

INPLASY

INPLASY2026100041

doi: 10.37766/inplasy2026.10.0041

Received: 9 October 2026

Published: 9 October 2026

Corresponding author:

Jiacai Xie

xjc_jiacaidenti66@163.com

Author Affiliation:

Shaoxing Stomatological Hospital.

**Bond Strength of Computer-Aided Design/
Computer-Aided Manufacturing Milled Fiber Posts
versus Prefabricated Fiber Posts: A Systematic
Review and Meta-Analysis**

Ying, CC; Yan, QY; Xie, JC.

ADMINISTRATIVE INFORMATION**Support** - This work did not receive any funding support.**Review Stage at time of this submission** - Completed but not published.**Conflicts of interest** - None declared.**INPLASY registration number:** INPLASY2026100041**Amendments** - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 9 October 2026 and was last updated on 9 October 2026.**INTRODUCTION**

Review question / Objective To compare the push-out bond strength of computer-aided design/computer-aided manufacturing (CAD/CAM) milled fiber posts with prefabricated fiber posts in endodontically treated teeth.

Condition being studied Endodontically treated teeth (ETT) often experience substantial loss of tooth structure due to caries, previous restorations, and endodontic procedures, compromising their biomechanical integrity and increasing the risk of fracture. When insufficient coronal tooth structure remains to support a definitive restoration, intraradicular post-and-core systems are used to provide retention and stability. Glass fiber posts are widely used because their elastic modulus is closer to that of dentin than that of traditional metal posts.

Prefabricated glass fiber posts have standardized geometries that may not adequately adapt to irregular, oval, or flared root canals, resulting in

thick and uneven resin cement layers that may compromise the adhesive interface. Computer-aided design/computer-aided manufacturing (CAD/CAM) milled glass fiber posts are custom-fabricated to match individual root canal anatomy and may improve adaptation and bonding performance. This systematic review and meta-analysis evaluates the in vitro push-out bond strength of CAD/CAM milled glass fiber posts compared with prefabricated glass fiber posts in extracted human teeth.

METHODS

Participant or population Extracted human teeth that have undergone endodontic treatment and post space preparation. Eligible specimens must be used in in vitro studies comparing CAD/CAM milled glass fiber posts with prefabricated glass fiber posts. Studies using bovine teeth or artificial teeth will be excluded.

Intervention CAD/CAM milled glass fiber posts fabricated using computer-aided design and

computer-aided manufacturing technology and cemented into prepared root canals of extracted human teeth. Eligible interventions include custom-milled glass fiber posts evaluated for push-out bond strength, with resin cementation protocols as reported in the original studies.

Comparator Prefabricated glass fiber posts cemented into prepared root canals of extracted human teeth. Comparators will be evaluated against CAD/CAM milled glass fiber posts using push-out bond strength testing. Different resin cement types and cementation protocols will be considered as reported in the included studies.

Study designs to be included In vitro experimental studies comparing CAD/CAM milled glass fiber posts with prefabricated glass fiber posts in extracted human teeth and reporting quantitative push-out bond strength data. Eligible studies must provide sufficient data, including means, standard deviations, and sample sizes for both groups.

Eligibility criteria Studies will be eligible if they: (1) are in vitro investigations comparing CAD/CAM milled glass fiber posts with prefabricated glass fiber posts; (2) use extracted human teeth that have undergone endodontic treatment and post space preparation; (3) assess push-out bond strength; (4) report sufficient quantitative data, including group means, standard deviations, and sample sizes, or provide information from which these data can be calculated; and (5) are published in English in peer-reviewed journals between January 2015 and December 2025.

Studies will be excluded if they are reviews, case reports, letters, conference abstracts, editorials, investigations using bovine or artificial teeth, duplicate reports from the same study cohort, studies using post materials other than glass fiber for the CAD/CAM intervention, studies without a prefabricated glass fiber post comparison group, studies using bond strength tests other than push-out testing, or reports with insufficient statistical data that cannot be extracted or calculated.

Information sources The following electronic databases will be searched: PubMed/MEDLINE, Scopus, Web of Science, and the Cochrane Library, including the Cochrane Central Register of Controlled Trials. The search will cover publications from January 2015 to December 2025. The initial electronic search will not apply language restrictions. The search strategies will combine Medical Subject Headings (MeSH) and free-text keywords related to CAD/CAM technology, glass fiber posts, post-and-core systems, dental

bonding, push-out bond strength, retention, and adhesion, using Boolean operators.

The reference lists of all included studies and relevant systematic reviews will also be manually searched to identify additional potentially eligible publications. Search strategies will be adapted for each database. Only English-language, peer-reviewed studies meeting the predefined eligibility criteria will be included in the final review. No additional author contact, trial registry search, or grey literature search is specified in the manuscript.

