# Reasons for Crown Failures in Primary Teeth: A Systematic Review and Meta-Analysis

Stephan Lampl, Deepa Gurunathan, Deepak Mehta, Krithikadatta Jogikalmat

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Stephan Lampl[1]; Deepa Gurunathan[2]; Deepak Mehta[3]; Krithikadatta Jogikalmat[4]

[1]PhD Student, Department of Pediatric Dentistry, Saveetha Dental College and Hospitals. Saveetha Institute of Medical and Technical Sciences Chennai IN
[2]Professor & Head, Department of Pediatric Dentistry, Saveetha Dental College and Hospitals. Saveetha Institute of Medical and Technical Sciences Chennai IN
[3]Adjunct Professor, Department of Conservative Dentistry, Saveetha Dental College and Hospitals. Saveetha Institute of Medical and Technical Sciences Chennai IN
[4]Professor & Head, Department of Cariology, Saveetha Dental College and Hospitals. Saveetha Institute of Medical and Technical Sciences Chennai IN

**Corresponding Author:**
Deepa Gurunathan
Professor & Head, Department of Pediatric Dentistry, Saveetha Dental College and Hospitals.
Saveetha Institute of Medical and Technical Sciences
162, Poonamallee High Rd, Velappanchavadi
Chennai
IN



## *Abstract*

**Background:** There is a tendency nowadays to restore large defects in primary dentition with pediatric crowns instead of conventional restorations. Thus, understanding the factors contributing to the survival or failure of dental crowns in pediatric dentistry is essential for optimizing treatment outcomes.

**Objective:** This systematic review aims to descriptively analyze the crown-retention rates, complications of crown retention along with the biological and technical complications of pediatric crowns for primary teeth. The meta-analysis reported herein was performed to estimate long-term (3-year and 5-year) retention rates of these pediatric crowns fabricated using various materials.

**Methods:** Using the PICOS paradigm, a systematic search was carried out in the PubMed and Cochrane databases to identify randomized controlled trials (RCTs) and clinical (prospective and retrospective) studies reporting retention rates, complications of crown retention, biological and technical complications. After selecting studies with a predefined set of selection criteria, data from included studies were used for a systematic review aimed at a descriptive analysis of factors associated with failure of crowns for primary tooth. Data from the included RCTs were used for meta-analysis, wherein 3-year and 5-year crown retention rates were estimated using Poisson regression models.

**Results:** The systematic review analyzed data from 13 RCTs and 5 clinical studies, with a median follow-up of 12 months (IQR: 9 months) and 20.8 months (IQR: 5 months). In total, 454 children (1172 crowns) and 810 children (2667 crowns) were included. Retention rates of crowns fabricated using compomer, composite resins, and stainless steel ranged from 77.8% to 100%, 80.6% to 100%, and 92.31% to 100%, respectively. Retention rates of strip crowns and zirconia ranged from 78% to 100% and 86.36% to 100%. Estimated 3-year and 5-year retention rates, according to Poisson regression, revealed clinically acceptable rates for compomer (71.65% to 100% and 57.38% to 100%), composite resin (82.40% to 100% and 72.43% to 100%), stainless steel (75.65% to 100% and 62.81% to 100%), strip crowns (28.48% to 100% and 12.33% to 100%), and zirconia (44.12% to 100% and 25.57% to 100%). Common biological complications were secondary caries and gingival inflammation, while frequent technical complications included issues with marginal adaptation, shade mismatch, and wear on the opposing tooth.

**Conclusions:** While retentive complications such as chipping, material loss and fractures do occur across materials, crowns fabricated with compomer, composite resin, stainless steel, strip crowns and zirconia all have clinically acceptable retention rates. However, differences noted between materials for biological and technical complications may offer insights for selecting materials for pediatric crowns based on clinical considerations. Clinical Trial: PROSPERO CRD42023442266;

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# Original Manuscript

# Reasons for Crown Failures in Primary Teeth: A Systematic Review and Meta-Analysis

Stephan Lampl[1], Deepa Gurunathan[2,*], Deepak Mehta[3], Jogikalmat Krithikadatta[4]

**1.** PhD Student, Department of Pediatric Dentistry, Saveetha Dental College and Hospitals. Saveetha institute of Medical and Technical Sciences, Saveetha University, Chennai, India; stephanphd@gmail.com. **2.** Professor & Head, Department of Pediatric Dentistry. Saveetha Dental College and Hospitals. Saveetha Institute of Medical and Technical Sciences, Chennai, India; deepag@saveetha.com. **3.** Adjunct Professor, Department of Conservative Dentistry, Saveetha Dental College and Hospitals. Saveetha Institute of Medical and Technical Sciences, Chennai, India; deepak.mehta.e6@tohoku.ac.jp. **4.** Professor & Head, Department of Cariology. Saveetha Dental College and Hospitals. Saveetha Institute of Medical and Technical Sciences, Chennai, India; krithikadatta.sdc@saveetha.com.

**Corresponding Author**
Deepa Gurunathan
Professor & Head, Department of Pediatric Dentistry.
Saveetha Dental College and Hospitals.
Saveetha Institute of Medical and Technical Sciences,
Chennai, India; deepag@saveetha.com

# Abstract

**Aim:** This systematic review aims to descriptively analyze the crown-retention rates, complications of crown retention along with the biological and technical complications of pediatric crowns for primary teeth. The meta-analysis reported herein was performed to estimate long-term (3-year and 5-year) retention rates of these pediatric crowns fabricated using various materials.

**Materials and methods:** Using the PICOS paradigm, a systematic search was carried out in the PubMed and Cochrane databases to identify randomized controlled trials (RCTs) and clinical (prospective and retrospective) studies reporting retention rates, complications of crown retention, biological and technical complications. After selecting studies with a predefined set of selection criteria, data from included studies were used for a systematic review aimed at a descriptive analysis of factors associated with failure of crowns for primary tooth. Data from the included RCTs were used for meta-analysis, wherein 3-year and 5-year crown retention rates were estimated using Poisson regression models.

**Results:** The systematic review analyzed data from 13 RCTs and 5 clinical studies, with a median follow-up of 12 months (IQR: 9 months) and 20.8 months (IQR: 5 months). In total, 454 children (1172 crowns) and 810 children (2667 crowns) were included. Retention rates of crowns fabricated using compomer, composite resins, and stainless steel ranged from 77.8% to 100%, 80.6% to 100%, and 92.31% to 100%, respectively. Retention rates of strip crowns and zirconia ranged from 78% to 100% and 86.36% to 100%. Estimated 3-year and 5-year retention rates, according to Poisson regression, revealed clinically acceptable rates for compomer (71.65% to 100% and 57.38% to 100%), composite resin (82.40% to 100% and 72.43% to 100%), stainless steel (75.65% to 100% and 62.81% to 100%), strip crowns (28.48% to 100% and 12.33% to 100%), and zirconia (44.12% to 100% and 25.57% to 100%). Common biological complications were secondary caries and gingival inflammation, while frequent technical complications included issues with marginal adaptation, shade mismatch, and wear on the opposing tooth.

