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Treatment options for large posterior restorations: Systematic review and Meta-Analysis

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ABSTRACT

Background: There is an indication of rising costs for dental care over time, primarily due to the insertion and repair of restorations. The most effective therapy approach for extensive care in permanent posterior teeth is still debated in dental literature.

Aim: To investigate treatment options for large posterior teeth restoration.

Materials and methods: Two authors performed separate searches of internet databases, including EMBASE, PubMed, Scopus, Cochrane Library, Web of Science &MEDLINE. The inclusion criteria have been determined by the PICOSelements. Population (P): posterior molars. Intervention (I): adhesively bonded indirect restorations. Comparison (C): direct restoration. Outcome (O): the duration until the initial non-repairable or repairable restoration failure and the rate of annual failure. research design (S): Retrospective and prospective, (non-)randomized (un-)blinded clinical tests with a minimum monitoring duration of 3 years; Extractable information includes: quantity of repairs placed, evaluation of outcomes, and reasons for failure.

Main findings and conclusion:A total of 512 articles have beendiscovered by electronic databases. Finally, eight RCTs have beenchosen. Our eight studies were conducted mainly in Germany, the Netherlands, Canada, and 4 other countries around the world, patients were subjected to different procedure and implants.Our pooled research revealed that direct resin composite exhibited better results for direct restorations, while gold was optimal for indirect restorations.Our pooled studies for AM Versus GI and DR Versus GI were homogenous. The pooled studies for DR versus AM were heterogenous with I^2 99% and chi-p 0.019.

Keywords: Indirect restoration, Direct restoration,Meta-analysis

1. INTRODUCTION

Expenditure on dental care tends to rise with time, primarily due to the insertion & replacement of restorations. In this respect, while there is some evidence suggesting that composites are the optimal choice for correcting minor flaws in load-bearing restorations, there is limited information about more extensive restorations **(1)**. The probability posterior restoration failure rises by thirty to forty percent with each additional surface added. The life span of restorations is affected by various factors, including material attributes, choices made by dental health care doctors, and characteristics of cases, including as caries risk and occlusal stress **(2)**.

Despite the transition from amalgam to composite resin over the past several decades, thorough studies in literature continue to support both materials**(3)**.

In load-bearing restorations (i.e., occlusal-proximal or posterior occlusal), the emphasis of studies is on restorative materials, particularly due to the need for alternatives to conventional amalgams. Although bonded conventional composites (CCs) or composite polymers (CPs) are widely utilized, bulk fill composites &glass ionomer cements are promoted as substitutes to amalgam, concerning both their efficacy and their handling and cost-effectiveness **(4)**.

Indirect restorations are seen as a viable option for addressing significant abnormalities, demonstrating beneficialclinical efficacy in general practice & a reduced need for replacing and repairing. Various indirect restorations exist materials; however, some ceramic kinds, including glass ceramics and feldspathic, may be fewer appropriate for areas subjected to great functional loads **(5)**.

The selection of restorative material and approach (indirect ordirect) is significantly influenced by the surfaces number involved, the location of lesions, & the dental hard tissues remaining. Laboratory-processed or Computer-aided design /Computer-aided manufacturing made restorations givetherapeutic advantages, such as color stability, marginal integrity, wear resistance comparable to enamel, compatibility with the remaining natural teeth, fracture resistance, compressive strength, & elastic modulus **(6)**.
Furthermore, indirect restorations are generally greater because of their design for larger restorations, exhibiting perfect anatomic morphology with good proximal adaptation & occlusion in comparison to direct composite restorations **(7)**.

2. MATERIAL AND METHODS

This study aimed to systematically retrieve and analyze randomized controlled trials (RCTs) examining different therapies for large posterior teeth. The review has been executed in accordance with the Cochrane Collaboration criteria and adhered to the PRISMA declaration (Preferred Reporting Items for Systematic Reviews and Meta-analyses).

