



## Review Article

## Influence of post placement on single unit full coverage restorations in endodontically treated teeth - A systematic review

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## ABSTRACT

**Aim:** The aim of this systematic review is to analyse the effect of post placement on single unit full coverage restorations in endodontically treated teeth.

**Materials and Methods:** Published articles related to post placement on single unit full coverage restorations in endodontically treated teeth which includes original research and literature review from databases such as PubMed, Scopus, Cochrane, Ovid Medline etc., were taken into the study for review. Articles from 2002 to 2023 were included. Two authors independently extracted data and assessed the quality of the selected studies.

**Results:** Six studies involving 991 patients were analyzed in this systematic review, which comprised 229 anterior and 910 posterior teeth. The risk of failure or the survival rate was associated with the teeth that had no post placement when the number of coronal walls was less than two. When three or four coronal walls present the success or survival rate seem to be higher with the post placement.

**Conclusions:** Post-retained crowns are better, post-free crowns may be considered when three or four tooth walls are still present, whereas teeth with one or two remaining walls may be better candidates for post-retained crowns. When the ferrule is absent, prosthetic components may be explored

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### 1. Introduction

Significant loss of tooth structure occurs during the removal of caries, previous restorations, access cavity preparations and trauma during the endodontic treatment.<sup>1</sup> This can in turn compromise the tooth to withstand the functional loads.<sup>2</sup> Excessive loss of tooth structure during the endodontic treatment results in very minimal tooth structure and inadequate ferrule leading to reduction in the clinical crown height which will compromise the retention of the post endodontic restoration.<sup>3</sup> So in most of the cases post placement is suggested to retain the core for the better

prognosis of the root filled teeth.<sup>4</sup>

But so many studies suggested that the radicular dentin removed during the post space preparation will further compromise the prognosis. The success of post-endodontic restorations is largely dependent on the degree of tooth structure loss and the presence or absence of a 2 mm circumferential ferrule.<sup>5</sup>

When making decisions in clinical dentistry, it is best to follow the evidence-based practice. In order to provide clinical recommendations based on evidence, it entails using trustworthy and verified methodologies to carefully examine all published data in a particular clinical setting.

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Considering the endodontically treated teeth, the ideal approach to treatment planning is to look at the success and failure rates of each treatment strategy based on the risk factors. Finding published studies on the success, survival or failure rate of traditional single-unit restorations with and without post placement in permanent dentition is the primary goal of this systematic review.

## 2. Materials and Methods

This study followed the PRISMA declaration, the criteria of the Cochrane Collaboration, and the quality requirements put forth by AMSTAR for treatments while conducting its systematic review Liberati et al. 2009,<sup>5</sup> Moher et al. 2009;<sup>6</sup> Higgins & Green 2012;<sup>7</sup> Shea et al. 2009.<sup>8</sup> The systematic review was registered in the PROSPERO database: (CRD42023416326). By encouraging openness Faggion 2013,<sup>9</sup> quality approach Faggion 2010,<sup>10</sup> and improved reporting Faggion 2012,<sup>11</sup> this was done to reduce the possibility of bias in the review process.

### 2.1. Search strategy

Published articles related to post placement on single unit full coverage restorations in endodontically treated teeth which includes original research and literature review from databases such as PubMed, Scopus, Cochrane, Ovid Medline etc were taken into the study for review. Articles published from 2002 to 2023 were included. We also searched Google Scholar to get a better sense of the grey literature.

### 2.2. Inclusion criteria

For this systematic review, both RCTs and observational studies were considered for answering the research question as suggested in the literature Peinemann et al. 2013.<sup>12</sup> Reports were included if they met the following inclusion criteria that were defined a priori in the protocol:

1. Population: Anterior and posterior teeth of permanent dentition
2. Intervention: Full coverage crowns with or without post and core.
3. Comparison: Comparing full coverage crowns with and without posts determines the success survival or failure rate.
4. Outcome: The number and/or percentage of restorations of interest that survived, succeeded or failed clinically or radiographically. Success: when the post and the final post endodontic restoration remained in situ without any clinical or radiographic signs of technical failures. Survival rate: If the post is still intact in function at the last dental visit without any clinical or radiographic signs of failure (eg. Root fracture or post fracture) Failure: Restorations that

were deemed clinically inappropriate necessitated either their replacement or repair.

