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RESEARCH ARTICLE

Systematic reviews in restorative dentistry: discussing relevant aspects

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Abstract

Objective: This article aims to discuss key aspects of systematic reviews (SR) focusing on the improvement of the conduct and reporting.

Methods: Important aspects of SRs, such as prospective registration of the review protocol, basic structure, inclusion criteria, use of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Statement, confidence in the results and future directions are discussed. To determine relevant aspects, a search was conducted without date limitations in PubMed (October 15th, 2017) to identify SRs written in English evaluating clinical performance of direct composite resin restoration in permanent posterior teeth or comparing direct composite resin with other material/techniques. The quality of SRs included was assessed using the Assessing the Methodological Quality of Systematic Reviews 2 tool.

Results: Fifteen SRs were included. The overall confidence in the results of SRs was classified as critically low. Some aspects should be highlighted: SRs of in vitro studies are an important tool in restorative dentistry, and initiatives such as the PRISMA Statement and PROSPERO should be considered a standard code of practice.

Conclusions: The compliance with and awareness of the discussed aspects may be a significant feature of the improvement of SR quality in the dentistry.

Clinical significance: Initiatives such as the PRISMA Statement and PROSPERO should be taken in account by systematic reviewers in dentistry to improve the conduct and reporting of SRs, and to make their reviews are more clinically helpful.

KEYWORDS

PRISMA, PROSPERO, reproducibility, restorative dentistry, systematic reviews, transparency

1 | INTRODUCTION

Systematic reviews (SRs) are considered the best tool to aid the healthcare decision-making process based on methodological rigor and because they synthesize all studies addressing a specific question. In addition, through SRs, researchers can identify gaps in the literature and inform future research agendas.[1] Nevertheless, when SRs are poorly performed and reported, like all research, their utility may be limited.[2]

A recent study suggested that more than 8 000 SRs are indexed in MEDLINE annually, corresponding to a threefold increase over the last decade. In addition, in many situations, SRs were poorly conducted, resulting in important flaws such as imprecise estimates of treatments and inaccurate conclusions.[3,4] A similar trend has occurred in dentistry—one estimate suggested that 1 188 SRs focused on oral health interventions were published between 1991 and 2012[5] with many publications showing that the quality of SRs published varies widely across dental specialties.[6–8]

Although many SRs are published in dentistry, important elements of SRs, such as the use of the PRISMA Statement to facilitate complete and transparent reporting and prospective registration of SR protocols through PROSPERO (crd.york.ac.uk/PROSPERO/), as another measure of conduct transparency, are scarcely disclosed.[9,10] This suggests that there is room for improvement in the conduct and reporting of SRs, and consequently the effort of all stakeholders is necessary to implement the tools already available. This article aims to discuss certain key aspects

that should be taken in account by systematic reviewers in dentistry to improve the conduct and reporting of SRs, and to make their reviews are more clinically helpful. In addition, we highlight the importance of transparency in all steps of SR process from protocol to final manuscript, which will help the reproducibility of SRs. To discuss relevant aspects of the SR process, we selected published SRs evaluating clinical performance of direct composite resin restoration in permanent posterior teeth or comparing direct composite resin with other material/techniques and evaluated the quality of these SRs using the AMSTAR 2 tool.[11]

2 | MATERIALS AND METHODS

2.1 | Protocol

This Study was not registered in PROSPERO since PROSPERO indicates that "Reviews of methodological issues need to contain at least one outcome of direct patient or clinical relevance in order to be included in PROSPERO." However, the study selection is an update of the study of Aquino et al.'s 2017[12] and the protocol is available on request.

2.2 | Search and eligibility criteria

A search was conducted without date limitations in PubMed to identify SRs written in English that met the following Patient, Intervention, Comparison, Outcome, Studies (PICOS) description: P: adults over 18 years of age I: direct composite resin restoration in posterior teeth; C: other materials/techniques used in posterior teeth; O: any clinical outcome, and S: SRs and that met the Preferred Reporting Items for SR and Meta-Analysis Protocols (PRISMA-P) definition of a SR.[13] SRs should be based on explicit methods for identifying studies, study selection, and data synthesis. The search strategy is available in the previous publication[12] and the date of the last search was October 15th, 2017.

2.3 | Screening method

Titles and abstracts retrieved were assessed based on inclusion criteria by one author (RSO). The full-texts articles of the records classified as include and uncertain were screened by the same author. The study selection was performed by one reviewer because this study is an update of the study of Aquino et al.'s 2017.

