

# EVALUATE THE FAILURE RATES BETWEEN OCCLUSAL AND OCCLUSOPROXIMAL AMALGAM AND COMPOSITE RESIN OF POSTERIOR RESTORATIONS: A SYSTEMATIC REVIEW AND META-ANALYSIS

Turkish Online Journal of Qualitative Inquiry (TOJQI)  
Volume 12, Issue 10, October 2021: 3775-3783

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Dorara Dortaj<sup>1</sup>, Dorsa Khosravi<sup>2</sup>, Yasser Samadi<sup>3</sup>, Zahra Jahanshahiafshar<sup>4</sup>

<sup>1</sup>Post Graduate Student, Department of Operative Dentistry, School of Dentistry, Tehran University of Medical Sciences, Tehran, Iran.

<sup>2</sup>Assistant Professor, Department of Operative Dentistry, School of Dentistry, Kerman University of Medical Sciences, Kerman, Iran.

<sup>3</sup>Postgraduate Student, Department of Endodontics, School of Dentistry, Shiraz University of Medical Science, Shiraz, Iran.

<sup>4</sup>Postgraduate student, Department of Oral and Maxillofacial Radiology, Faculty of Dentistry, Babol University of Medical Sciences, Babol, Iran.

### **Abstract :**

the aim of present study was compared Failure Rates between occlusal and occlusoproximal amalgam and composite resin of posterior restorations.

From the electronic databases, PubMed, Scopus, LILACS, Web of Science, EBSCO, LIVIVO, and Embase have been used to perform a systematic literature over the last 20 years between 2001 and September 2021. Risk ratio with 95% confidence interval, fixed effect model and Mantel-Haenszel method were calculated. The Meta analysis have been evaluated with the statistical software Stata/MP v.16 (The fastest version of Stata).

113 studies were selected to review the abstracts, the full text of 19 studies was reviewed. Finally, five studies were selected. Risk ratio of restoration failure rate and secondary caries between amalgam and composite resin was 0.14 (RR, 0.14 95 % CI 0.10, 0.17; p=0.00) and 0.15 (RR, 0.15 95 % CI 0.11, 0.18; p=0.00), respectively. Composite resin significantly increased the risk of restoration failure and secondary caries.

meta-analysis showed that the failure rate in composite resin restorations is higher than amalgam in the restoration of posterior teeth. Present study suggested that amalgam was better than composite resin restorations. More RCT studies are needed to provide sufficient and stronger evidence.

**Keywords:** amalgam, composite resin, posterior restorations

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## **Introduction :**

Amalgam has been the traditional material for filling cavities in posterior teeth for the last 150 years and, due to its effectiveness and cost, amalgam is still the restorative material of choice in certain parts of the world. In recent times, however, there have been concerns over the use of amalgam restorations (fillings), relating to the mercury release in the body and the environmental impact following its disposal. Resin composites have become an esthetic alternative to amalgam restorations and there has been a remarkable improvement of its mechanical properties to restore posterior teeth (1). With respect to amalgam restorations, failures are more often found in premolar teeth (34%) than in molars (27%)(2). Under optimal conditions, Class I and II amalgam restorations have a median survival time, between 57 and 70 years according to Mitchell et al.,2007 (3). Few RCT studies have been performed to evaluate the lifespan of restorations, especially in posterior teeth. There is insufficient evidence in this regard, as the size of the cavities, experience and expertise, type of consumables may have a significant impact on restoration performance. Therefore, the present study compared Failure Rates between occlusal and occlusoproximal amalgam and composite resin of posterior restorations.

## **Methods :**

### **Search strategy :**

From the electronic databases, PubMed, Scopus, LILACS, Web of Science, EBSCO, LIVIVO, and Embase have been used to perform a systematic literature over the last twenty years between 2001 and September 2021. The reason for choosing studies in the last ten years is to be able to provide sufficient evidence in this area and use newer studies. Therefore, a software program (Endnote X8) has been utilized for managing the electronic titles.

