reported higher treatment survival or pulpotomy success compared with glass ionomer or amalgam. However, other studies found no significant differences in VPT success between restorative strategies. In several trials, restoration deterioration did not correspond with biological VPT failure, or the relationship was not directly analyzed.

Conclusion: Coronal restoration is an important component of VPT, but restorative performance and biological VPT success are distinct outcomes. Current evidence does not support a universally superior restorative strategy after VPT. Future trials should evaluate both outcomes separately using standardized criteria and longer follow-up.

1. Introduction

Vital pulp therapy (VPT) aims to preserve the vitality and function of the dental pulp while avoiding more invasive endodontic treatment. Depending on the clinical condition of the pulp, VPT may include indirect pulp treatment, direct pulp capping, partial pulpotomy, or full/coronal pulpotomy. Contemporary evidence supports favorable outcomes for these procedures in appropriately selected primary and permanent teeth, particularly with the use of calcium silicate-based materials.[1,2] Current evidence-based guidelines have therefore expanded the role of VPT in the management of deep caries and pulp exposure. The 2024 American Academy of Pediatric Dentistry (AAPD) guideline supports indirect pulp treatment and calcium silicate cement pulpotomy for vital primary teeth with deep caries,[1] while the more recent guideline for permanent teeth also recognizes several VPT procedures as treatment options according to pulpal diagnosis and clinical conditions.[2] Recent network meta-regression of randomized clinical trials in mature permanent teeth found higher clinical success with Biodentine and MTA than with calcium hydroxide for direct pulp capping, although substantial heterogeneity and low certainty of evidence precluded definitive claims of material superiority.[3] Clinical decision-making for direct pulp capping is also multifactorial; national and multinational surveys have shown that treatment choices vary according to exposure characteristics, patient age, caries-removal approach, and the preferred pulp-capping material.[4,5]

Successful VPT, however, depends on more than preservation and management of the pulp tissue itself. Following treatment, the remaining pulp must be protected from oral contamination by an adequate coronal restoration. The American Association of Endodontists includes restoration among the relevant clinical considerations for VPT, together with diagnosis, caries management, pulp management, and biomaterial placement.[6] The importance of the coronal restoration is biologically plausible, as deterioration of the restorative seal may permit bacterial penetration and potentially compromise the treated pulp.

Despite this rationale, the clinical influence of the definitive restoration on VPT outcome remains unclear. An umbrella review evaluating VPT in carious pulp-exposed permanent teeth reported that restorative material did not appear to have a significant influence on treatment outcome.[7] Similarly, a systematic review and meta-analysis of mature permanent molars found no statistically significant effect of different restorative materials on the success of coronal pulpotomy.[8] In primary teeth, VPT generally shows favorable outcomes, although success may also vary according to the VPT procedure, pulp treatment material, and other clinical factors.[9]

Randomized clinical trials also suggest that restoration performance and biological VPT success may not always follow the same pattern. Some studies have reported higher treatment survival with full-coverage restorations such as stainless steel crowns,[10,11] whereas others have shown similar clinical or radiographic VPT outcomes despite differences in marginal integrity, restoration deterioration, or restoration type.[12,13,14] For example, marginal deterioration of composite restorations has been reported without corresponding pulpotomy failure,[12] while other trials have demonstrated higher treatment failure with less durable restorative approaches.[10] This variability makes it difficult to determine the extent to which the definitive restoration itself contributes to VPT success and whether restorative performance and biological pulp survival should be considered separate outcomes.

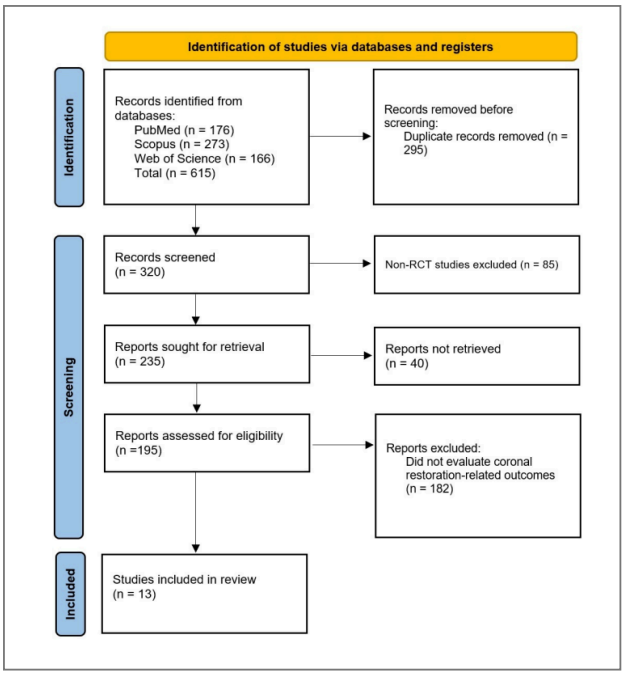

Figure 1. Flow diagram

Although prior umbrella reviews and meta-analyses provide higher-level syntheses of VPT success, they do not specifically map randomized trials in which coronal restoration performance is reported separately from biological pulp outcomes.[7–9] The present scoping review therefore addresses a complementary evidence-mapping question: which coronal restorative strategies have been evaluated in randomized clinical trials, how their clinical performance has been measured, and whether restoration-related findings have been directly linked to clinical or radiographic VPT success. By distinguishing these outcome domains across primary and permanent teeth, the review identifies reporting gaps and priorities for future restorative-VPT trials.