5. Time: A mean follow up of 3- 10 years.

All research participants were required to provide the following information: the total number of restored tooth surfaces or the number of residual coronal walls prior to restoration; whether or not a post and core were used; and whether or not a full coverage crown was used.

### 2.3. Exclusion criteria

1. Title and abstract do not mention planned restoration.
2. Periodontally compromised teeth.
3. No antagonist teeth.
4. Fixed restorations to partial denture abutments.

### 2.4. Data extraction

Specifically designed electronic spreadsheet.

1. Name of author.
2. Year of publication.
3. Country of trial.
4. Study design.
5. Mean follow up.
6. Characteristics of patients (Age ,Gender, clinical or dental school Setting).
7. Type of restoration.
8. Materials used in study.
9. Tooth location (Anteriors, Premolar, molar, maxillary , mandibular).

### 2.5. Mesh terms

1. Full coverage restorations
2. Treatment outcome
3. Randomized controlled trial
4. Remaining tooth structure
5. Post endodontic restoration
6. Post and core

### 2.6. Study selection

After the elimination of duplicates, the titles and abstracts were reviewed by two writers separately. The remaining studies were reviewed in their entirety, and papers that met the qualifying criteria were chosen. Disputes that arose among the reviewers were settled by a third author.

### 2.7. Exclusion criteria

Reports that did not relate to the inclusion criteria's search phrases, non-human research conducted in vitro, or did not specify the title's intended restoration type or abstract; failed to disclose the relevant conclusion; did not distinguish between data on anterior, posterior, wisdom,

or primary dentition; included comprised periodontal dentition; documented indirect restorations (such inlays and onlays) other than complete crowns; cases that were reported without antagonist teeth; contained restorations supported by implants; had <10 participants completing the research; placed restorations on abutments of partial dentures (i.e. FPD/RPD); and if 25% or more of the included subjects were bruxers.

## 2.8. Data extraction

Based on their independent research, two writers culled the following data from the studies: authors, publication dates, study designs, mean observation periods, post types, number of surviving walls, restorative material types, and results. As far as the retrieved studies were concerned, the third author settled any disputes.

## 2.9. Quality assessment

A modified version of the Cochrane risk of bias instrument was used to evaluate the included studies' quality Robertson C et al. 2014,<sup>13</sup> According to published guidelines A lundh et al., 2008,<sup>14</sup> two independent researchers who were both dentists and well-versed in the subject matter and details of the Cochrane risk of bias tool examined the following biases: selection bias, detection bias, attrition bias, reporting bias, and others. A third author was involved in resolving any conflicts that arose.

## 3. Results

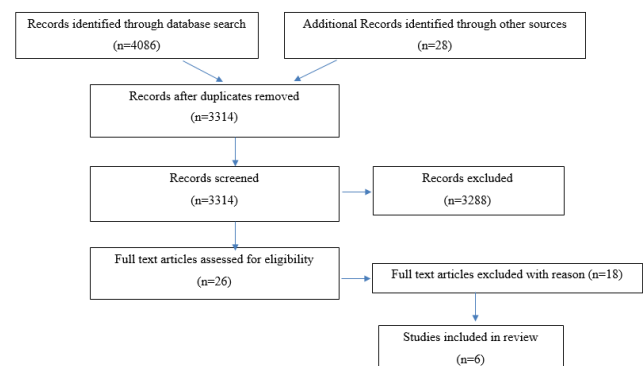
The first database search yielded 4086 references. A total of 26 complete texts were considered for eligibility after titles and abstracts were screened and duplicates were removed (Figure 1). Information acquired from the six papers that were included in the analysis after full text reviewing is shown in Table 1.