Search Strategy

Two authors performed separate searches of internet databases, involving PubMed, EMBASE, Scopus, MEDLINE, Cochrane Library, and Web of Science. The authors selected both retrospective and prospective research that examined a minimum of two distinct therapies for permanent teeth, each with at least three years of monitoring.
The inclusion criteria have been dependent on the afterPICOS elements:
1_Population (P): posterior molars
2_Intervention (I): adhesively-luted indirect restorations.
3_Comparison (C): direct restorations
4_Outcome (O): Time to initial non-repairable or repairable restoration failure and annual failure rate .
5_Study design (S): prospective&retrospective, (non-)randomized (un-)blinded clinical study with a minimum monitoring duration of three years; Extractable information includes the restorations number placed, outcome evaluation, and reasons for failure.

Exclusion criteria

The subsequent exclusion criteria have been implemented for PICOS.:
Other than in-vivo experiments (e.g.: in situ, in vitro, reviews, case report)
_Case reports
_Restorations for small posterior teeth (premolars)
_Examinations with fewer than three years follow.

Study quality assessment

The quality of each investigation has been evaluated. Essential factors encompassed the design of the research, its ethical permission, the estimationof power ofevidence, the appropriate controls, the specified eligibility criteria, thespecified evaluation measures, and the availability of adequate information. Also providing an explanation for the data that was missing, it has been expected that those confounding factors would be recorded and adjusted for, and that proper data analysis would be performed.
Data Synthesis: A structured systematic review has been conducted, and its findings were tabulated.

3. RESULTS

The literature search produced 512 titles & abstracts. Following eliminating duplicates and analyzing the titles and abstracts, thirty-six articles have been chosen for full-text access. Finally, we have included 8 studies. Figure 1 represents the PRISMA flow diagram for selecting eligible researches.

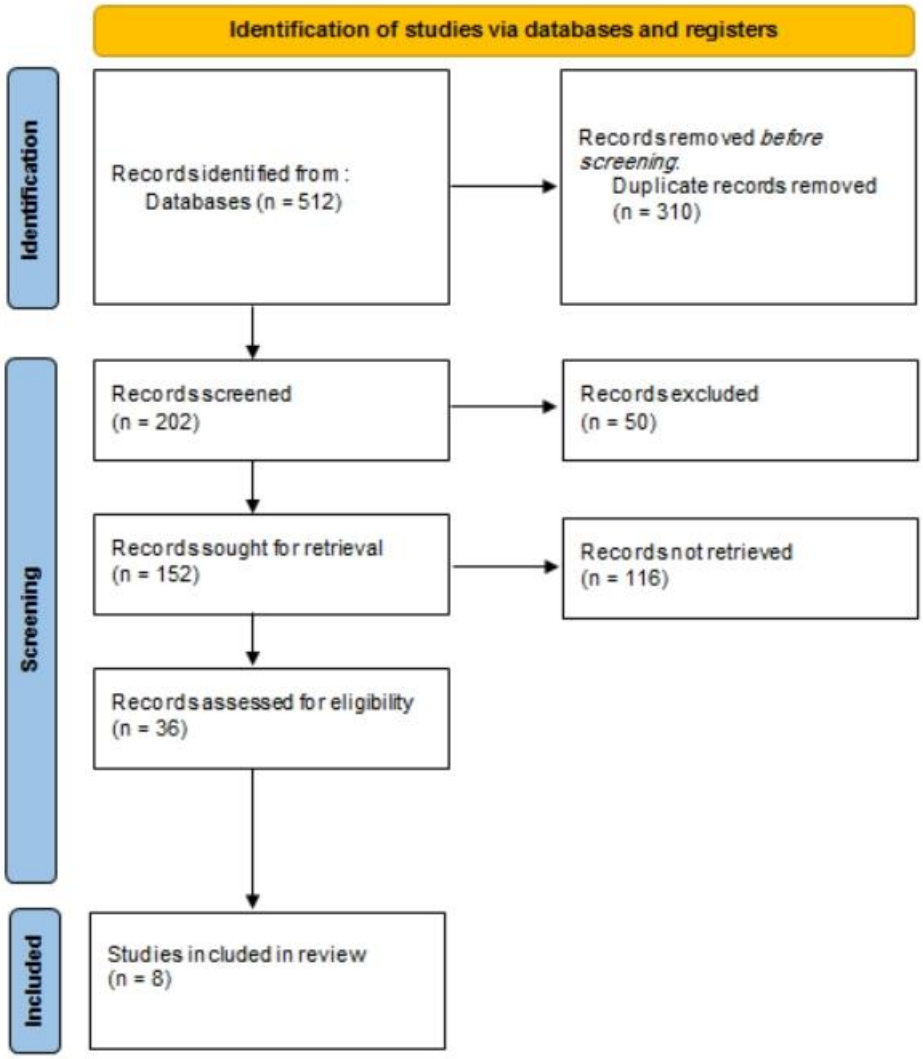

Figure 1: represents flow diagram of PRISMA for selecting eligible researches.