**Conclusion:** While retentive complications such as chipping, material loss and fractures do occur across materials, crowns fabricated with compomer, composite resin, stainless steel, strip crowns and zirconia all have clinically acceptable retention rates. However, differences noted between materials for biological and technical complications may offer insights for selecting materials for pediatric crowns based on clinical considerations.

**Trial Registration:** PROSPERO CRD42023442266; https://www.crd.york.ac.uk/prospero/display_record.php?RecordID=442266

## Keywords

Crowns; Primary Teeth; Biological Complications; Technical Complications; Survival Rates

## Introduction

A systematic review by Kassebaum et al. highlighted that untreated caries of the primary tooth may affect over 621 million children globally [1]. Moreover, considering that bruxism affects up to 40.6% of children and adolescents [2], the elevated prevalence of caries and parafunction-related risk factors contributes to structural damage in primary teeth [3]. This structural damage is frequently linked to compromised mastication, speech difficulties, challenges in maintaining space for permanent teeth, and psychosocial complications related to aesthetics. This necessitates restorative interventions like pediatric dental crowns to preserve the tooth's functionality and prevent premature loss [4].

Over the years, several studies have documented the usefulness and efficacy of materials such as stainless steel, zirconia, composite resins, and polycarbonate materials for fabricating pediatric dental crowns [5-8]. Despite notable advancements in dental materials and restorative techniques, various biological and technical factors persist in influencing the longevity and acceptability of pediatric dental crowns [8]. Chisini et al., in their systematic review, highlight that composite resins exhibited the lowest annual failure rate (1.7% to 12.9%), while stainless steel crowns (SSC) had the highest success rate (96.1%) [8].

Furthermore, this 2018 systematic review highlighted secondary caries as the main reason for the failure of pediatric crowns and recommended an anti-cariogenic, health-promoting approach [8]. Since the publication of this systematic review, several RCTs have been published, and including these additional articles to arrive at an updated systematic review is a key objective of the article presented herein. Several systematic reviews have also reported on the efficacy of individual restorative materials such as stainless steel, zirconia, and prefabricated crowns [9-11]. As an addition to this accruing body of literature, the systematic review reported herein presents a qualitative assessment of crown retention rates and the impact of technical and biological factors on the overall success and acceptability of crowns for the primary tooth.

Most, if not all available studies on crowns for primary teeth have recruited children aged < 10 years [12-29]. However, the age distribution of the included participants is not commonly reported. This makes it difficult to ascertain the optimal retention rates for ensuring a smooth transition from the primary tooth to the eruption of the permanent tooth. To address this, a quantitative estimation (meta-analysis) of crown retention rates of materials such as stainless steel, zirconia, composite

resins, and polycarbonate materials was performed using a Poisson regression model. Thus, the systematic review and meta-analysis presented herein presents estimated 3-year and 5-year retention rates of crowns for primary/deciduous teeth and provides a qualitative summary of technical and biological factors that influence the success and acceptability of crowns for the primary tooth until the transition from primary to permanent teeth occurs in routine clinical settings.

# Methods

The protocol for this systematic review and meta-analysis [30] was registered with PROSPERO (CRD42023442266) and conducted in accordance with the MOOSE (Meta-Analysis of Observational Studies in Epidemiology) and PRISMA-P (Preferred Reporting Items for Systematic Reviews and Meta-Analysis Protocols) guidelines [31,32].

## Eligibility Criteria

Randomized controlled trials (RCTs) and clinical studies (prospective and retrospective) evaluating crowns fabricated using stainless steel, zirconia, composite resins, compomer, and resin-modified glass ionomer cement (RMGIC) were included. The predefined inclusion criteria for this systematic review encompassed studies with an English abstract that evaluated crown restorations in pediatric patients aged 1-10 years, reporting crown retention data, reasons for retentive loss, and technical and biological complications. Qualitative interviews, quasi-experimental studies, single-case studies, and series of single-case studies were excluded. Additionally, articles based on conference abstracts and dissertations were excluded. Biological factors in this analysis included secondary caries, gingival index, and periodontal pathology. Technical factors included anatomic form, marginal adaptation, color match, surface texture, and wear on the opposing tooth. Success rates, if reported, were also included for the purposes of this systematic review and meta-analysis.

## Data Sources and Search Strategy

Employing a database-appropriate search strategy, electronic databases, including Cochrane, Embase, and PubMed (MEDLINE), were systematically searched to identify RCTs and clinical studies (prospective and retrospective) based on the eligibility criteria described above. The PICOS format for this systematic review/meta-analysis was as follows: Population (P): children with primary tooth decay, Intervention (I): Crown restorations, Comparators (C): materials such as stainless steel, zirconia, composite resins, compomer, and RMGIC, Outcomes (O): crown retention, technical and biological factors, Study Design (S): RCTs and clinical studies (prospective and retrospective). Appendix 1 presents the search syntax employed for searching electronic databases.

The search strategy was considered adequate to reduce the risk of selection and detection bias.

## Selection of Studies

The search results were imported into Zotero, and duplicates were removed to create a virtual library. Two independent reviewers (S.L. and K.D) conducted the literature review and assessed the selection criteria, quality assessments of included RCTs, and prospective clinical studies. Articles meeting the eligibility criteria underwent double and independent data extraction. In case of disagreement, a third expert (D.G.) was consulted, with D.G. serving as a veto. All disagreements were resolved through discussion. Figure 1 presents the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow diagram.

## Risk of Bias Assessments

The Risk of Bias 2 (RoB 2) tool developed by the Cochrane Collaboration was utilized to assess the quality of included RCTs [33]. Two independent reviewers evaluated various bias domains in RCTs, including randomization, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective reporting, and other sources of bias. After assessing each included RCT for risk of bias domains specified by the RoB 2 tool, an overall risk of bias judgment (low, some concerns, or high) was assigned to each trial [33]. A checklist proposed by Moga et al [34] was adapted for assessing the risk of bias in the included prospective and retrospective clinical studies. Only studies with a moderate or low risk of bias were included in the current analysis. Furthermore, a funnel plot was generated to assess for any publication bias.