Study by Mannocci et al. (2002)<sup>15</sup> revealed that at 1-year recall, no failure was reported. The only failure modes observed at 2 and 3 years were post decementations and the presence of marginal gap formation. The observed failures were post decementation (1 from Group 1 and 2 from Group 2) and marginal gaps as revealed by radiographs (3 from Group 1 and 1 from Group 2). There was no difference between the number of post decementations or marginal gaps between the 2 groups (95% confidence intervals, -9.7 to 16.2 and -17.8 to 9.27). Bitter k et al (2009)<sup>16</sup> in his study showed that after a mean observation period of 32.4 (13.7) months in subgroups no post, the failure rates were 10%, whereas in subgroups post, failure rates of 7% were observed. In no-wall group post placement significantly affected the time to failure of total restorations. Teeth without post retention revealed a significantly higher failure rate (31%) compared with teeth restored with post retention (7%).

Ferrari et al (2012)<sup>17</sup> in his study revealed that the least satisfactory clinical performance was demonstrated by teeth restored without any intraradicular retention (Subgroup A: success rate 42.1%, survival rate 85.9%). Success rate with post [4 coronal walls -100% (BOTH LP and ES); 3 coronal walls -94.1%(LP), 76.5%(ES); 2 coronal walls -88.9%(LP), 66.7%(ES); 1 coronal wall -77.8%(LP), 50.0%(ES), Ferrule present -61.1%,28.5%-Ferrule absent,38.9%(LP), 31.6%(ES)] Success rate without post [4 coronal walls-100%, 3 coronal walls-66.7%, 2 coronal walls- 52.9%, 1 coronal wall-29.4%; Ferrule present -11.1%; Ferrule absent-0%].

Study by K A Guldener et al (2017)<sup>18</sup> showed that the overall tooth survival rate was 89.6%. The survival rate was 94.3% for teeth with a fiber post and 76.3% for teeth without a post, respectively. 106 teeth (73.6%) were restored with a fiber post and either a single-unit crown (SUC) or a direct composite restoration (DCR). Teeth without a post (n=38, 26.4%) were restored either with an SUC or a DCR. Teeth restored with a fiber post yielded a statistically significantly (P<.001) higher survival rate compared with teeth restored without a post, irrespective of the restoration type.

Cloet et al(2017)<sup>19</sup> in his study showed that of the restorations, 49.3%(n=101) were cast gold alloy based post and cores, 32.0% (n=65) were prefabricated glass fiber posts with composite cores, 12.8% (n=26) were custom made glass fiber posts with composite cores, and 5.9% (n=13) were composite cores without posts. Success rate with Prefabricated wrought posts-86.9%, Prefabricated glass fiber posts- 81.6%, Custom made glass fiber post -87.8%; Success rate without posts- 83.3%. Study by E.J. Kramer (2019)<sup>20</sup> in his study had 195 patients with a mean (95% CI) age of 54 (52 - 56) years and with 195 coronal restorations in ETT were included. Failure rate with posts [On anterior -55%, On premolars-24%; Based on proximal contacts (28%) 0-50%, 1-42%, 2-30%; Based on post material 1(28%) {Glass fiber-31%, Metallic-25%, Titanium (threaded)-30%, Titanium (stepped) 24%, On full crown-10%]



**Figure 1:** Prisma flow chart of study selection process

**Table 1:** Summary of the included studies

Study	Journal	Study design	Mean observation period	Patients at baseline	No and type of restorations at baseline	Remaining no.of wall	Type of post	Type of restoration material	no of teeth with/without post	Results
<b>Mannocci et al. (2002)</b> <sup>15</sup>	Journal of Prosthetic Dentistry	Randomized control trial	3 years	117	Posterior (maxillary and mandibular premolars)	3	GROUP I – composite Resins with post and core GROUP II- Composite core followed by metal ceramic crown Fiber post	Metal ceramic crowns with post and core	GROUP I -60 GROUP II-57	There was no difference between the number of post decementations or marginal gaps between the 2 groups (95% confidence intervals, -9.7 to 16.2 and -17.8 to 9.27). The Newman-Kenls multfple compar ison test (at the 0.05 significance level) I was used to evaluate statistical differences between the means of the results obtained. Kaplan meier analysis were used to evaluate failure rates of 7% were observed (P = .318). In no-wall group post placement significantly affected the time to failure of total restorations (P =.029, log-rank test) Failure rate without post was 31%.
<b>Bitter k et al (2009)</b> <sup>16</sup>	JOE	Randomized control trial	32.4 months	90	120 (25 anterior 95 posterior)	1	Fiber post	Crowns with post and core/ direct composite	With post-60 (anterior-15 Posterior-45) Without post-60 (anterior-10 Posterior-50)	