2. Materials and Methods

This scoping review was conducted and reported in accordance with the PRISMA Extension for Scoping Reviews (PRISMA-ScR).[15] It evaluated randomized controlled clinical trials reporting coronal restoration-related outcomes in teeth undergoing VPT. The review focused on the restorative approaches used in association with VPT, their clinical performance, and their relationship with clinical or radiographic VPT outcomes. The study-selection process was summarized in a PRISMA flow diagram.

2.1. Search strategy and study selection

The final electronic literature searches were completed on 1 August 2026 in PubMed/MEDLINE, Scopus, and the Web of Science Core Collection. The search strategy combined terms related to vital pulp therapy and pulp treatment procedures with terms related to coronal restorations, restorative materials, and restoration performance. Terms identifying randomized clinical trials were also included. The search syntax was adapted according to the requirements of each database. Only articles published in English were considered. The complete search strategies for all databases are provided in Table 1.

All records retrieved from the three databases were imported into EndNote X7.7. Duplicate records identified by EndNote X7.7 were removed first. The remaining records were then checked manually, and additional duplicates were removed when identified.

Study selection was performed by a single reviewer. Titles and abstracts were initially screened to identify randomized controlled clinical trials relevant to VPT. Full texts of potentially eligible studies were subsequently assessed according to the predefined eligibility criteria. During full-text assessment, particular attention was given to whether the studies reported clinical outcomes related to the coronal restoration. The study selection process is presented in Figure 1.

2.2. Eligibility criteria

Randomized controlled clinical trials conducted in human primary or permanent teeth were eligible for inclusion. Studies were included when VPT was performed in the entire study population or in at least one study group or subgroup and a coronal restoration was placed following treatment. Eligible VPT procedures included direct pulp capping, indirect pulp capping or indirect pulp treatment, partial pulpotomy, and coronal pulpotomy.

Studies were required to report at least one clinical outcome related to the coronal restoration, such as restoration survival or failure, retention, marginal integrity or adaptation, proximal contact, gingival health, secondary caries, discoloration, or restoration quality. Studies reporting clinical or radiographic VPT success in relation to the restorative approach were also eligible. No restrictions were applied regarding tooth type, VPT material, restorative material, or follow-up duration.

Only English-language articles were included. Non-randomized studies, in vitro or ex vivo studies, animal studies, reviews, meta-analyses, and studies that did not report coronal restoration-related outcomes were excluded.

2.3. Data extraction process

Data extraction was performed by a single reviewer using a data extraction table prepared in Microsoft Excel. For each included study, the following information was recorded: author and year of publication, study design and sample size, tooth type and VPT procedure, coronal restorative strategy, follow-up period, method used for restoration assessment, restoration-related results, and the reported effect of the restorative strategy on VPT success.

Restoration-related outcomes and VPT outcomes were recorded separately. Restoration-related outcomes included restoration survival or failure, retention, marginal integrity or adaptation, proximal contact, gingival health, secondary caries, discoloration, and overall restoration quality, when reported.

The effect on VPT success was recorded only when clinical or radiographic VPT outcomes were directly reported or analyzed in relation to the restorative strategy. When this relationship was not directly assessed in the original study, no association was inferred from restoration performance alone.

2.4. Data synthesis

Because the included studies differed in terms of tooth type, VPT procedure, pulp treatment material, restorative strategy, follow-up period, and outcome assessment methods, the findings were synthesized descriptively.

Restoration-related findings and VPT outcomes were summarized separately. Numerical data, including restoration or treatment success rates, survival rates, hazard ratios, confidence intervals, and *p* values, were reported as presented in the original studies when available. No meta-analysis was performed.

3. Results

3.1. Study selection

The database search identified a total of 615 records: 176 from PubMed, 273 from Scopus, and 166 from Web of Science. After removal of 295 duplicate records, 320 records remained for title and abstract screening. Of these, 85 non-randomized studies were excluded, and 235 reports were sought for full-text retrieval. Forty reports could not be retrieved, leaving 195 full-text articles for eligibility assessment. A further 182 reports were excluded because they did not evaluate coronal restoration-related outcomes. Finally, 13 randomized controlled clinical studies fulfilled the eligibility criteria and were included in the review (Figure 1).

3.2. Characteristics of the included studies

The 13 included randomized clinical studies were published between 2007 and 2026. Most studies involved primary molars, while a smaller number evaluated permanent teeth. The VPT procedures included direct and indirect pulp capping, indirect pulp treatment, partial pulpotomy,

