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Accuracy of Silicone, Rigid Resin, and Bilayered/ Hybrid Injection Guides for Maxillary Anterior Direct Composite Restoration: A Systematic Review

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ADMINISTRATIVE INFORMATION

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Review Stage at time of this submission - Data analysis.

Conflicts of interest - None declared.

INPLASY registration number: INPLASY202690125

Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 29 September 2026 and was last updated on 29 September 2026.

INTRODUCTION

Review question / Objective Population (P): Patients requiring maxillary anterior direct composite restorations or in vitro tooth models simulating such restorations

Intervention (I): Use of injection guides (silicone/ resin/hybrid) for composite resin placement in maxillary anterior teeth

Comparison (C): Different guide types (S-type vs R-type vs H-type) or injection guide vs free-hand technique

Outcome (O):
Primary: Trueness and precision of restoration (dimensional accuracy, marginal adaptation, surface contour)
Secondary: Clinical success rate, aesthetic outcomes, operator time.

Rationale Direct composite restoration in maxillary anterior teeth demands high precision in contour, shade, and marginal adaptation. Injection guides (silicone index, rigid resin stent, or bilayered hybrid) are widely used chairside to transfer the diagnostic wax-up/mock-up to the final restoration. However, the comparative accuracy of these guide systems—particularly the emerging 3D-printed rigid (R-type) and hybrid (H-type) designs versus conventional silicone (S-type) indices—remains unclear. No systematic review has synthesized the evidence on dimensional trueness, marginal adaptation, and clinical outcomes across these guide modalities. This review aims to inform clinical decision-making and guide future research priorities.

Condition being studied Maxillary anterior direct composite restoration using injection guides (silicone index, resin stent, or bilayered hybrid guide) for precise composite resin placement.

METHODS

Search strategy 6.1 PubMed/MEDLINE:
((("Dental Restoration, Permanent"[Mesh]) OR "Composite Resins"[Mesh])
OR "Dental Bonding"[Mesh]) AND (("Dental Veneers"[Mesh]) OR "Esthetics,
Dental"[Mesh]) AND (("Stents"[Mesh]) OR "inject* guide*"[tiab] OR
"silicone index*"[tiab] OR "silicone stent*"[tiab] OR "resin stent*"[tiab]
OR "mock-up"[tiab] OR "putty index*"[tiab])

[Full strategies for all 7 databases available in Supplementary File 1]

6.2 Grey Literature: ProQuest Dissertations & Theses, OpenGrey, Google Scholar
(first 200 results)

6.3 Hand-searching: Reference lists of included studies and relevant reviews.

Participant or population Participants:
– In vitro: extracted human maxillary anterior teeth or standardized
resin/simulation models
– Clinical: patients requiring direct composite restoration in maxillary
anterior region.

Intervention Use of injection guides (silicone/resin/hybrid) for
composite resin placement in maxillary anterior teeth.

Comparator Different guide types (S-type vs R-type vs H-type) or
injection guide vs free-hand technique.

Study designs to be included In vitro studies (laboratory/computational) - Randomized controlled clinical trials (RCTs) - Controlled clinical trials (CCTs) - Case-control studies.

Eligibility criteria Inclusion criteria:(1) In vitro studies using extracted human maxillary anterior teeth or standardized models; clinical studies on patients requiring maxillary anterior direct composite restorations. (2) Studies evaluating injection guides (silicone/resin/hybrid) for composite placement. (3) Studies reporting at least one outcome: dimensional accuracy, marginal adaptation, surface contour, or clinical success. (4) English or Chinese publications.
Exclusion criteria:
1 Studies on posterior teeth only
2 Indirect restorations (inlays, onlays, veneers, crowns)
3 CAD/CAM milling or 3D-printed definitive restorations
4 Case reports, reviews, editorials, conference abstracts
5 Non-English and non-Chinese publications
6 Duplicate publications (keep earliest/most complete version)
Qualitative synthesis: Narrative summary of all included studies
Quantitative synthesis (meta-analysis): Will be conducted if:
– At least 3 studies report the same outcome with comparable methodology
– Clinical and methodological heterogeneity is acceptable ($I^2 < 75\%$).