## Meta-analytic Approach

For quantitative analysis (meta-analysis), retention was defined as the number of crowns that were in situ, regardless of technical and biological complications. Failure rates resulting from retentive complications were calculated by dividing the number of failures by the total exposure time. Exposure time for each included study was calculated by summing the exposure time for all restorations. A Poisson regression model was employed to analyze the calculated rates. Proportions of retained crowns at 3 years and 5 years were estimated with an assumption of constant event rates. The Pearson goodness-of-fit statistics were used to assess the heterogeneity of the model. A *P*-value <.05 was considered significant. All analyses were performed using R Statistical software (version 4.1.2; R Core Team).

# Results

## Selection of Studies and Risk of Bias Assessments

A total of 13 RCTs and 5 clinical studies (prospective and retrospective) were included in this systematic review [12-29]. Figure 1 presents the PRISMA flow diagram illustrating the study selection process. Tables 1 and 2 provide the risk of bias assessments for the included RCTs and clinical studies, respectively.

## Qualitative Analysis of the Included Studies

Table 3 summarizes the 13 included RCTs, presenting data on crown retention and retentive complications [12-24]. Conducted between 2014 and 2022, these RCTs involved 454 children who received a total of 1172 crowns [12-24]. The follow-up duration ranged from 6 to 36 months (median: 12 months; interquartile range (IQR): 9 months), with a cumulative dropout rate of 10.58% (124 out of 1172 crowns). Table 4 outlines the 5 included clinical studies, reporting data on crown retention and retentive complications [25-29]. Spanning from 2008 to 2020, these studies included 810 children, with a follow-up duration ranging from 12 to 24 months (median: 20.8 months; IQR: 5 months) [25-29].

## Crown Retention and Related Complications

Figure 2 provides a descriptive analysis of retention rates for crowns fabricated with different materials, as reported in the included RCTs [12-24]. Retention rates varied between 77.8% and 100%, 80.6% and 100%, and 92.31% and 100% for compomer, composite resins, and stainless steel, respectively. Additionally, retention rates for strip crowns and zirconia ranged from 78% to 100% and 86.36% to 100%, respectively. Figure 3 illustrates various retentive complications reported in the RCTs for different materials. Regarding clinical studies, debonding and loss of crown were reported for zirconia crowns, while crown fractures were reported for composite resins (Table 4) [25-29].

## Biological Complications Reported in the Included Studies

Figure 4 depicts the distribution of biological complications reported in the included RCTs [12-24]. In the prospective and retrospective clinical studies, 8.3% of children receiving compomer crowns and 8.8% receiving composite resins reported secondary caries [25-29]. Additionally, 3.3% and 21.83% of children with stainless steel crowns and zirconia crowns, respectively, in these studies exhibited gingival inflammation [25-29].

## Technical Complications Reported in the Included Studies

Table 5 outlines the distribution of technical complications reported in the included RCTs [12-24]. In the prospective and retrospective clinical studies, 13.33% and 22.22% of stainless steel and compomer crowns, respectively, had marginal adaptation complications [25-29]. Moreover, 8.3% and 5.6% of compomer crowns showed marginal discoloration and plaque retention complications [25-29]. Among the 157 zirconia crowns reported in the studies, 10.19% exhibited shade mismatch, and 3.82% had marginal integrity complications [25-29].

## Quantitative Analysis (Meta-analysis) of the Included Studies

Table 6 presents the estimated 3-year and 5-year retention rates of crowns fabricated using various materials, as reported in the included RCTs [12-24]. The Pearson goodness-of-fit test, conducted to assess heterogeneity and determine the need for employing random-effects Poisson regression, did not show statistical significance for any of the individual groups and rates ($P > 0.05$). Therefore, standard Poisson regression was used for estimating the parameters.

# Discussion

The systematic review scrutinized data from 13 RCTs involving 454 children (1172 crowns) with a median follow-up of 12 months, and 5 prospective/retrospective studies involving 810 children (2667 crowns) with a median follow-up of 20.8 months [12-29]. Two crucial aspects emerged from these studies that bear implications for evidence-based decision-making regarding the performance of crowns for primary teeth. Firstly, the included RCTs displayed a notable prevalence of allocation concealment, performance bias, and detection bias (Table 1) [12-24]. These biases, inherent to the nature of interventions that often preclude optimal double-blinding, necessitate careful consideration in assessing the risk of bias for studies involving crowns for primary teeth. These findings align with a previous systematic review by Chisini et al., which also identified a high risk of bias [8]. Secondly, the age distribution of the study population is often not reported, posing challenges in determining optimal retention rates for a smooth transition from primary to permanent teeth, especially in younger age groups. Children in the RCTs and prospective/retrospective studies ranged from 1 to 10 years and 3 to 10 years, respectively [12-29]. The reported crown retention rates for different age groups suggest potential nuances in the transition from primary to permanent teeth, underscoring the need for future studies to provide detailed age-distribution data. To address the confounders related

to age-distribution, a Poisson regression model was employed to estimate 3-year and 5-year retention rates (Table 6). The results indicated clinically acceptable crown retention rates for compomer, composite resin, stainless steel, strip crowns, and zirconia. These findings align with the crown retention rates reported in the included RCTs and prospective/retrospective clinical studies (Figure 2 and Table 4), demonstrating high retention rates for stainless steel, zirconia, and composite resins. This corroborates with the findings of Chisini et al., which highlighted the highest success rate with stainless steel crowns and the lowest annual failure rates with composite resins [8]. Retention complications such as chipping, material loss, and loss of crowns were more frequently reported for strip crowns, composite resins, and zirconia in the included RCTs (Figure 3). The observed retention superiority of stainless steel crowns aligns with previous studies [8,35,36].

Effective mitigation of biological complications is crucial for the success of crowns for primary teeth [8]. Across materials, secondary caries emerged as a significant biological complication in the included RCTs (Figure 4). The uncertainty regarding rankings for caries risk adjacent to different materials, as noted by Askar et al. [37], emphasizes the need for an anti-cariogenic health-promoting approach in managing crowns for primary teeth. Gingival inflammation was more prevalent with composite resins and least with Zirconia Crowns in the current study (Figure 4), in agreement with reports from Pei et al. and El-Kalla et al. [38, 39]. The conflicting data on plaque accumulation on zirconia crowns, as noted by Pei et al., underscores the importance of considering heterogeneity among studies before assigning material rankings for biological complications [38].

Regarding technical complications, compomer was associated with the highest marginal adaptation issues (Table 5). However, the limited number of studies on compomer in this review should be acknowledged (Table 3). El-Kalla's observation that compomers showed good adaptation at the cavosurface margin, except in non-etched class V cavities restored with Dyract, adds contextual understanding [39]. Marginal staining and shade mismatch were notable issues with composite resins and strip crowns. Stainless steel and strip crowns exhibited the highest wear on the opposing tooth. While wear on the opposing tooth with stainless steel seems related to material strength, conflicting data exist in other studies regarding material superiority concerning wear on the opposing tooth [40-42].