Our eight studies were conducted mainly in Germany, the Netherlands, Canada, and 4 other countries around the world, patients were subjected to different procedure and implants. Demographic characteristics of patients and a summary of the involvedstudies are provided in Table 2.

Table 2: Demographic characteristics of cases and a summary of the involved investigates

Study No.	Study ID	Site	Study design	Sample size	Type of Surgery
1	**Banomyong et al.,(8)**	Thailand	RCT	75	restorations of posterior resin composite with or without glass-ionomer cement lining, resin-modified
2	**Kim et al.,(9)**	Korea	Retrospective	76	amalgam
				161	direct resin
				45	glass inomer
3	**Laske et al., (10)**	Netherlands	Descriptive study	26.751	amalgam
				175.128	direct resin
				5.141	glass inomer
4	**Naghipuret al., (11)**	Canada	Comparative	1.125	amalgam
				1.625	direct resin
5	**Olley et al.,**	United	Retrospective	101	metal ceramic

	(12)	Kingdom		25	gold
6	**Rinke et al., (13)**	Germany	Comparative	50	zirconia ceramic
				41	metal-ceramic
7	**Skupien et al., (14)**	Germany	Retrospective	479	direct resin
				233	metal ceramic
8	**Van de sandeet al., (15)**	Brazil	Retrospective	244	resin sandwich
				124	direct resin

According to the Cochrane ROB1 tool, our 8 RCTs were ranked from good to fair quality, most studies represented low risk in the domain of reporting bias. Figure 2 visually represents the probability of bias summary regarding the Cochrane ROB 1 tool.

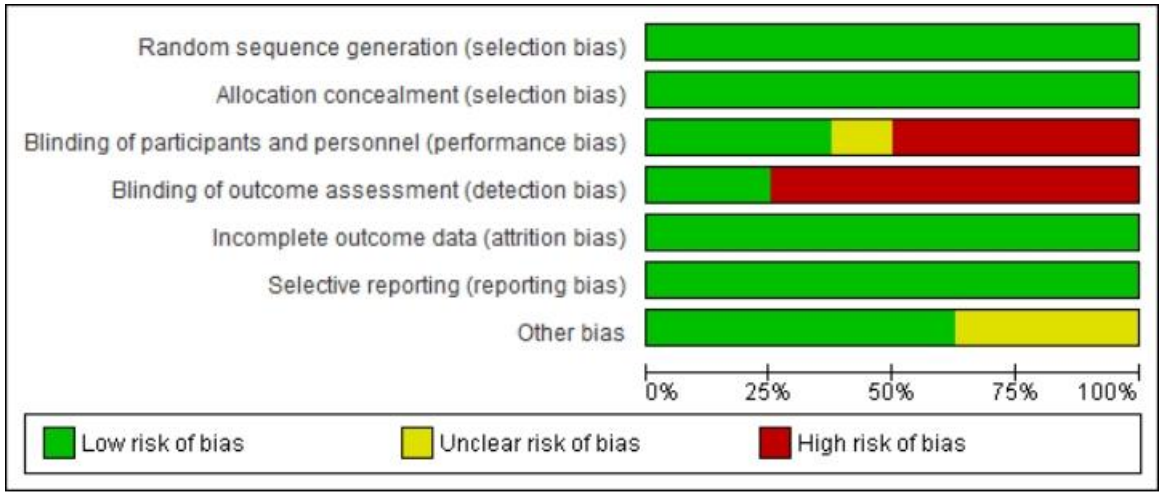

Figure 2. visually represents the probability of bias graph regarding the Cochrane ROB 1 tool.