Information sources Databases (7):
– PubMed / MEDLINE
– Embase
– Web of Science
– Cochrane Library
– CNKI (China National Knowledge Infrastructure)
– WanFang Data
– SinoMed (CBM).

Main outcome(s) Primary outcomes: (1) Trueness (dimensional accuracy/deviation from ideal) and precision (repeatability) of restoration; (2) Marginal adaptation measured by micro-CT or SEM; (3) Surface contour accuracy by 3D digital deviation analysis.

Secondary outcomes: (1) Clinical success/survival rate; (2) Aesthetic outcomes (colour match, surface texture); (3) Operator time/efficiency.

Additional outcome(s) (1) Fabrication time and chairside workflow efficiency of each guide type; (2) Material compatibility and degradation of guides during repeated use; (3) Cost-effectiveness comparison; (4) Operator experience/skill requirements; (5) Patient-reported outcome measures (PROMs) for aesthetic satisfaction when clinical data are available.

Data management All extracted data will be managed using a standardized Microsoft Excel extraction form stored on a password-protected local drive. A backup copy will be maintained on an institutional cloud drive with access restricted to the review team. Data will be retained for a minimum of 5 years post-publication. Screening

and extraction records will be archived for audit and reproducibility purposes.

Quality assessment / Risk of bias analysis In vitro studies: Risk of Bias in Dental-Examination Accuracy Studies
(RoBDEMAT) adapted for in vitro accuracy studies
RCTs: Cochrane Risk of Bias Tool 2.0 (RoB 2)
Two reviewers independently assess; disagreements resolved by discussion
GRADE (Grading of Recommendations, Assessment, Development and Evaluations) framework will be used to rate certainty of evidence for each outcome.

Strategy of data synthesis (1) Narrative synthesis with structured summary tables for all included studies; (2) Meta-analysis using random-effects model if ≥3 studies report the same outcome with acceptable heterogeneity (I^2 < 75%); (3) Forest plots and pooled effect estimates with 95% confidence intervals for quantitative synthesis; (4) SWiM (Synthesis Without Meta-analysis) reporting guideline if meta-analysis is not feasible due to clinical/methodological heterogeneity; (5) Subgroup analyses by guide type, restoration extent, and measurement method.

Subgroup analysis Planned subgroup analyses: (1) By guide type (S-type silicone vs R-type rigid resin vs H-type bilayered hybrid); (2) By restoration extent (single-tooth vs multi-tooth/splinted); (3) By outcome measurement method (micro-CT vs 3D optical scanning vs clinical evaluation).

Sensitivity analysis Sensitivity analyses will be conducted by: (1) Excluding studies with high risk of bias to assess robustness of findings; (2) Comparing fixed-effect vs random-effects models if meta-analysis is performed; (3) Sequential exclusion of each study to evaluate influence on pooled estimates.

Language restriction English and Chinese only. Publications in other languages will be excluded due to resource constraints for translation and verification.

Country(ies) involved China.

Other relevant information This systematic review protocol was initially submitted to OSF Registries; however, registration was delayed due to platform technical failure (reCAPTCHA Enterprise service exceeding free quota, preventing new account creation for multiple days). INPLASY registration is therefore submitted to ensure timely protocol transparency. The protocol follows PRISMA 2020 and PRISMA-P 2015 reporting guidelines. Risk of bias for in vitro studies will be assessed using an adapted RoBDEMAT framework; RCTs will be assessed using Cochrane RoB 2. Evidence certainty will be graded using GRADE.

Keywords injection guide; silicone index; resin stent; direct composite restoration; maxillary anterior; dimensional accuracy; trueness; precision; 3D-printed guide; bilayered hybrid guide.

Dissemination plans Results will be disseminated through (1) peer-reviewed publication in a dental journal (target: Journal of Dentistry); (2) presentation at national/international dental conferences; (3) sharing of findings with collaborating institutions.

Contributions of each author

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