The assessment of publication bias in our meta-analysis revealed noteworthy findings. The Egger's test for zirconia crowns suggested potential publication bias (Figure 5A). In contrast, for stainless steel (Figure 5B), composite resins (Figure 5C), and strip crowns (Figure 5D), the limited number of studies precluded robust evaluation of small study effects. Thus, caution is warranted in interpreting these outcomes due to the small sample size. The significant results indicate asymmetry in the funnel plot, potentially influencing effect size estimates. Acknowledging these limitations is crucial, as

publication bias may impact the generalizability of findings. Future research with an increased number of studies is essential for a more comprehensive understanding of outcomes associated with these materials.

## Conclusion

Despite the high prevalence of bias in the included studies, the systematic review indicates that crowns for primary teeth fabricated with stainless steel, zirconia, and composite resins exhibit good retention rates. Furthermore, results of the Poisson regression indicate that all the materials reported herein may have good retention rates at 3-years and 5-years. While currently available data do not support material ranking with respect to technical and biological complications, operative and clinical adjustments seem mandated to optimize the usefulness, longevity and satisfaction with crowns for primary teeth.

## Conflicts of Interest

Authors declare no conflicts of interests

## Funding

Nil

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## Tables

**Table 1: Risk of bias assessments of the included RCTs using the Cochrane RoB tool**

| Sl.No. | Author (Publication Year) | Selection Bias | | Performance Bias | Detection Bias | Attrition Bias | Reporting Bias | Other Bias |
|---|---|---|---|---|---|---|---|---|
| | | Random Sequence Allotment | Allocation Concealment | Blinding of participants and personnel | Blinding of outcome assessment | Incomplete Outcome data | Selective Reporting | Funding/ conflicts of interest |
| 1 | Zulekha *et al.* (2022)[12] | | | | | | | |
| 2 | Vaghela *et al.* (2021)[13] | | | | | | | |
| 3 | Talekar *et al.* (2021)[14] | | | | | | | |
| 4 | Hanafi *et al.* (2021)[15] | | | | | | | |
| 5 | Güçlü *et al.* (2021)[16] | | | | | | | |
| 6 | Nischal *et al.* (2020) [17] | | | | | | | |
| 7 | Mathew *et al.* (2020)[18] | | | | | | | |
| 8 | Gill *et al.* (2020)[19] | | | | | | | |
| 9 | Taran *et al.* (2018)[20] | | | | | | | |
| 10 | Donly *et al.* (2018)[21] | | | | | | | |
| 11 | Donmez *et al.* (2016)[22] | | | | | | | |
| 12 | Sengul *et al.* (2015)[23] | | | | | | | |
| 13 | Walia *et al.* (2014)[24] | | | | | | | |

Note: Red: High risk of bias; Yellow: moderate risk of bias; Green: low risk of bias

**Table 2: Risk of bias assessments of the included prospective and retrospective clinical studies**

| Sl.No | Author | Domain 1 | Domain 2 | Domain 3 | Domain 4 | Domain 5 | Domain 6 | Domain 7 | Overall |
|---|---|---|---|---|---|---|---|---|---|
| | | Study design | Population | Intervention | Outcomes | Statistical analysis | Results/ Conclusion | Competing Interests | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Prabhu *et al*. (2022)[25] | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ |
| 2 | Al Hissan *et al.* (2021)[26] | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ |
| 3 | Holsinger *et al.* (2016)[27] | ++ | ++ | ++ | ++ | ++ | ++ | - | + |
| 4 | Bucher *et al.* (2015)[28] | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ |
| 5 | Daou *et al.* (2008)[29] | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ |
| Judgement guide: ++ low; + moderate; - serious; ! critical | | | | | | | | | |

**Table 3: Summary of included RCTs along with their crown retention data**

| Author (Publication year) | Number of Children | Age (years) | Number of Tooth | Tooth type | Crown Material | Dropout | Follow up duration (months) | Crown Retention (%) | Retention Complications |
|---|---|---|---|---|---|---|---|---|---|
| Zulekha et al. (2022)[12] | 25 | 3 to 5 | 25 | Incisors | One shade composite resin | 0 (0) | 12 | 100 | None |
| | | | 25 | | Composite resin | 0 (0) | 12 | 100 | None |
| Vaghela et al. (2021)[13] | 31 | 3 to 6 | 55 | Incisors | Strip Crowns | 4 (7.27) | 9 | 80.4 | Chipping (4); material loss (6) |
| | | | 47 | | Zirconia | 2 (4.25) | 9 | 97.8 | Complete loss of crown (1) |
| Talekar et al. (2021)[14] | 30 | 4 to 9 | 33 | Molars | Glass-reinforced resin | 1 (3.03) | 18 | 87.8 | Chipped 13, ccl;1 |
| | | | 33 | | Zirconia | 1 (3.03) | 18 | 93.93 | none |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Hanafi et al. (2021)[15] | 44 | 5 to 9 | 31 | Molars & incisors | CCZC | 1 (3.22) | 6 | 100 | None |
| | | | 32 | | NZC | 1 (3.12) | 6 | 96.87 | Crown Fracture (1) |
| Güçlü et al. (2021)[16] | 26 | 1 to 10 | 11 | Molars & incisors | Strip Crowns | 4 (15.38) | 6 | 100 | None |
| | | | 22 | | Zirconia | | 6 | 86.36 | Decementation (3) |
| | | | 13 | | Stainless steel | | 6 | 100 | None |
| Nischal et al. (2020)[17] | 45 | Not Known | 15 | Incisors | Strip Crowns | Not Known | 9 | 80 | loss of bulk (2) |
| | | | 15 | | Zirconia | | 9 | 100 | None |
| | | | 15 | | Luxa | | 9 | 80 | loss of bulk (2) |
| Mathew et al. (2020)[18] | 30 | 6 to 8 | 30 | Molars | Zirconia | Not Known | 36 | 100 | None |
| | | | 30 | | Stainless steel | | 36 | 100 | None |
| Gill et al. (2020)[19] | 49 | 2 to 4 | 70 | Incisors | Strip Crowns | 22 (31.42) | 12 | 79 | Partial material loss (6); Complete material loss (3) |
| | | | 70 | | Zirconia | 30 (42.85) | 12 | 95 | Partial material loss (1) |
| | | | 80 | | Stainless steel | 33 (41.25) | 12 | 100 | None |
| Taran et al. (2018)[20] | 13 | 6 to 9 | 26 | Molars | Zirconia | Not Known | 12 | 98 | Decementation (2) |
| | | | 26 | | Stainless steel | | 12 | 92.31 | None |
| Donly et al (2018)[21] | 50 | 3 to 7 | 50 | Molars | Zirconia | Not Known | 24 | 100 | None |
| | | | 50 | | Stainless steel | | 24 | 100 | None |
| Donmez et al. (2016)[22] | 31 | 4 to 7 | 31 | Molars | RMGIC | 2 (6.45) | 18 | 90.3 | Poor anatomic form (3) |
| | | | 31 | | Compomer | 1 (3.22) | 18 | 100 | None |
| | | | 31 | | Composite resin | 4 (12.90) | 18 | 80.6 | Poor anatomic form (3) |
| Sengul et al. (2015)[23] | 41 | 5 to 7 | 40 | Molars | Hybrid composite resin | 0 (0) | 24 | 92.5 | Crown fracture (3) |
| | | | 32 | | RMGIC | 0 (0) | 24 | 90.3 | Crown fracture (3) |
| | | | 36 | | Compomer | 0 (0) | 24 | 77.8 | Crown fracture (8) |
| | | | 38 | | Giomer | 0 (0) | 24 | 89.5 | Crown fracture (4) |
| Walia et al. (2014)[24] | 39 | 3 to 5 | 43 | Incisors | Strip Crowns | 7 (16.27) | 6 | 78 | Partial material loss (2); Complete loss of crown (7) |
| | | | 43 | | Zirconia | 5 (11.62) | 6 | 100 | None |
| | | | 43 | | Stainless steel | 6 (13.95) | 6 | 95 | Partial material loss (2) |