Searches were performed with mesh terms:

((((((((( "Dental Restoration, Permanent/adverse effects"[Mesh] OR "Dental Restoration, Permanent/classification"[Mesh] OR "Dental Restoration, Permanent/instrumentation"[Mesh] OR "Dental Restoration, Permanent/methods"[Mesh] OR "Dental Restoration, Permanent/statistics and numerical data"[Mesh] )))) OR "Dental Restoration, Permanent"[Mesh]) OR "Dental Occlusion"[Mesh]) AND "Bicuspid"[Mesh]) OR ( "Molar"[Mesh] OR "Molar, Third"[Mesh] )) AND "Failure of Tooth Eruption, Primary" [Supplementary Concept]) AND "Survival Rate"[Mesh] OR "Contraceptive Effectiveness"[Mesh].

This systematic review has been conducted on the basis of the key consideration of the PRISMA Statement– Perfumed Reporting Items for the Systematic Review and Meta-analysis(4), and PICO strategy (Table1).

### **Selection criteria :**

Inclusion criteria: Randomized controlled trials studies, controlled clinical trials; Prospective and retrospective cohort studies; in human; molar and premolar; posterior restorations; in English. In vitro studies, case studies, case reports and reviews were excluded from the study.

**Table 1. PICO OR PECO strategy.**

| <b>PICO strategy</b> | <b>Description</b>  |
|----------------------|---|
| P                    | Population/ Patient: human participants with posterior restorations |
| E                    | Intervention: amalgam   |

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|   |                             |
|---|-----------------------------|
| C | Comparison: composite resin |
| O | Outcome: Failure Rate       |

**Data Extraction and analysis method**

The data were extracted from the research included study. Years, study design, Number of patients, sample size, mean of age, cavity, number of restorations and follow-up period.

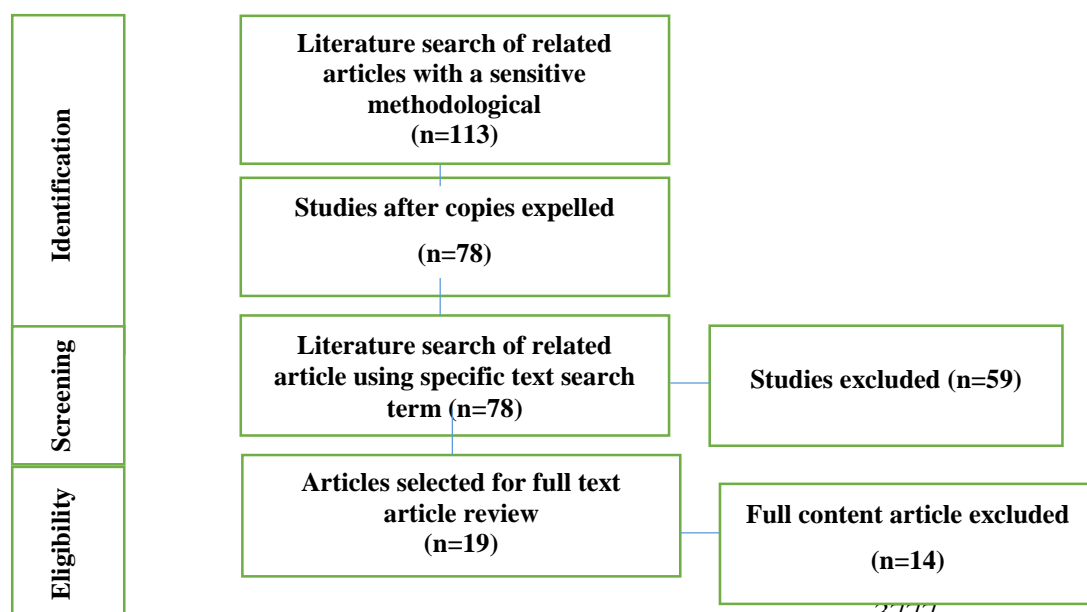
The quality of randomized studies included was assessed using Collaboration’s tool(5). The scale scores for low risk was 1 and for High and unclear risk was 0. Scale scores range from 0 to 6. A higher score means higher quality. Newcastle-Ottawa Scale (NOS) (6) used to assessed quality of the cohort studies and case-control studies, This scale measures three dimensions (selection, comparability of cohorts and outcome) with a total of 9 items. In the analysis, any studies with NOS scores of 1-3, 4-6 and 7-9 were defined as low, medium and high quality, respectively.

For Data extraction, two reviewers blind and independently extracted data from abstract and full text of studies that included. Prior to the screening, kappa statistics was carried out in order to verify the agreement level between the reviewers. The kappa values were higher than 0.80.