Table 1. Database search strategies

Database	Search strategy
PubMed	#1: ("Pulpotomy"[MeSH Terms] OR "Dental Pulp Capping"[MeSH Terms] OR "vital pulp therapy" [Title/Abstract] OR "vital pulp treatment"[Title/Abstract] OR pulpotom*[Title/Abstract] OR "direct pulp capping"[Title/Abstract] OR "indirect pulp capping"[Title/Abstract] OR "indirect pulp treatment" [Title/Abstract])
	#2: ("coronal restoration"[Title/Abstract] OR "definitive restoration"[Title/Abstract] OR "final restoration" [Title/Abstract] OR "permanent restoration"[Title/Abstract] OR "temporary restoration"[Title/Abstract] OR "coronal seal"[Title/Abstract] OR "restoration timing"[Title/Abstract] OR "restorative material" [Title/Abstract] OR "restorative materials"[Title/Abstract] OR "marginal integrity"[Title/Abstract] OR "marginal adaptation"[Title/Abstract] OR "cuspal coverage"[Title/Abstract] OR "resin composite" [Title/Abstract] OR "composite resin"[Title/Abstract] OR "glass ionomer"[Title/Abstract] OR "stainless steel crown"[Title/Abstract])
	#3: ("Randomized Controlled Trial"[Publication Type] OR randomized[Title/Abstract] OR randomised[Title/Abstract] OR randomly[Title/Abstract] OR "split mouth"[Title/Abstract] OR "split-mouth" [Title/Abstract])
	#4: (animals[MeSH Terms] NOT humans[MeSH Terms])
	#5: ("in vitro"[Title/Abstract] OR "ex vivo"[Title/Abstract] OR "extracted teeth"[Title/Abstract] OR Review[Publication Type] OR Meta-Analysis[Publication Type])
	#1 AND #2 AND #3 NOT #4 NOT #5
Scopus	#1: TITLE-ABS-KEY("vital pulp therap*" OR "vital pulp treatment*" OR pulpotom* OR "pulp cap*" OR "direct pulp cap*" OR "indirect pulp cap*" OR "indirect pulp therap*" OR "indirect pulp treatment*" OR "Cvek pulpotom*")
	#2: TITLE-ABS-KEY(restor* OR filling* OR "coronal seal*" OR "marginal integrity" OR "marginal adaptation" OR "cuspal coverage" OR microleak* OR composite* OR compomer* OR amalgam* OR crown* OR onlay* OR overlay* OR adhesive* OR "glass ionomer*" OR "resin modified glass ionomer*" OR RMGIC)
	#3: TITLE-ABS-KEY(random* OR placebo* OR trial* OR allocat* OR "split mouth" OR "parallel group*")
	#4: DOCTYPE(ar)
	#1 AND #2 AND #3 AND #4
Web of Science	#1: TS=("vital pulp therap*" OR "vital pulp treatment*" OR pulpotom* OR "pulp cap*" OR "direct pulp cap*" OR "indirect pulp cap*" OR "indirect pulp therap*" OR "indirect pulp treatment*" OR "Cvek pulpotom*")
	#2: TS=(restor* OR filling* OR "coronal seal*" OR "marginal integrity" OR "marginal adaptation" OR "cuspal coverage" OR microleak* OR composite* OR compomer* OR amalgam* OR crown* OR onlay* OR overlay* OR adhesive* OR "glass ionomer*" OR "resin modified glass ionomer*" OR RMGIC)
	#3: TS=(random* OR placebo* OR trial* OR allocat* OR "split mouth" OR "parallel group*")
	#4: DT=(Article)
	#1 AND #2 AND #3 AND #4

and coronal pulpotomy. In one trial, pulpotomy was performed only in teeth in which pulp exposure occurred during caries removal.

A wide range of coronal restorative approaches was investigated. Full-coverage restorations included SSCs, preformed metal crowns, zirconia crowns, lithium-disilicate endocrowns, and 3D-printed resin crowns. Direct restorative approaches included resin composite, glass-ionomer or glass-hybrid restorations, Cention-N, amalgam, modified open-sandwich restorations, and direct composite celluloid crowns. The studies therefore differed not only in restorative material but also in restoration design, timing, and technique.

Follow-up periods ranged from 6 to 24 months. Restorations were commonly assessed using modified USPHS/Ryge criteria or related clinical criteria. Outcomes included restoration survival or failure, retention, marginal integrity or adaptation, proximal contact, gingival health, secondary caries, discoloration, and overall restoration quality. Clinical and radiographic VPT outcomes were also reported in several studies, although their relationship with the restorative strategy was not directly analyzed in all trials. The main characteristics and outcomes of the included studies are presented in Table 2.

3.3. Coronal restorative strategies and restoration-related outcomes

Full-coverage restorations, particularly SSCs, generally showed favorable restorative performance in pulpotomized primary molars. In comparisons with glass-ionomer-based restorations and amalgam, SSCs were associated with fewer restorative failures or higher survival in some studies. Abdelwahab et al. reported a higher risk of failure when glass ionomer was used instead of an SSC,[10] while Sönmez and Durutürk reported restoration failure rates of 2.4% for SSCs and 14.3% for amalgam.[11] In contrast, Atieh found similar 2-year survival between SSCs and modified open-sandwich restorations, with no significant differences in marginal integrity, proximal contact, occlusion, or recurrent caries.[13]

Comparisons between SSCs and tooth-colored restorative alternatives produced more variable findings. Hutcheson et al. observed greater marginal deterioration with multi-surface composite restorations than with SSCs, although the difference in intact restorations was not statistically significant; gray discoloration was also reported in 94% of composite-restored teeth.[12] Kaur et al. found no significant difference in marginal integrity between Cention-N and SSCs, although proximal contact was better maintained with SSCs and gingival health deteriorated more in the SSC group.[14] Ramazani and Mollaei Nezhad reported no clinical restoration failure when comparing SSC alone with a glass-ionomer build-up beneath the SSC.[16]