**Table 4: Summary of included prospective/ retrospective studies along with their crown retention data**

| Author | # of Children | Age | #ofTooth | Tooth type | Crown Material | Follow up | Crown retention | Complications |
|---|---|---|---|---|---|---|---|---|
| Prabhu *et al.* (2022)[25] | 60 | 6 to 10 | 30 | Molars | Stainless Steel | 24 months | 100 | None |
| | | | 30 | | Zirconia | | 100 | None |
| Al Hissan *et al.* (2021)[26] | 20 | 3 to 5 | 70 | Incisors | Zirconia | 24 months | 80 | Debonding (18.57%); Failure without debonding (1.43%) |
| Holsinger *et al.* (2016)[27] | 18 | Not reported | 57** | Incisors | Zirconia | 20.8 months* | 96 | Complete loss of crown (4%) |
| Bucher *et al.* (2015)[28] | 667 | Not Known | 2388 | Molars/ incisors | Composite fillings | 19 months | 82.8 | Technical failures (8.3%) |
| Daou *et al.* (2008)[29] | 45 | 6 to 8 | 39 | Molars | PMRC | 12 months | 100 | None |
| | | | 37 | | RMGIC | | 100 | None |
| | | | 35 | | HVGIC | | 100 | None |
| | | | 38 | | Amalgam | | 100 | None |

**Table 5: Percentage of technical complications reported in the included RCTs[12-24]**

| | Surface roughness | Occlusal wear | Marginal adaptation | Marginal discoloration | Marginal integrity | Staining | Plaque retention | Shade mismatch | Opposing tooth wear |
|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Compomer (n=67)** | 0 | 0 | 28.95 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Composite resin (n=154)** | 1.29 | 11.03 | 5.19 | 1.29 | 0 | 15.58 | 12.98 | 29.22 | 0 |
| **Stainless steel (n=242)** | 0 | 0 | 0 | 0 | 0.41 | 2.89 | 0 | 0 | 13.63 |
| **Strip Crowns (n=194)** | 0 | 0 | 7.21 | 0 | 3.6 | 3.09 | 0 | 21.13 | 15.97 |
| **Zirconia (n=399)** | 0.25 | 0 | 0.5 | 0 | 1 | 1.75 | 0.5 | 4.76 | 8.52 |

**Table 6: Estimated 3-year and 5-year crown retention rates in primary tooth from data reported in the included RCTs[12-24]**