Risk ratio with 95% confidence interval (CI), fixed effect model and Mantel-Haenszel method were calculated. Random effects were used to deal with potential heterogeneity and I<sup>2</sup> showed heterogeneity. I<sup>2</sup> values above 50% signified moderate-to-high heterogeneity. The Meta analysis have been evaluated with the statistical software Stata/MP v.16 (The fastest version of Stata).

**Results :**

In the initial review of the existing literature and based on keywords related to the subject of the study, first 113 studies were found in databases. After deleting similar and duplicate studies, the abstract of 78 studies was reviewed. At this stage, studies that did not meet the inclusion criteria were excluded from the study (59 studies). The full text of 19 studies was reviewed and 14 studies were excluded, finally five studies were selected.



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**Figure 1.** Flowchart of the literature search and selection criteria

**Table2. Summary of characteristics of included studies**

| Study. Year               | Study design  | Number of restorations |                 | Type and size of Cavity                            | Type of Tooth      | Observation Period |
|---------------------------|---------------|------------------------|-----------------|--|--------------------|--------------------|
|                           |               | amalgam                | composite resin |  |                    |                    |
| Kemaloglu et al.,2016 (7) | RCT           | 20                     | 20              | Occlusal and occlusoproximal                       | posterior teeth    | 3                  |
| Kim et al.,2013 (8)       | Retrospective | 139                    | 175             | Occlusal and occlusoproximal                       | posterior teeth    | 5                  |
| Bernardo et al., 2007 (9) | RCT           | 856                    | 892             | Occlusal and occlusoproximal, Small, medium, large | Premolar and molar | 7                  |
| Levin et al., 2007 (10)   | Prospective   | 557                    | 93              | Occlusal and occlusoproximal                       | posterior teeth    | 1                  |
| Wilson et al., 2002 (11)  | RCT           | 52                     | 52              | Occlusal and occlusoproximal, medium               | Premolar and molar | 1                  |

**Table 3. Risk of bias assessment (Randomized clinical trials).**

| Study                      | Random generation of sequences | Concealment of Allocation | Blinding of participants and personnel | Blinding of outcome assessment | Incomplete data on outcomes | Selective reporting | Total score |
|----------------------------|--------------------------------|---------------------------|--|--------------------------------|-----------------------------|---------------------|-------------|
| Kemaloglu et al., 2016 (7) | ?                              | +                         | +                                      | -                              | +                           | +                   | 4           |
| Bernardo et al., 2007 (9)  | ?                              | +                         | +                                      | -                              | +                           | +                   | 4           |
| Wilson et al., 2002 (11)   | ?                              | +                         | +                                      | -                              | +                           | +                   | 4           |

Low (+), unclear (?), high (-)

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**Table 4. Risk of bias assessment (NOS tool)**

| Study. Years            | Selection (5 score)   |             |                 |                               | Comparability (2 score)      | Outcome (2 score)     |                  | Total score |
|-------------------------|-----------------------|-------------|-----------------|-------------------------------|------------------------------|-----------------------|------------------|-------------|
|                         | representative sample | Sample size | Non respondents | Ascertainment of the exposure | Based on design and analysis | Assessment of outcome | Statistical test |             |
| Kim et al.,2013 (8)     | 1                     | 1           | 1               | 1                             | 2                            | 1                     | 1                | 8           |
| Levin et al., 2007 (10) | 1                     | 1           | 1               | 0                             | 1                            | 1                     | 1                | 6           |