Esthetic crown alternatives also showed generally acceptable short-term clinical performance. Al-Halabi et al. found no significant difference in crown failure between 3D-printed resin crowns and direct composite celluloid crowns at 12 months, although differences were observed in marginal integrity and gingival health.[17] Khattab et al. similarly reported comparable performance between lithium-disilicate endocrowns and zirconia crowns, with marginal adaptation rates of 95.5% and 90.9%, respectively.[18]

In studies evaluating direct composite restorations, factors other than the restorative material were also examined. Franzon et al. reported higher 24-month composite restoration survival following total compared with partial caries removal (86% vs 66%; $p = 0.03$), with the lowest success observed in occlusoproximal restorations after partial caries removal.[19] Hashem et al. found no difference in composite restoration integrity when restorations were placed over Biodentine or Fuji IX, and similar results were obtained using both USPHS and FDI criteria.[20] Demir and Çehreli also reported that marginal integrity scores did not correspond closely with clinical and radiographic pulp-treatment outcomes.[21]

Restoration timing was specifically assessed by Rana et al. Following MTA pulpotomy in mature permanent molars, definitive composite restorations placed immediately or after a 24-hour interim

Table 2. General characteristics and coronal restorative strategies of included studies

Study	Design / sample	Tooth / VPT	Coronal strategy	Follow-up	Restoration assessment	Restoration result	Effect on VPT success
Abdelwahab et al., 2024	Parallel RCT; 64 teeth	Primary molars; pulpotomy (MTA / BC RRM-F)	SSC vs GI (EQUIA Forte HT)	1, 3, 6, 12 months	Clinical/radiographic; survival	SSC associated with higher overall survival than GI	GI significantly increased the risk of treatment failure compared with SSC
Al-Halabi et al., 2022	RCT; 50 teeth	Primary molars; post-pulpotomy	3D-printed resin crown vs celluloid composite crown	3, 6, 12 months	USPHS: retention, margin, gingiva	No significant crown-failure difference at 12 months; significant differences in gingival health and marginal integrity during follow-up	Not directly analyzed
Atieh, 2008	RCT; 160 restorations	Primary molars; post-pulp therapy	SSC vs modified open-sandwich	6, 12, 18, 24 months	Ryge criteria; survival	Similar 2-year survival: SSC 95.0% vs open-sandwich 92.5%; better gingival health with open-sandwich	Not separately analyzed
Demir & Çehreli, 2007	RCT; 100 teeth	Primary molars; DPC	Amalgam vs Dyract AP (by capping group)	3–24 months	Modified USPHS/Ryge; marginal integrity	Marginal integrity scores were not compatible with clinical/radiographic outcomes	No concordance between restoration marginal integrity and VPT clinical/radiographic outcome
Elsharkawy et al., 2026	Parallel RCT; 120 teeth	Primary molars; partial pulpotomy	PMC vs GIC	12 months	Modified Zurn–Seale; survival	No significant effect of restoration type on treatment survival	GI vs PMC: HR 1.79; 95% CI 0.82–3.92; p = 0.145; not significant
Franzon et al., 2015	RCT; 120 teeth	Primary molars; PCR/TCR; pulpotomy if exposed	Composite after PCR vs TCR	24 months	Modified USPHS; survival	Restoration survival: 66% with PCR vs 86% with TCR (p = 0.03)	VPT success was not directly analyzed; pulpotomized teeth showed 92% restoration survival (p = 0.09)
Hashem et al., 2019	RCT; 72 restorations	Permanent teeth; IPC (Biodentine vs Fuji IX)	Resin composite over Biodentine vs Fuji IX	12, 24 months	Modified USPHS + FDI	No difference in restoration integrity between Biodentine and Fuji IX groups at 12 and 24 months	Restoration-related effect on IPC success was not directly analyzed
Hutcheson et al., 2012	Split-mouth RCT; 40 pairs	Primary molars; MTA pulpotomy	Multi-surface composite vs SSC	6, 12 months	Clinical margins + C/R success	Composite showed fewer intact margins than SSC, but the difference was not significant	Clinical and radiographic VPT success was 100% in both restoration groups at 6 and 12 months
Kaur et al., 2023	RCT; 60 teeth	Primary molars; pulpotomy	Cention-N vs SSC	6, 9, 12 months	Margin, contact, gingiva, caries	Comparable marginal integrity; SSC showed better proximal contact and Cention-N better gingival health	No significant difference in clinical or radiographic pulpotomy success between groups
Khattab et al., 2022	Split-mouth RCT; 88 teeth	Primary 2nd molars; pulpotomy	LS2 endocrown vs zirconia crown	24 months	Modified USPHS + gingival indices	Comparable clinical performance; marginal adaptation 95.5% for endocrowns and 90.9% for zirconia crowns (p = 0.68)	VPT success was not directly analyzed
Ramazani & Nezhad, 2020	Split-mouth RCT; 47 pairs	Primary 2nd molars; formocresol pulpotomy	SSC vs GI + SSC	6 months	Clinical/radiographic success	No clinical failure in either restoration group	No significant difference in radiographic pulpotomy success (p = 0.198)
Rana et al., 2025	RCT; 30 teeth	Mature permanent molars; full MTA pulpotomy	Immediate vs 24-h delayed definitive composite	3, 6, 12 months	Modified USPHS	No significant difference in restoration quality between immediate and delayed restoration groups	100% treatment success in both groups at 12 months
Sönmez & Durutürk, 2010	RCT; 154 teeth	Primary molars; Ca(OH)2 pulpotomy	SSC vs amalgam	12 months	Restoration failure + VPT success	Restoration failure: 2.4% with SSC vs 14.3% with amalgam (p < 0.01)	Pulpotomy success: 79.9% with SSC vs 60% with amalgam (p < 0.01); restoration failure itself was not significantly associated with treatment prognosis

period showed comparable quality at 12 months, with no secondary caries or gross restoration fractures reported.[22]