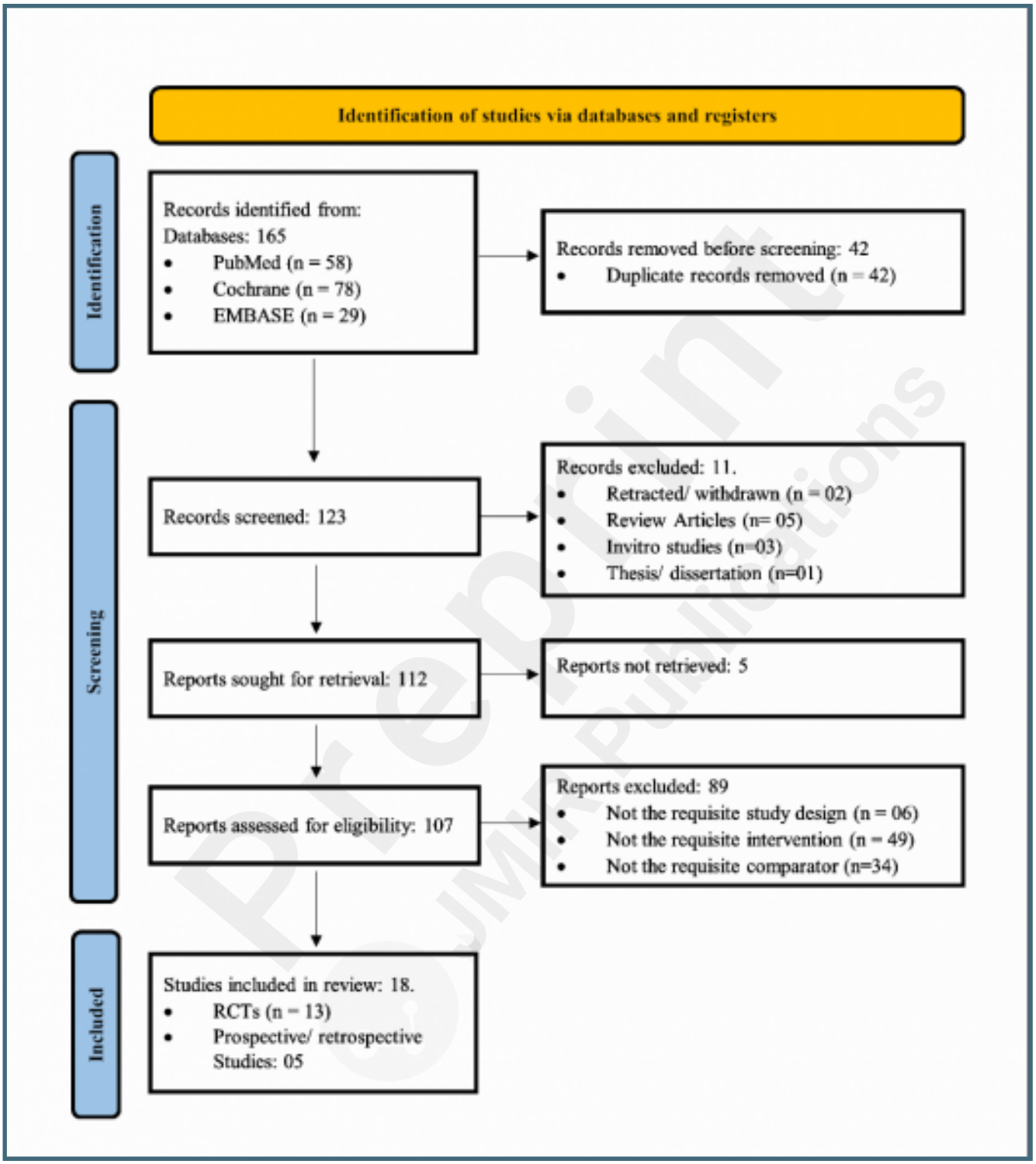
| **Author (Publication Year)** | **Crown Material** | **Exposure time** | **Estimated failure rate per crown year** | **Estimated 3-year Retention rate (%)** | **Estimated 5-year Retention rate (%)** |
|---|---|---|---|---|---|
| Zulekha et al. (2022)[12] | One shade composite resin | 300 | 0.00 | 100.00 | 100.00 |
| | Composite resin | 300 | 0.00 | 100.00 | 100.00 |
| Walia et al. (2014)13 | Strip Crowns | 258 | 0.42 | 28.48 | 12.33 |
| | Zirconia | 258 | 0.00 | 100.00 | 100.00 |
| | Stainless steel | 258 | 0.09 | 75.65 | 62.81 |
| Vaghela et al. (2021) | Strip Crowns | 495 | 0.24 | 48.32 | 29.76 |
| | Zirconia | 423 | 0.03 | 91.84 | 86.78 |
| Taran et al. (2018) | Stainless steel | 312 | 0.00 | 100.00 | 100.00 |
| | Zirconia | 312 | 0.08 | 79.39 | 68.07 |
| Talekar et al. (2021) | Glass-reinforced resin | 594 | 0.28 | 42.81 | 24.31 |
| | Zirconia | 594 | 0.00 | 100.00 | 100.00 |
| Sengul et al. (2015) | Hybrid composite resin | 960 | 0.04 | 89.36 | 82.90 |
| | RMGIC | 768 | 0.05 | 86.88 | 79.11 |
| | Compomer | 864 | 0.11 | 71.65 | 57.38 |
| | Giomer | 912 | 0.05 | 85.39 | 76.86 |
| Nischal et al. (2020) | Strip Crowns | 135 | 0.18 | 58.66 | 41.11 |
| | Zirconia | 135 | 0.00 | 100.00 | 100.00 |
| | Luxa | 135 | 0.18 | 58.66 | 41.11 |

| | | | | | |
|---|---|---|---|---|---|
| Mathew et al. (2020) | Zirconia | 1080 | 0.00 | 100.00 | 100.00 |
| | Stainless steel | 1080 | 0.00 | 100.00 | 100.00 |
| Hanafi et al. (2021) | Zirconia | 186 | 0.00 | 100.00 | 100.00 |
| | Zirconia | 192 | 0.06 | 82.90 | 73.16 |
| Güçlü et al. (2021) | Strip Crowns | 66 | 0.00 | 100.00 | 100.00 |
| | Zirconia | 132 | 0.27 | 44.12 | 25.57 |
| | Stainless steel | 78 | 0.00 | 100.00 | 100.00 |
| Gill et al. (2020) | Strip Crowns | 840 | 0.13 | 68.00 | 52.58 |
| | Zirconia | 840 | 0.01 | 95.80 | 93.11 |
| | Stainless steel | 960 | 0.00 | 100.00 | 100.00 |
| Donmez et al. (2016) | RMGIC | 558 | 0.06 | 82.40 | 72.43 |
| | Compomer | 558 | 0.00 | 100.00 | 100.00 |
| | Composite resin | 558 | 0.06 | 82.40 | 72.43 |
| Donly et al. (2018) | Zirconia | 1200 | 0.00 | 100.00 | 100.00 |
| | Stainless steel | 1200 | 0.00 | 100.00 | 100.00 |