**Characteristics**

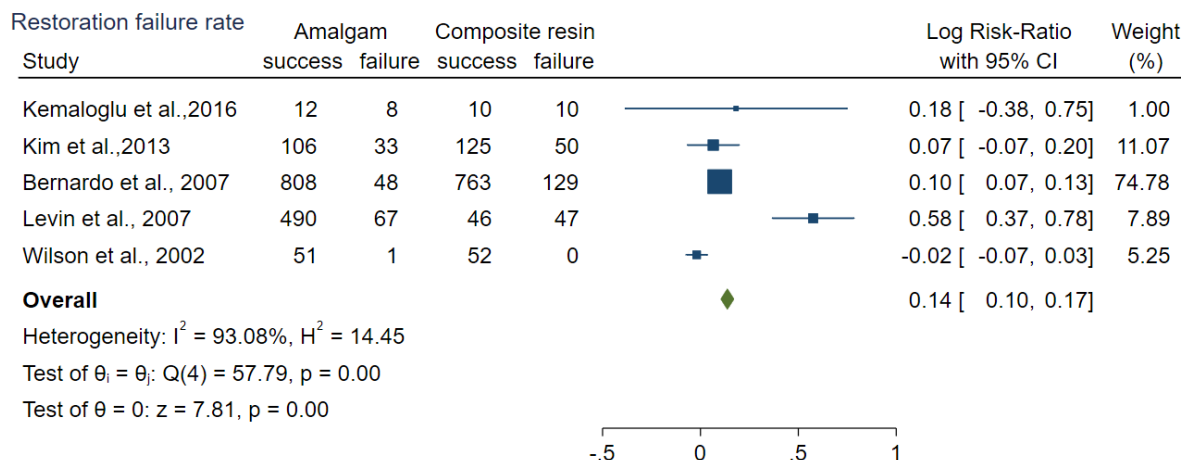
Five studies (3 Randomized clinical trials, one Retrospective study and one Prospective study) have been included in present article. The Number of restorations in amalgam group and composite resin group was 1624 and 1232, respectively; a total was 2856. Other characteristics of the selected studies are reported in Table 2.

**Bias assessment**

According to Collaboration’s tool, all studies had a total score of 4/6; and According to NOS tool, one study had a total score of 8/9 and one study a total score of 6/9. Four studies had moderate risk of bias and one study had low risk of bias or high quality (Table 3 and 4).

**Restoration failure rate**

Risk ratio of restoration failure rate between amalgam and composite resin was 0.14 (RR, 0.14 95 % CI 0.10, 0.17; p=0.00) with high heterogeneity ( $I^2 = 93.08\%$ ; p=0.00) (Figure2). This result shows statistically significant difference of restoration failure rate between amalgam and composite resin; composite resin significantly increased the risk of failure. In amalgam and composite resin the number of Restoration failure was 157/1624 (9.66%) and 236/1202 (19.63%), respectively (Figure2).



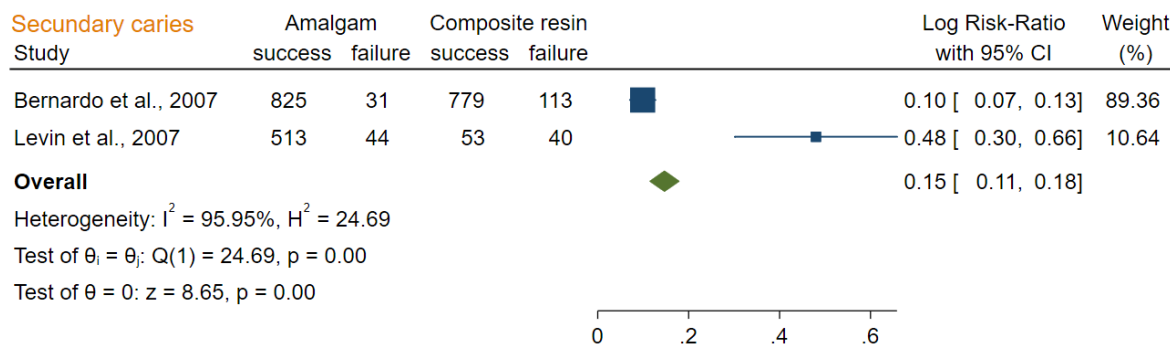
Fixed-effects Mantel-Haenszel model

**Figure 2. The Forest plot showed restoration failure rate between amalgam and composite resin**

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## Secondary caries :

Risk ratio of secondary caries between amalgam and composite resin was 0.15 (RR, 0.15 95 % CI 0.11, 0.18;  $p=0.00$ ) with high heterogeneity ( $I^2 = 95.95\%$ ;  $p=0.00$ ) (Figure3). This result shows statistically significant difference of Secondary caries between amalgam and composite resin; composite resin significantly increased the risk of secondary caries. In amalgam and composite resin the number of event secondary caries was 75/1413 (5.3%) and 153/985 (15.53%), respectively (Figure3).