3.4. Relationship between coronal restoration and VPT success

The effect of the coronal restorative strategy on VPT outcome was directly examined in only part of the included evidence.

Two studies reported significant differences in VPT outcomes according to restorative strategy. Abdelwahab et al. found that the use of glass ionomer instead of an SSC was significantly associated with an increased risk of treatment failure, and one-year clinical and radiographic survival was higher with SSC restoration.[10] Similarly, Sönmez and Durutürk reported higher pulpotomy success with SSCs than with amalgam (79.9% vs 60%; p < 0.01).[11] However, restoration failure itself was not significantly associated with pulpotomy prognosis in that study.[11]

Other trials did not demonstrate a significant difference in VPT success according to restorative strategy. Hutcheson et al. reported 100% clinical and radiographic success at 6 and 12 months with both composite and SSC restorations despite differences in marginal performance.[12] Kaur et al. likewise found no significant difference in clinical or radiographic pulpotomy success between Cention-N and SSCs, with 12-month radiographic success rates of 79.3% and 86.6%, respectively.[14] Ramazani and Mollaei Nezhad found no clinical failures in either restoration group and no significant difference in radiographic success between SSC and GI build-up plus SSC (p = 0.198).[16] Elsharkawy et al. also reported no significant effect of restoration type on treatment survival,[23] while Rana et al. achieved 100% clinical and radiographic success with both immediate and delayed definitive restoration.[22]

In several studies, restoration performance and VPT outcomes were both reported, but the relationship between them was not formally tested. Franzon et al. reported 92% restoration survival among pulpotomized teeth, but this represented a restorative outcome rather than direct evidence of an effect on VPT success.[19] Hashem et al. similarly reported comparable restoration integrity over Biodentine and Fuji IX without directly analyzing whether restoration performance affected indirect pulp-treatment success.[20] Atieh reported restorative failures during follow-up but no pulpotomy failures,[13] while Demir and Çehreli found that marginal integrity scores were not consistent with clinical and radiographic treatment outcomes.[21] Al-Halabi et al. and

Khattab et al. also primarily assessed restorative clinical performance rather than the independent effect of restoration type on VPT outcome.[17,18]

Overall, the relationship between coronal restoration and VPT success was evaluated differently across the included studies. Some studies reported significant differences in VPT outcomes according to restorative strategy, whereas others found no significant differences between groups. In several studies, restoration performance and VPT outcomes were reported separately without direct analysis of their relationship.

4. Discussion

This scoping review evaluated randomized clinical evidence on coronal restorative strategies used in association with VPT, with particular emphasis on whether restorative performance was reflected in clinical or radiographic VPT outcomes. The main finding was that these outcomes were not consistently linked. Although some trials reported higher VPT success or survival with specific restorative strategies, particularly SSCs in primary molars, other studies showed comparable VPT outcomes despite differences in restoration performance. In several trials, restoration quality and VPT success were reported separately without direct analysis of their relationship. Thus, the available evidence supports the importance of an adequate definitive restoration after VPT, but does not demonstrate that a single restorative strategy consistently provides superior biological outcomes across different clinical conditions.

4.1. Coronal restoration and VPT outcome

Maintenance of an adequate coronal seal is an important component of contemporary VPT. The American Association of Endodontists considers restoration together with diagnosis, caries management, pulp management, and biomaterial placement as part of VPT treatment planning.[6] However, the present findings suggest that the relationship between restoration and pulp survival cannot be explained by restoration quality alone.

This was evident in several included trials. Hutcheson et al. observed greater marginal deterioration in composite restorations than in SSCs, yet all pulpotomies remained clinically and radiographically successful during the 12-month follow-up.[12] Atieh reported several restorative failures without any pulpotomy failures during the observation period.[13] Demir and Çehreli similarly found that restoration marginal integrity scores did not correspond closely with clinical and radiographic pulp-treatment outcomes.[21] These findings indicate that restorative failure and biological VPT failure should not be regarded as interchangeable endpoints.