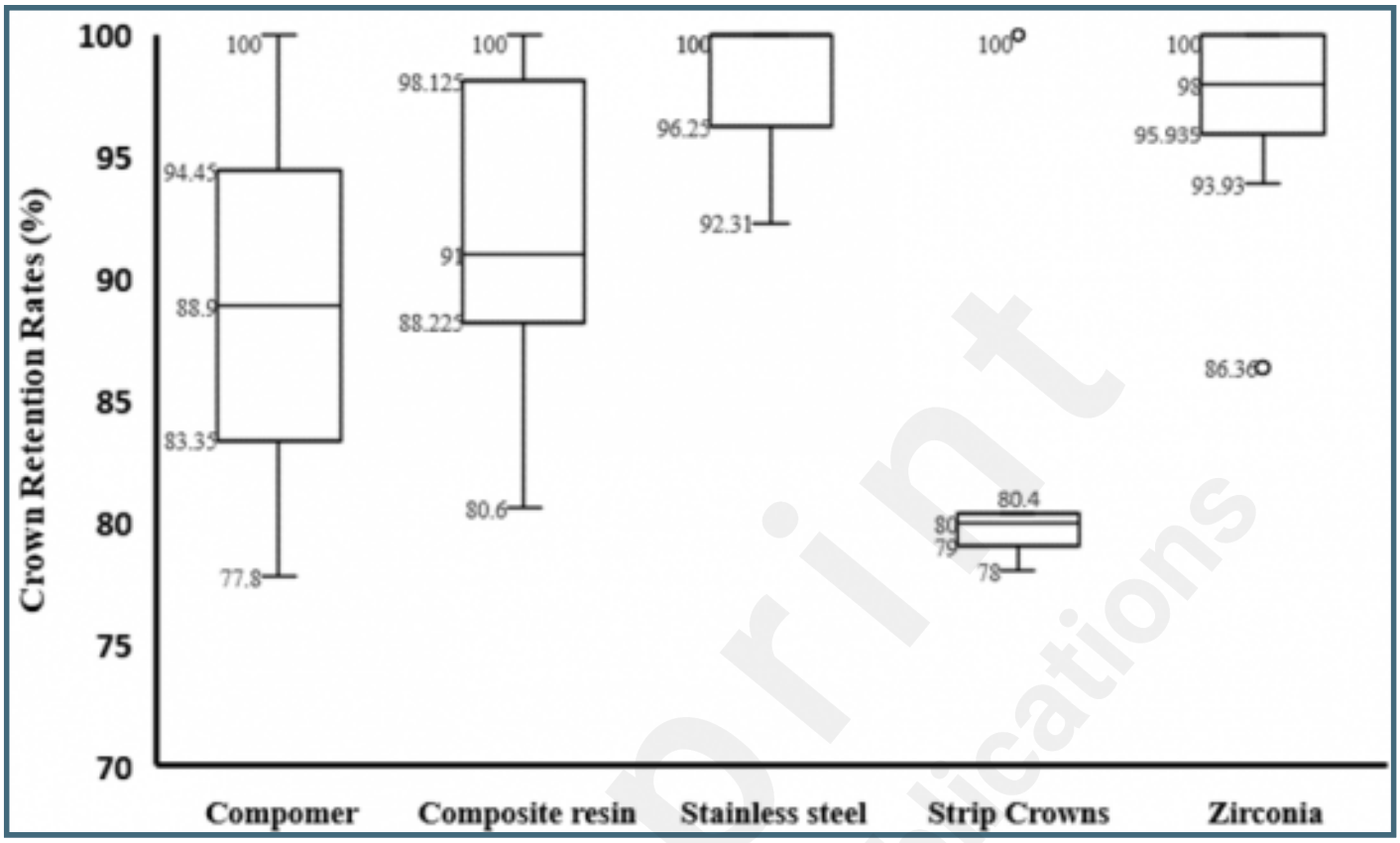
# Supplementary Files

# Figures

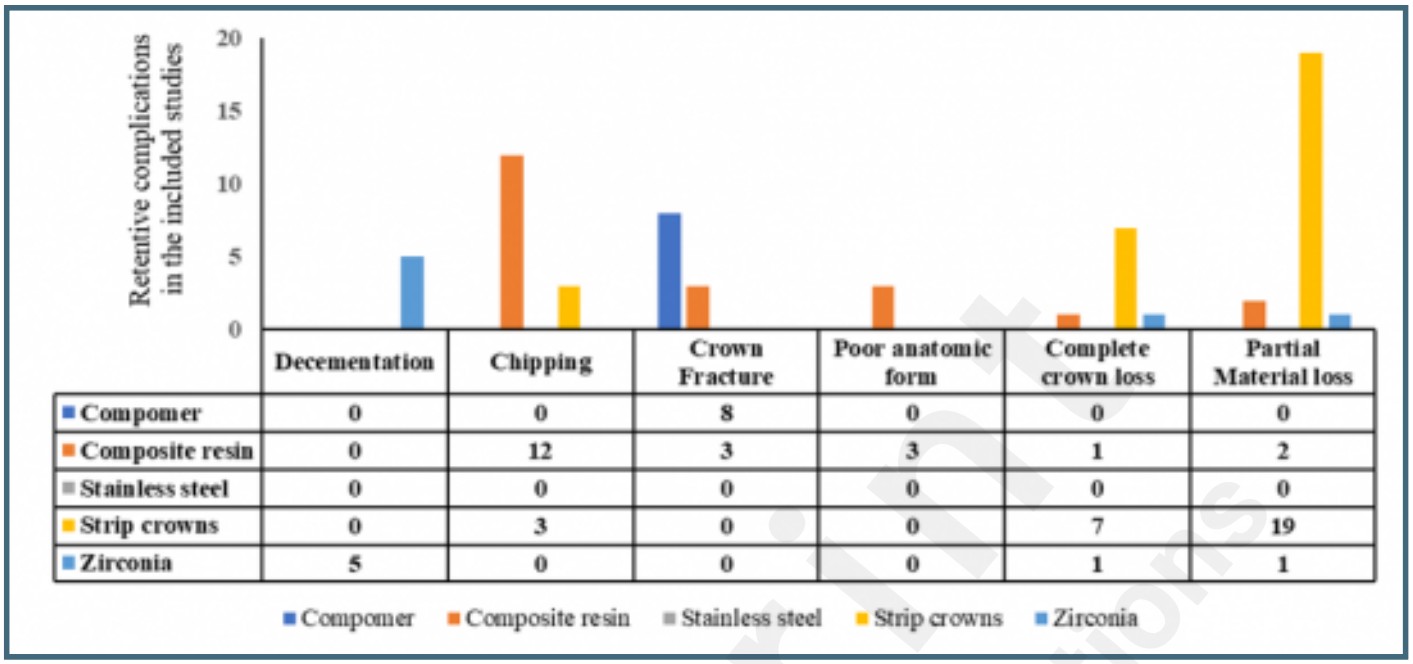
PRISMA flow diagram for selection of studies included in the systematic review and meta-analysis.



Crown retention rates reported for crowns fabricated with various materials in the included RCTs.