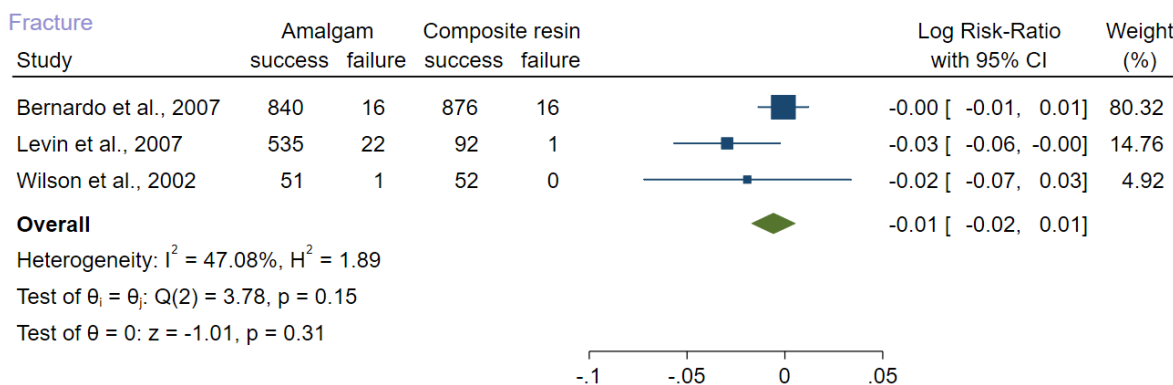


Fixed-effects Mantel-Haenszel model

**Figure 2. The Forest plot showed secondary caries between amalgam and composite resin**

## Fracture :

Risk ratio of event fracture between amalgam and composite resin was -0.01 (RR, -0.01 95 % CI -0.02, 0.01;  $p=0.31$ ) with low heterogeneity ( $I^2 = 47.08\%$ ;  $p=0.15$ ) (Figure4). This result shows no statistically significant difference of event fracture between amalgam and composite resin; In amalgam and composite resin the number of event fracture was 39/1465 (2.6%) and 17/1037 (1.6%), respectively (Figure3).



Fixed-effects Mantel-Haenszel model

## Discussion :

The aim of current systematic review and meta-analysis study was evaluate the Failure Rates between occlusal and occlusoproximal amalgam and composite resin of posterior restorations. The use of resin composite for routine restoration of cavities in posterior teeth is now commonplace, and will increase further following the Minamata Agreement and patient requests for tooth-coloured restorations in their posterior teeth. It is therefore

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relevant to evaluate the published survival rates of such restorations (12). As reported in previously published data, secondary caries is the main reason for failure of both resin composites and amalgam restorations (9, 13). In present study failure rate and Secondary caries was more noticeable in resin composites than amalgams. Studies concluded that more extensive restorations showed reduced clinical performance, especially the survival rates decrease as the size of restorations increase(14, 15). Studies compared different composite resin brands (16-18), amalgams with composite resins (9), and different amalgams (19). Afrashtehfar et al., 2017 in a systematic review included Five RCT and nine observational studies Data obtained from the RCT showed that, regardless of the amount of remaining tooth structure, amalgams presented better outcomes than composite resins(20); these results are consistent with the present study. Burke et al., 2019 evaluate survival rates of resin composite restorations in loadbearing situations in posterior teeth, the result showed posterior composites may provide restorations of satisfactory longevity and with survival rates generally similar to those published on amalgam restorations. However, the ability of the operator in placing the restoration may have a profound effect (21). Worthington et al., 2021 in a review updated a review originally published in 2014, expanding the scope of the review by undertaking an additional search for harms outcomes. This review synthesises the results of studies that evaluate the long-term effectiveness and safety of amalgam versus composite resin restorations, and evaluates the level of certainty we can have in that evidence (22). A systematic review and meta-analysis by Moraschini et al., 2015 showed composite resin restorations in posterior teeth still have less longevity and a higher number of secondary caries when compared to amalgam restorations(23). Karrabi et al., 2020 showed higher longevity of the amalgam restorations compared to composite resin restorations (24).

### **Conclusion :**

Due to the few studies in this regard and despite the existing limitations, meta-analysis showed that the failure rate in composite resin restorations is higher than amalgam in the restoration of posterior teeth. Since restoration in posterior teeth is directly related to the rate of failure, proper treatment planning should be based on the structure of the remaining teeth. Ignoring this (the amount of tooth structure remaining in the posterior teeth), it is suggested that amalgam works better than composite resin restorations. More RCT studies are needed to provide sufficient and stronger evidence.

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