High-level evidence from permanent teeth supports this distinction. An umbrella review of VPT in carious pulp-exposed permanent teeth found that restorative material did not appear to affect treatment outcome, whereas potential prognostic factors such as preoperative pulp status and pulp-capping material showed inconsistent effects.[7] Similarly, a systematic review and meta-analysis of coronal and partial pulpotomy in mature permanent molars reported no significant effect of restorative material on coronal pulpotomy success in meta-regression analysis.[8]

4.2. Full-coverage restorations and stainless steel crowns

The clearest restorative pattern in the present review was observed for SSCs in pulpotomized primary molars. Abdelwahab et al. reported an increased risk of treatment failure when glass ionomer was used instead of an SSC as the final restoration, and one-year clinical and radiographic survival favored SSCs irrespective of the pulp-dressing material.[10] Sönmez and Durutürk also reported lower restoration failure and higher pulpotomy success with SSCs than with amalgam.[11]

These findings are clinically plausible because full-coronal coverage provides protection for extensively compromised primary molars. However, the advantage of SSCs was not uniform across all included trials. Hutcheson et al. reported equivalent biological outcomes for SSC and multi-surface composite restorations despite greater marginal deterioration of composite restorations.[12] Kaur et al. likewise found no significant difference in clinical or radiographic pulpotomy success between SSCs and Cention-N.[14]

Therefore, the available evidence does not support interpreting SSCs as an independent prerequisite for VPT success in every primary molar. Their advantage may be more evident in restoration longevity, protection of weakened remaining tooth structure, and multi-surface restorations than in biological pulp healing itself. This interpretation is consistent with higher-level evidence showing that VPT outcomes in primary teeth are also influenced by the treatment procedure and pulp medicament. An umbrella review of VPT in primary teeth reported high success across several vital pulp procedures but found insufficient evidence to identify one universally superior technique or material.[9]

4.3. Direct and esthetic restorative strategies

The evidence for tooth-colored and adhesive restorations was more heterogeneous. Composite resin, Cention-N, glass-ionomer-based restorations, modified open-sandwich restorations, 3D-printed resin crowns, zirconia crowns, and lithium-disilicate endocrowns were evaluated in different clinical settings and should therefore not be considered directly equivalent alternatives.

Several trials demonstrated acceptable short-term outcomes with tooth-colored restorations. Atieh reported similar 2-year survival for SSCs and modified open-sandwich restorations,[13] while Kaur et al. found no significant difference in VPT success between Cention-N and SSCs.[14] Al-Halabi et al. found no significant difference in crown failure between 3D-printed resin crowns and direct composite celluloid crowns, although differences were observed in marginal integrity and gingival health.[17]

These findings emphasize that restorative success after VPT is multidimensional. Retention alone does not capture marginal behavior, gingival response, esthetics, maintenance requirements, or protection of the remaining tooth structure. Franzon et al. further showed that restoration performance may be influenced by cavity-related factors: composite survival was lower after partial than total caries removal, and occlusoproximal restorations showed the poorest outcomes.[19] Thus, the clinical performance of a restoration may depend not only on the restorative material but also on cavity extent, remaining substrate, and restorative design. Beyond trial-level findings, a multinational survey of dentists from 13 countries also highlighted clinically relevant concerns associated with direct composite restorations, particularly polymerization shrinkage, marginal discoloration, and secondary caries.[24]

4.4. Restorative performance and biological success as separate outcomes

A central finding of this review is that restorative performance and biological VPT success represent related but distinct outcomes. A restoration may deteriorate, fracture, or require repair while the pulp remains clinically asymptomatic and radiographically healthy. Conversely, pulpal failure may occur because of biological or procedural factors even when the definitive restoration remains clinically acceptable.

This distinction is particularly relevant when interpreting individual studies. Franzon et al. reported 92% restoration survival among pulpotomized teeth, but this value represents restoration survival rather than VPT success.[19] Hashem et al. reported comparable integrity of composite restorations placed over Biodentine and Fuji IX, but did not directly test restoration performance as a determinant of indirect pulp-treatment success.[20] Similar separation between restorative and biological outcomes was evident in the studies by Al-Halabi et al. and Khattab et al.[17,18]

The broader literature provides a similar picture. In mature permanent molars, pooled evidence suggests high pulpotomy success while showing no significant effect of restorative material on coronal pulpotomy success.[8] Another umbrella review concluded that evidence regarding the effect of restorative materials on pulpotomy success remains inconclusive.[25] These findings reinforce the need to report restorative and biological endpoints separately in future VPT trials.

4.5. Clinical implications

The present findings support placement of a durable definitive restoration capable of maintaining an adequate coronal seal after VPT, but they do not support a universal restorative protocol for all VPT-treated teeth.

In extensively damaged primary molars, full-coronal coverage with SSCs appears to provide favorable restorative durability and structural protection. However, tooth-colored or adhesive alternatives may also provide acceptable outcomes in appropriately selected cases. Restorative selection should therefore take into account tooth type, amount of remaining tooth structure, cavity extent and number of surfaces involved, expected functional period, ability to obtain adequate isolation, esthetic requirements, and the underlying VPT procedure. Multinational survey data further suggest that preferences for direct composite restorations in pediatric patients vary with patient age and dentition, reinforcing the need for case-specific restorative selection rather than a uniform material choice.[26]

Importantly, follow-up should distinguish between restoration survival and pulp survival. A restoration requiring repair should not automatically be classified as VPT failure, while an apparently intact restoration does not by itself establish biological success. This distinction is particularly relevant for both clinical decision-making and the design of future trials. This distinction is also consistent with minimally invasive restorative practice, in which repair rather than complete replacement may be selected for defective direct restorations when clinically appropriate.[27]

4.6. Limitations and future research

Several limitations should be considered. Only 13 randomized clinical studies met the eligibility criteria, and substantial clinical and methodological heterogeneity was present. Studies differed in tooth type, VPT procedure, pulp-treatment material, restorative strategy, follow-up duration, and outcome assessment methods. These differences precluded quantitative synthesis and limited direct comparison among restorative approaches.