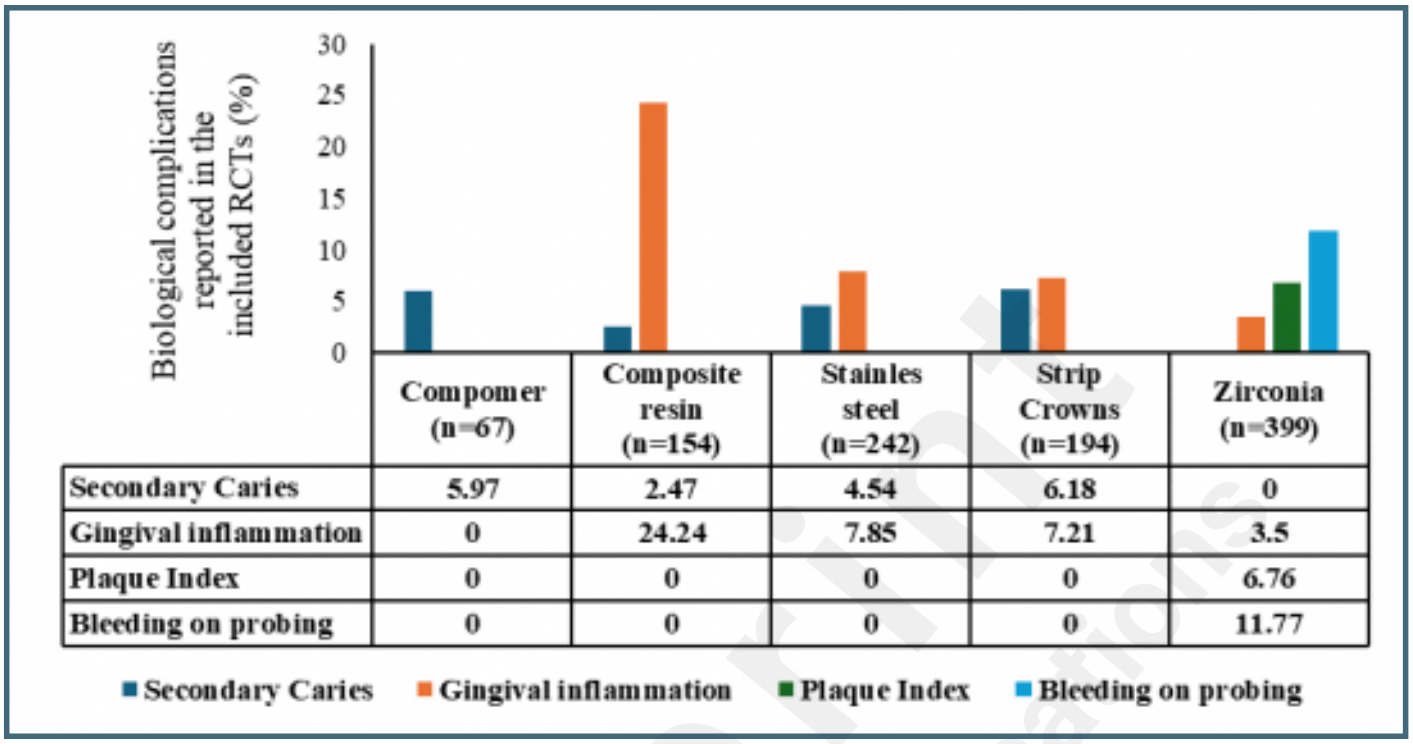


Retentive complications reported in the included RCTs for different materials.



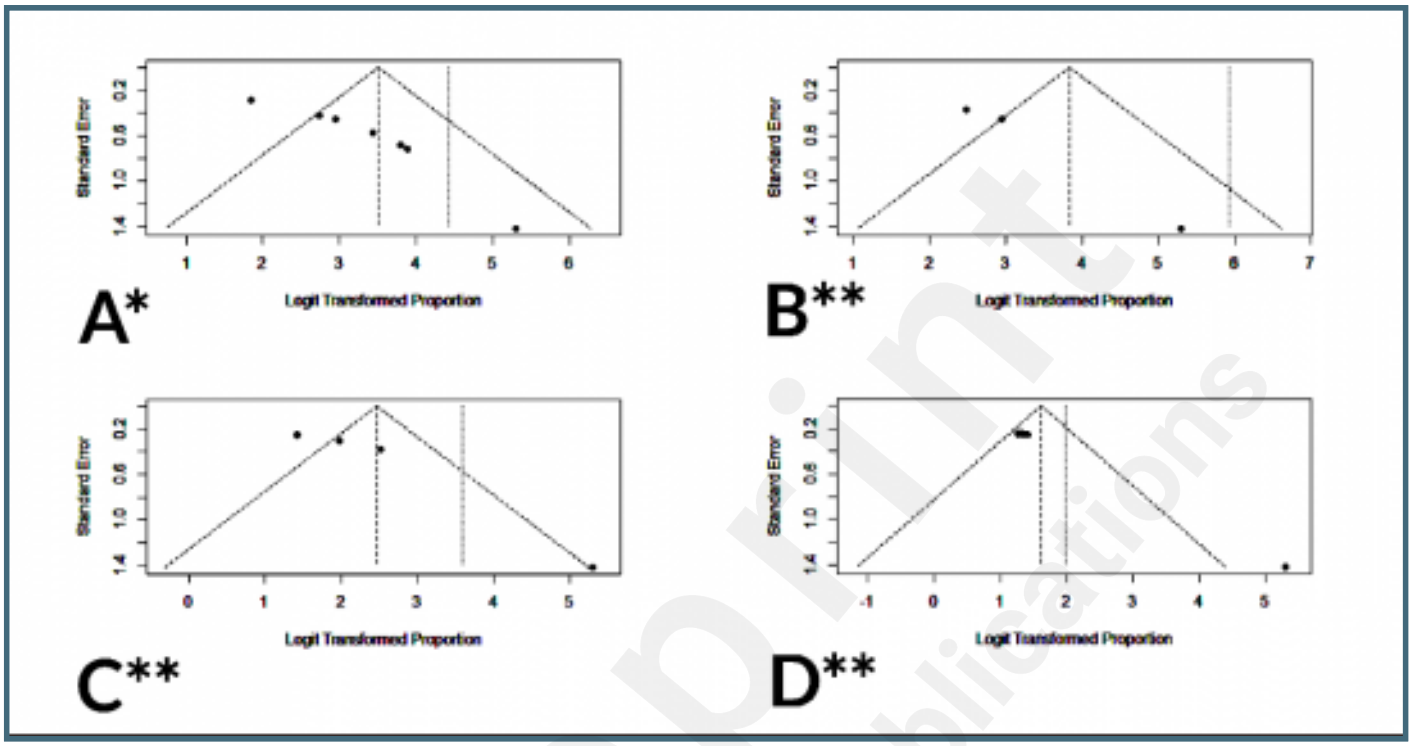

| | Decementation | Chipping | Crown Fracture | Poor anatomic form | Complete crown loss | Partial Material loss |
|---|---|---|---|---|---|---|
| Compomer | 0 | 0 | 8 | 0 | 0 | 0 |
| Composite resin | 0 | 12 | 3 | 3 | 1 | 2 |
| Stainless steel | 0 | 0 | 0 | 0 | 0 | 0 |
| Strip crowns | 0 | 3 | 0 | 0 | 7 | 19 |
| Zirconia | 5 | 0 | 0 | 0 | 1 | 1 |

Biological complications reported in the included RCTs for different materials.




| | Compomer (n=67) | Composite resin (n=154) | Stainles steel (n=242) | Strip Crowns (n=194) | Zirconia (n=399) |
|---|---|---|---|---|---|
| Secondary Caries | 5.97 | 2.47 | 4.54 | 6.18 | 0 |
| Gingival inflammation | 0 | 24.24 | 7.85 | 7.21 | 3.5 |
| Plaque Index | 0 | 0 | 0 | 0 | 6.76 |
| Bleeding on probing | 0 | 0 | 0 | 0 | 11.77 |

Funnel plots for assessments of publication bias in the included studies for zirconia (A), stainless steel (B), composite resins (C) and strip crowns (D). *Egger's test :t = 9.07, df = 9, P-value < 0.0001. **The number of studies was below the recommended threshold for robustly assessing publication bias and the potential for small study effects should be considered with prudence.



# Multimedia Appendixes

Search Syntax Used for Searching Databases.
URL: http://asset.jmir.pub/assets/35078e31efc0d142bf81997874b40cb0.docx

# TOC/Feature image for homepages

Pediatric crowns.