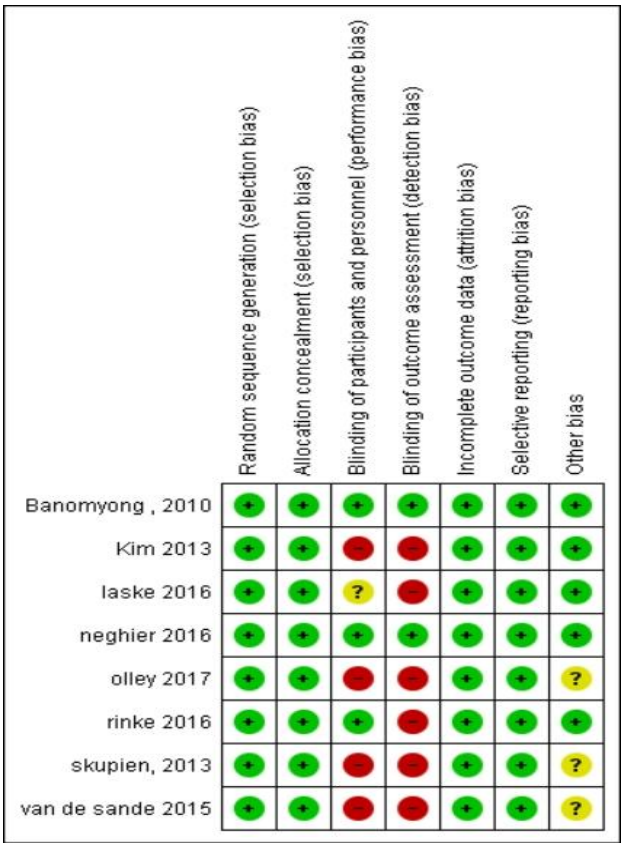

Figure 3. visually represents the risk of bias summary according to the Cochrane ROB 1 tool.

Outcomes

Good performance of restorations

Our meta-analysis of the five pooled trials revealed that direct resin composite exhibited superior performance for direct restorations, whereas gold was optimal for indirect restorations. Our pooled studies for AM Versus GI and DR Versus GI were homogenous with I^2 0% and chi-p 0.5 and 0.9, respectively. The pooled studies for DR versus AM were heterogenous with I^2 99% and chi-p 0.019. Figure 4 represents the forest plot for good performance of different restorations.

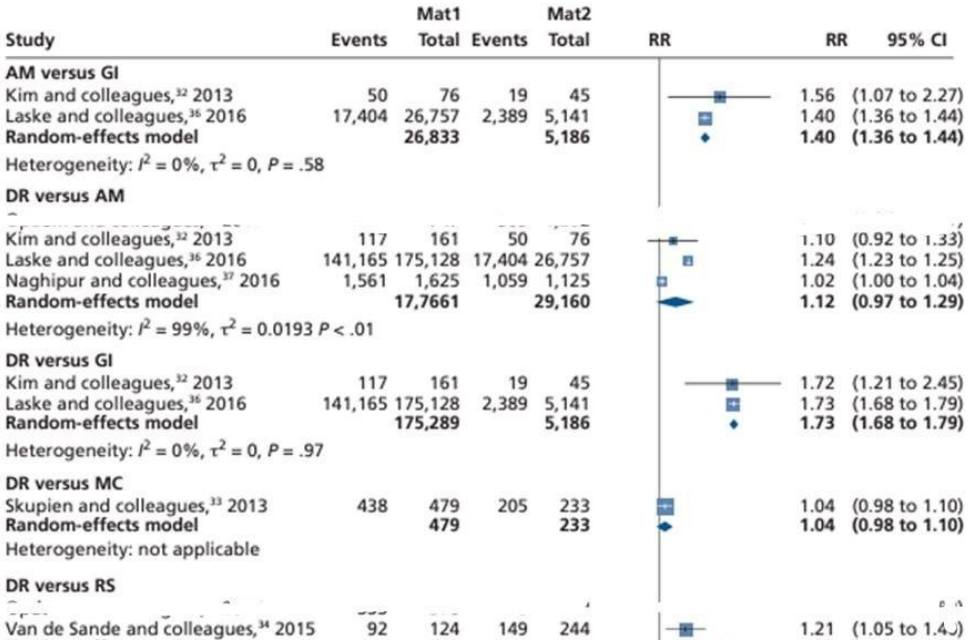

Figure 4. represents the forest plot for good performance of different restorations.