*Continued on next page*

*Table 1 continued*

<b>Ferrari et al (2012)</b> <sup>17</sup>	J DENT RES	Randomized control trial	6 years	345	360 premolars	0-4	customized (ES) or prefabricated (LP) post	Metal ceramic crown with post and core	With post – 229 Without post - 115	Cox regression analysis revealed that fiber post retention significantly improved tooth survival (p < 0.001). Failure risk was lower in teeth restored with prefabricated (p = 0.001) than with customized posts (p = 0.009). Teeth with one (p = 0.004), two (p < 0.001), and three coronal walls (p < 0.001) had significantly lower failure risks than those without ferrule. Similar failure risks existed for teeth without coronal walls, regardless of the presence/absence of ferrule (p = 0.151)
<b>K A Guldener et al (2017)</b> <sup>18</sup>	JOE	Randomized control trial	8.8+/- 2.3 years	100	144 (38 anterior 106 posterior)	0(n=40) 1(n=39) 2 and more(n=41)	Fiber post	Crowns with post and core / direct composite	With post- 106 (anterior- 27 Posterior- 79) Without post-38 (anterior- 11 Posterior- 27)	Chi-square and Fisher exact tests were applied to detect statistically significant differences between groups. The overall tooth survival rate was 89.6% after a mean observation time of 8.8+/- 2.3years. The survival rate of teeth with a fiber post amounted to 94.3%, and for teeth without a post, it was 76.3% (P < .001). The main reason for tooth loss was root fracture (9.7%). No loss of post retention was observed.

*Continued on next page*

Table 1 continued

<b>Cloet et al(2017)<sup>19</sup></b>	The international journal of prosthodontics	Controlled clinical trial	5 years	144	205 restorations Anterior – 68 Posterior- 135	0-1 dentinal walls (post) Atleast 2 dentinal walls $\geq 2\text{mm}$	CONTROL GROUP Prefabricated wrought post and cast core GROUP I- Prefabricated glass fiber post GROUP II-Custom made glass fiber post GROUP III-Direct composite buildup without post	All ceramic crowns with post and core All ceramic crowns without post	With post(192) Anterior -68 Posterior – 123 Without post (12) Posterior- 12	Success rate was evaluated using Kaplan meier analysis. At five years success and survival probabilities were 85.2% and 91.5%. P= .85 for success group and P= .57 for survival group . (With post Prefabricated wrought posts-86.9% Prefabricated glass fiber posts- 81.6% Custom made glass fiber post -87.8% Success rate without posts- 83.3%)
<b>E.J. Kramer (2019)<sup>20</sup></b>	International Endodontic Journal	Randomized control trial	6.5years	195	(Anterior 98) (Posterior –97 Premolars)	0-2 proximal contacts present	Glass fiber Metallic Titanium (threaded) Titanium (stepped)	Crown with post and core	With post -195 teeth	Kaplan-Meier Survival Graphs and Log-rank Test were used for analyzing Failure rate with posts On anterior -55% On premolars-24% Multivariate Cox regression analysis the factor dentist was used as a cluster-specific random effect (dependent model) Based on proximal contacts (28%) 0-50% 1-42% 2- 30% Based on post material (28%) Glass fiber-31% Metallic-25% Titanium (threaded)-30% Titanium (stepped) 24% On full crown 10%

#### 4. Discussion

Prognosis of endodontically treated teeth depends upon various factors like biomechanical preparation, increased or inappropriate usage of irrigants and intracanal medicaments and last but not the least the inappropriate placement of post endodontic restoration. Often we are in a dilemma whether to place a post or not to place a post after the endodontic treatment. There are so many clinical trials and invitro studies on evaluating the performance of different types of posts but their significance in the prognosis or reducing the failure rates in root filled teeth is very less. Thus, the purpose of this systematic review is to gather clinical data about the effects of post-retained and post-free full coverage restorations on teeth that have had endodontic treatment.