Main outcome(s) The primary outcome is the push-out bond strength of CAD/CAM milled glass fiber posts compared with prefabricated glass fiber posts in extracted human teeth following endodontic treatment and post space preparation. Bond strength will be measured in megapascals (MPa), as reported in the original in vitro studies.

The primary effect measure will be the standardized mean difference (SMD), calculated using Hedges' *g*, with corresponding 95% confidence intervals. Group means, standard deviations, and sample sizes will be extracted for both intervention and comparator groups. Where results are reported separately for cervical, middle, and apical root thirds, overall means and pooled standard deviations will be calculated using standard methods for combining subgroup means and variances.

As the included studies are in vitro experiments, clinical follow-up timing is not applicable. Testing conditions, including thermocycling where reported, will be recorded and considered in subgroup analyses.

Quality assessment / Risk of bias analysis The methodological quality and risk of bias of included in vitro studies will be assessed independently by two reviewers using the Quality Assessment Tool for In Vitro Studies (QUIN tool). The tool covers 12 domains, including study aims, sample-size calculation, sampling and specimen preparation, randomization, blinding, experimental protocol, operator details, outcome measurement, statistical analysis, presentation of results, and clinical relevance.

Each applicable domain will be rated according to the QUIN guidance as adequately specified, inadequately specified, not specified, or not applicable. The percentage score for each study will be calculated by dividing the score obtained by the maximum applicable score. Studies will be classified as having low risk of bias ($\geq 70\%$), moderate risk of bias (50–69%), or high risk of bias

(<50%). Disagreements between reviewers will be resolved through discussion and consensus.

Strategy of data synthesis Quantitative data will be synthesized using a random-effects meta-analysis. Effect sizes will be expressed as standardized mean differences (SMDs) calculated using Hedges' *g*, with 95% confidence intervals. The restricted maximum likelihood (REML) estimator will be used to estimate between-study variance. Analyses will be conducted using R software (version 4.3.2) with the meta and metafor packages.

Statistical heterogeneity will be assessed using Cochran's *Q* test, the I^2 statistic, and the between-study variance (τ^2). I^2 values of approximately 25%, 50%, and 75% will indicate low, moderate, and high heterogeneity, respectively. Prediction intervals will also be calculated to estimate the range of true effects expected in future comparable studies.

Subgroup analyses will investigate potential sources of heterogeneity according to cement type, root canal morphology, and thermocycling status. Differences between subgroups will be evaluated using the chi-squared test. Sensitivity analyses will assess the robustness of the pooled effect using the leave-one-out method, and Baujat diagnostic plots will identify studies contributing disproportionately to heterogeneity and the overall result.

Potential publication bias or small-study effects will be evaluated through visual inspection of funnel plots and Egger's regression test. The Duval and Tweedie trim-and-fill method will be applied to estimate potentially missing studies and calculate an adjusted effect estimate. A *P* value of less than 0.05 will be considered statistically significant. All findings will be interpreted in light of heterogeneity, risk of bias, and the limitations of the available in vitro evidence.

Subgroup analysis Subgroup analyses will be performed to explore potential sources of heterogeneity and determine whether the comparative push-out bond strength of CAD/CAM milled and prefabricated glass fiber posts varies according to the following factors:

1. Cement type: dual-cure resin cement versus self-adhesive resin cement.
2. Root canal morphology: normal, oval, or flared root canals.
3. Thermocycling status: studies performing thermocycling before bond strength testing versus studies not performing thermocycling.

Pooled standardized mean differences (Hedges' *g*) and 95% confidence intervals will be calculated for each subgroup using the random-effects model.

Heterogeneity will be assessed using the I^2 statistic and Cochran's *Q* test. Differences between subgroups will be evaluated using the chi-squared test, with $P < 0.05$ indicating statistical significance. Subgroup findings will be interpreted cautiously when the number of studies in a subgroup is small.

Sensitivity analysis Sensitivity analysis will be conducted using the leave-one-out method. Each included study will be sequentially removed, and the pooled standardized mean difference (Hedges' *g*), 95% confidence interval, statistical significance, and heterogeneity will be recalculated to assess the influence of individual studies on the overall findings.

A Baujat diagnostic plot will also be used to identify studies that contribute disproportionately to between-study heterogeneity and influence the pooled effect estimate. The robustness of the primary findings will be evaluated by examining the consistency of effect direction, magnitude, statistical significance, and heterogeneity across the sensitivity analyses. Any substantial changes in the pooled estimate or heterogeneity after excluding an individual study will be investigated and interpreted in the context of that study's characteristics and methodological features.

Country(ies) involved China.

Keywords Computer-Aided Design; Post and Core Technique; Dental Bonding; Resin Cements; Root Canal TherapyComputer-Aided Design;.

Contributions of each author

Author 1 - Chongchong Ying.

Author 2 - Qiaoyi Yan.

Author 3 - Jiakai Xie.