DR: Direct resin. AM: Amalgam. GC: Glass ceramic. FC: Feldspathic ceramic. GO: Gold. GI: Glass ionomer. MC: Metal ceramic. IR: Indirect resin. RS: Resin sandwich

4. DISCUSSION

Dentists must select among multiple restorative alternatives for their cases on a daily basis. There is an agreement that resin composite is the preferred option for small problems **(16),(17)**. Nonetheless, the selection among direct & indirect materials for larger problems was examined in only one clinical research **(18)**.

This review has been done to systematically acquire and analyze randomized controlled trials (RCTs) examining possible treatments for the restoration of large posterior teeth. Our pooled research revealed that direct resin composite exhibited better results for direct restorations, while gold was optimal for indirect restorations.

This research concurred with **Vetromilla et al. (19)**, who performed a meta-analysis and systematic review to address the question: What are the optimal restorative therapykinds&items for extensive restorations in adults' permanent posterior teeth. The findings indicated that metal &gold crowns of ceramic are superior for broadly damaged teeth, but amalgam excel

&resin composite in direct restoration. During informationgathering, composites have been categorized as bulk-fill materials, hybrid resins, and other types. They deemed it suitable to amalgamate the composite groupings, as categorizing most of the evaluated restorative materials into a specific categorization proves to be difficult. Such as, bulk-fill material is frequently a hybrid composite. Moreover, resin composites have been categorized in many ways over time based on differing assumptions.

In general, glass ionomers exhibited inferior performance compared to other materials in bigger restorations. Similarly, restorations of composite glass ionomer sandwich demonstrated less favorable results relative to composite restorations applied without glass ionomer, as indicated by a prior systematic evaluation carried out by Opdam et al. (20).

Recently, **Tennert et al. (7)** performed a meta-analysis and systematic review to evaluate the direct versus indirect composite restorations longevity in posterior teeth. The greatest annual failure rates (AFR) for indirect restorations have been observed to range from zero percent to 15.5 percent. Lower adverse event rates have been observed for direct restorations, varying from zero percent to 5.4 percent. The predominant failures identified were chipping &repair fracture, succeeded by caries. The meta-analysis indicated that the rate of failure for direct restorations was significantly less Report Phrase than that for indirect restorations (Risk Ratio

(RR) [ninety five percent confidence interval] = 0.61 [0.47; 0.79]; extremely low level of evidence). Moreover, every investigation exhibited a significant risk of bias. The authors determined that indirect as well as direct composite restorations are advisable for extensive class two cavities, involving cusp coverage, in posterior teeth for single-tooth restoration.

In 2016, **Naghipur et al. (11)** assessed the longevity and failure causes of directly applied two-surface composite resin and amalgam restorations on premolars performed by Canadian dental students. It has been observed that both composite resin & amalgam restorations exhibit rates ofacceptable success & share comparable modes of failure. Recurrent caries is the predominant cause of restoration failure and can be reduced through meticulous placement of composite resin and amalgam restorations, in conjunction with enhanced caries prevention strategies.

The research by **Banomyong et al. (8)** examined the impact of resin-modified glass-ionomer cement lining on the quality of restorations of posterior resin composite. All restorations were assessed and rated on a scale ranging from one (clinically excellent) to five (clinically poor). At one year, the characteristics of the restorations weren't significantly influenced using glass-ionomer cement lining, irrespective of the adhesive utilized(P-value more than 0.05). Most of the restorations received a score of one in all categories. The efficacy of including a restoration of glass-ionomer cement liner in resin composite is uncertain.

5. CONCLUSION

The research determined that direct resin composite exhibited superior performance for direct restorations, while gold was optimal for indirect restorations. Nonetheless, factors such as the requirement for more invasive preparation, elevated costs, and inferior aesthetics—particularly for gold—must be considered when choosing daily practice materials. Restorations of glass ionomer and sandwich composite were the least effective in the network meta-analysis pairwise comparisons. Furthermore, primary research assessing restoration longevity must adhere to standardized guidelines for outcome reporting to enhance future indirect and direct comparisons.

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