More than 991 patients who satisfied the inclusion criteria at baseline were analyzed in this systematic review, which comprised six trials totaling 229 anterior restorations and 910 posterior restorations. Additionally, the included studies had follow-up periods ranging from three to ten years.

Based on the research that were considered, it seems that placing posts is unnecessary when there are four remaining walls and that complete crowns are the optimum course of therapy. An increase in coronal tooth structure was associated with an improvement in the success rate. Research conducted by Mannocci et al.,<sup>15</sup> Ferrari et al.,<sup>17</sup> and K. A. Guldener et al.,<sup>18</sup> on teeth with three remaining walls and complete crowns has not shown an improved success rate when installing a post at a 9-year follow-up.

According to research cited by E.J. Kramer,<sup>20</sup> Cloet et al.,<sup>19</sup> and Ferrari et al.,<sup>17</sup> the success rate of teeth treated with endodontics seems to be higher after seven years when restored with two remaining walls, a post is placed, and a complete crown is placed. The two remaining walls could not be enough to support the teeth and prevent crowns from falling out or other problems that might cause catastrophic or relative failures. It is recommended to use a post and then restore the whole covering when there are just two walls remaining.

Teeth with one or less than one remaining wall had a higher success rate when placing a post followed by full crown when compared with no posts with crown Bitter k et al 2009,<sup>16</sup> Ferrari et al 2012,<sup>17</sup> Cloet et al 2017,<sup>19</sup> Guldener et al 2017,<sup>18</sup> E J Kramer 2019.<sup>20</sup> Also Ferrari et al. (2012)<sup>18</sup> concluded that teeth with crowns that had ferrule showed significant lower failure rates when compared with those crowns retained by posts which did not had the ferrule effect . In that scenario dental implants may be considered. Therefore teeth with one or less than one remaining wall with ferrule effect recommend the placement of post followed by full coverage restoration.

From three to ten years was the span of the follow-up duration for all the primary studies that were included. Both the front and back teeth were examined in the

included studies. In addition, they lacked an abutment for a permanent or partial denture and had oppositional teeth. Studies that were considered had the flaw of focusing just on the total number of dentinal walls and ignoring their thickness and height. Furthermore, the sample sizes of the different groups are not appropriately distributed in these investigations. Clearly, the failure rates will be higher in the group with a larger sample size; for instance, if there are 20 teeth in the anterior group and 100 teeth in the posterior group. Thus, it is possible that this review's conclusions are not applicable to a broader context.

Patients' quality of life and healthcare expenditures may both be improved by providing them with the best possible post endodontic restoration Grol & Grimshaw 2003,<sup>21</sup> Darmstadt et al. 2005.<sup>22</sup> When it comes to recommending a particular treatment choice, we find this systematic review to be lacking in quality. Post implantation requires additional tooth structure to be removed, increasing the risk of fracture and failure Balevi 2013.<sup>23</sup> To conserve more coronal tooth structure, conservative access cavities should be constructed.

As a result, studies should be planned for the future to include bigger samples, appropriate treatment allocation, and long-term prospective data. Treatment implementation should occur in a variety of contexts (e.g., with students and physicians from both public and private practices), and failure should be reported using accurate and repeatable evaluations (e.g., USPHS evaluation methodologies).

#### 5. Conclusion

A better prognosis for teeth treated endodontically is associated with a larger quantity of residual tooth structure. Therefore, the amount of coronal tooth structure that is preserved during conservative access cavity preparations will determine the post endodontic restoration. It seems that intracoronal restorations, post-free crowns, and post-retained crowns are the three best treatments. Although post-retained crowns are better, post-free crowns may be considered when three or four tooth walls are still present, whereas teeth with one or two remaining walls may be better candidates for post-retained crowns. In situations when the ferrule is absent, other prosthetic components may be explored.

#### 6. Source of Funding

None.

#### 7. Conflict of Interest

None.


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