In addition, the relationship between coronal restoration and VPT outcome was not the primary research question in several trials. In some studies, restorative and biological outcomes were both reported but their association was not formally analyzed. Consequently, the current evidence is stronger for describing the clinical performance of restorations than for determining their independent effect on VPT success.

Follow-up ranged from 6 to 24 months, which may not adequately capture late restorative deterioration or delayed biological failure. Current umbrella reviews likewise emphasize the need for higher-quality clinical trials and longer follow-up when evaluating prognostic factors in VPT.[7,25]

At the review level, study selection and data extraction were conducted by a single reviewer, only English-language publications were included, and no formal risk-of-bias assessment was undertaken. These limitations should be considered when interpreting the findings.

Future randomized clinical trials should be designed specifically to evaluate the contribution of the definitive restoration to VPT outcome. Restorative and biological endpoints should be predefined and reported separately, while the relationship between them should also be formally analyzed. Standardized restoration-assessment criteria, clearly defined clinical and radiographic VPT-success criteria, longer follow-up periods, and adjustment for relevant variables such as pulpal diagnosis, VPT procedure, tooth type, cavity extent, number of restored surfaces, pulp-capping material, and restoration type would allow the independent contribution of the coronal restoration to be determined more reliably.

5. Conclusion

The available randomized clinical evidence indicates that coronal restoration is an important component of VPT, although restorative performance and biological VPT success do not always follow the same pattern. Full-coverage restorations, particularly SSCs in primary molars, showed favorable restorative outcomes in several studies; however, their superiority in terms of VPT success was not consistently demonstrated across the included trials. Tooth-colored and adhesive restorative approaches also provided acceptable outcomes in selected clinical conditions. Overall, the current evidence does not support a single restorative strategy as universally superior following VPT. Future randomized clinical trials should evaluate restorative and biological outcomes separately and directly investigate their relationship using standardized outcome criteria and longer follow-up periods.

References

1. Coll JA, Dhar V, Chen CY, Crystal YO, Guelmann M, Marghalani AA, et al. Use of vital pulp therapies in primary teeth 2024. *Pediatr Dent*. 2024;46(1):13-26.
2. Coll JA, Dhar V, Guelmann M, Crystal YO, Chen CY, Marghalani AA, et al. Guideline for use of vital pulp therapy in permanent teeth. *Pediatr Dent*. 2025;47(5):299-311.
3. Hatipoğlu Ö, Tekingür EV, Hatipoğlu FP. Comparative clinical success of direct pulp capping materials: a network meta-regression of randomized clinical trials. *J Dent*. 2025;162:106073. doi:10.1016/j.jdent.2025.106073.
4. Hatipoğlu Ö. Factors affecting the decision-making of direct pulp capping procedures amongst Turkish dental practitioners. *Eur Endod J*. 2018;3(3):167-173. doi:10.14744/eej.2018.09609.
5. Hatipoğlu Ö, Hatipoğlu FP, Javed MQ, Nijakowski K, Taha N, El-Saaidi C, et al. Factors affecting the decision-making of direct pulp capping procedures among dental practitioners: a multinational survey from 16 countries with meta-analysis. *J Endod*. 2023;49(6):675-685. doi:10.1016/j.joen.2023.04.005.
6. AAE Position Statement on Vital Pulp Therapy. *J Endod*. 2021;47(9):1340-1344. doi:10.1016/j.joen.2021.07.015.
7. Leong DJX, Yap AU. Vital pulp therapy in carious pulp-exposed permanent teeth: an umbrella review. *Clin Oral Investig*. 2021;25(12):6743-6756. doi:10.1007/s00784-021-03960-2.
8. Lin GSS, Hisham ARB, Cher CY, Cheah KK, Nik Abdul Ghani NR, Noorani TY. Success rates of coronal and partial pulpotomies in mature permanent molars: a systematic review and single-arm meta-analysis. *Quintessence Int*. 2021;52(3):196-208. doi:10.3290/j.qi.b912685.
9. Gizani S, Seremidi K, Stratigaki E, Tong HJ, Duggal M, Kloukos D. Vital pulp therapy in primary teeth with deep caries: an umbrella review. *Pediatr Dent*. 2021;43(6):426-437.
10. Abdelwahab DH, Kabil NS, Badran AS, Darwish D, Abd El Geleel OM. One-year radiographic and clinical performance of bioactive materials in primary molar pulpotomy: a randomized controlled trial. *J Dent*. 2024;143:104864. doi:10.1016/j.jdent.2024.104864.
11. Sonmez D, Duruturk L. Success rate of calcium hydroxide pulpotomy in primary molars restored with amalgam and stainless steel crowns. *Br Dent J*. 2010;208(9):E18. doi:10.1038/sj.bdj.2010.446.
12. Hutcheson C, Seale NS, McWhorter A, Kerins C, Wright J. Multi-surface composite vs stainless steel crown restorations after mineral trioxide aggregate pulpotomy: a randomized controlled trial. *Pediatr Dent*. 2012;34(7):460-467.
13. Atieh M. Stainless steel crown versus modified open-sandwich restorations for primary molars: a 2-year randomized clinical trial. *Int J Paediatr Dent*. 2008;18(5):325-332. doi:10.1111/j.1365-263X.2007.00900.x.
14. Kaur K, Suneja B, Jodhka S, Saini RS, Chaturvedi S, Bavabeedu SS, et al. Comparison between restorative materials for pulpotomised deciduous molars: a randomized clinical study. *Children (Basel)*. 2023;10(2):284. doi:10.3390/children10020284.

15. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. *Ann Intern Med*. 2018;169(7):467-473. doi:10.7326/M18-0850.

16. Ramazani N, Nezhad SM. Clinical and radiographic success rate of pulp treated primary molars restored with stainless steel crown (SSC) versus glass ionomer-SSC: a double-blind randomized clinical trial. *Iran J Pediatr*. 2020;30(1):e97311. doi:10.5812/ijp.97311.

17. Al-Halabi MN, Bshara N, Abou Nassar J, Comisi JC, Alawa L. Comparative assessment of novel 3D printed resin crowns versus direct celluloid crowns in restoring pulp treated primary molars. *J Evid Based Dent Pract*. 2022;22(1):101664. doi:10.1016/j.jebdp.2021.101664.

18. Khattab NMA, El Makawi YMF, Elheeny AAH. Clinical evaluation of CAD/CAM ceramic endocrown versus prefabricated zirconia crown in the restoration of pulpotomized primary molars: a two-year split-mouth randomized controlled trial. *Eur J Dent*. 2022;16(3):627-636. doi:10.1055/s-0041-1736417.

19. Franzon R, Opdam NJ, Guimaraes LF, Demarco FF, Casagrande L, Haas AN, et al. Randomized controlled clinical trial of the 24-month survival of composite resin restorations after one-step incomplete and complete excavation on primary teeth. *J Dent*. 2015;43(10):1235-1241. doi:10.1016/j.jdent.2015.07.011.

20. Hashem D, Mannocci F, Patel S, Manoharan A, Watson TF, Banerjee A. Evaluation of the efficacy of calcium silicate vs glass ionomer cement indirect pulp capping and restoration assessment criteria: a randomised controlled clinical trial—2-year results. *Clin Oral Investig*. 2019;23(4):1931-1939. doi:10.1007/s00784-018-2638-0.

21. Demir T, Cehreli ZC. Clinical and radiographic evaluation of adhesive pulp capping in primary molars following hemostasis with 1.25% sodium hypochlorite: 2-year results. *Am J Dent*. 2007;20(3):182-188.

22. Rana AS, Sharma S, Kumar V, Chawla A, Logani A. Evaluation of one- versus two-step technique on the outcome of mineral trioxide aggregate pulpotomy in mature permanent teeth with symptomatic irreversible pulpitis. *J Conserv Dent Endod*. 2025;28(2):161-167. doi:10.4103/jcde.jcde_819_24.

23. Elsharkawy AM, Kabil NS, Metwalli N, Abd El Geleel O. Clinical and radiographic outcomes of partial pulpotomy procedure in primary molars utilising different capping materials and different sealing methods: a randomised clinical trial. *Eur Arch Paediatr Dent*. 2026. doi:10.1007/s40368-026-01254-3.

24. Lehmann A, Nijakowski K, Jankowski J, Donnermeyer D, Palma PJ, Drobac M, et al. Awareness of possible complications associated with direct composite restorations: a multinational survey among dentists from 13 countries with meta-analysis. *J Dent*. 2024;145:105009. doi:10.1016/j.jdent.2024.105009.

25. Lin GSS, Yew YQ, Lee HY, Low T, Pillai MPM, Laer TS, Wafa SWWSST. Is pulpotomy a promising modality in treating permanent teeth? An umbrella review. *Odontology*. 2022;110(2):393-409. doi:10.1007/s10266-021-00661-w.

26. Nijakowski K, Jankowski J, Drobac M, Kopbayeva M, Javed MQ, Bekjanova O, et al. Choice preferences of direct composite restorations in paediatric patients: a multinational survey from 13 countries. *Int J Paediatr Dent*. 2025;35:1012-1017. doi:10.1111/ipd.13317.

27. Hatipoğlu Ö, Martins JFB, Karobari MI, Taha N, Aldhelai TA, Ayyad DM, et al. Repair versus replacement of defective direct dental restorations: a multinational cross-sectional study with meta-analysis. *J Dent*. 2024;148:105096. doi:10.1016/j.jdent.2024.105096.

Declarations

Authorship & CRediT Statement

Esma Nur Güney: Conceptualization, Methodology, Formal analysis, Data curation, Writing – original draft, Writing – review & editing, Visualization, Project administration.

Conflict of Interest

The authors declare no conflict of interest.

Ethics Approval & Consent

Not applicable.

Data Availability

Data are included in this article and/or its supplementary material.

AI Declaration

ChatGPT (OpenAI) was used solely for language editing and improving the clarity and readability of the manuscript.

Funding Statement

No external funding.

How to cite: Güney EN. Restorative Strategies Following Vital Pulp Therapy: Does the Coronal Restoration Determine Success? A Scoping Review. *J Endod Restor Dent. 2026; 4(2):58-64*. doi: 10.71350/endores.2026.010