2.4 | Data extraction

One author (RSO) collected the following data: author/year, journal, if the SR was an update of previous study, if the registration of the SR protocol was reported in the article, if the author reported use of PRISMA Statement, intervention and comparator evaluated, design of the studies included in the SRs, outcomes and main results.

2.5 | Quality appraisal

To determine the quality of SRs, one author applied A MeaSurement Tool to Assess Systematic Reviews 2 (AMSTAR 2)[11] in the included SRs and all information was reviewed twice. In addition, the corresponding authors of included SRs were contacted by e-mail and they were invited to review our quality assessments to ensure the information was correctly extracted. A reminder was sent if the author did not return the e-mail after 2 weeks. Discrepancies between our responses and the responses of authors of SRs included were discussed between two authors of this study (RSO and TPC).

The AMSTAR 2 contains 16 items related to the conduct of SRs of randomized controlled trials and nonrandomized studies, among them, seven items are considered critical domains. Based on the responses of critical and noncritical items, the overall confidence in the results of the SR is classified in high, moderate, low, or critically low. More details about AMSTAR 2 tool, including all questions are available in the Supporting Information Appendix A.

2.6 | Data synthesis

Tables were generated to summarize the included SRs and results.

3 | RESULTS AND DISCUSSION

Fifteen SRs fulfilled the eligibility criteria.[14–28] Eleven studies are from Aquino et al.'s study[12] and four from the update. The PRISMA 2009 flow diagram is available in Supporting Information Appendix B. The characteristics of the studies are presented in Table 1. Table 2 presents the AMSTAR 2 results of 15 included SRs considering that 12 of the corresponding authors returned our email.[14,16,17,19–26,28] Among them, one sent a document available only in German with information about the SR and it was impossible to evaluate due language restrictions of our team.[16]

The characteristics of included SRs and the results of critical appraisal are discussed in the next sections of the article together of key aspects used as measure of transparency and that can affect directly the confidence in the results and the reproducibility of SRs. All aspects should be taken in account by researchers to improve the conduction and reporting of SRs and to ensure the reproducibility.

3.1 | Basic structure of SR

To carry out any type of research, it is necessary to know all that is involved in the study. Although this sentence sounds like a clichéd remark, many of the items summarized in this section are poorly reported or simply omitted, generating a huge impact on the outcomes of a SR. The Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P) 2015 statement defines a systematic review as a study with the goal to collecting all evidence that fits some certain pre-specified criteria addressing a specific answer. SRs should be based on explicit methods for identifying studies, study selection and data synthesis.[13]

TABLE 1 Characteristics of included studies

Author/Year	Journal	Updated SR	Prospective register of Protocol	Use of PRISMA Statement	Comparison	Design of included studies	Outcomes	Conclusion
Afrashtehfar et al., 2017	Journal of Prosthetic Dentistry	No	No	SR conducted according to the PRISMA	Crowns vs composite resin vs amalgam	RCTs, quasiexperimental studies and observational	Complete or partial loss of the restoration that required replacement or repair	Amalgam seems to perform better than composite resin
Angeletaki et al., 2016	Journal of Dentistry	No	No	SR based on the guidelines of PRISMA	Direct vs indirect inlays/onlays composite restorations	RCTs	Secondary caries, postoperative sensitivity, marginal discoloration, color match between groups	Similar longevity
Antony et al., 2008	GMS Health Technology Assessment	No	No	No	Amalgam vs composite materials	Unclear	Longevity	Favors amalgam
Ástvaldsdóttir et al., 2015	Journal of Dentistry	No	No	No	Resin composite restorations	RCTs, prospective CCT, Prospective observational study without comparison group	Failures according the included studies	High survival
Beck et al., 2015	Dental Materials	Yes	No	No	Direct resin restorations	Prospective clinical studies (randomized and nonrandomized)	Failures according the included studies	Failure rate increases with longer time observation periods
da Veiga et al., 2016	Journal of Dentistry	No	Yes	Only in Protocol	Direct vs indirect resin composite	RCTs	Failures according the included studies	No difference in the longevity
Grivas et al., 2014	European Journal of Prosthodontics and Restorative Dentistry	No	No	No	Indirect composite inlays vs direct composite restoration vs cerami and gold inlays	RCTs, CCTs	Longevity, colour match, postoperative pain	Insufficient evidence to identify any difference among restorations
Heintze et al., 2012	Journal of Adhesive Dentistry	No	No	No	Class II amalgam restoration vs resin composite	Prospective clinical studies (randomized and nonrandomized)	Marginal discoloration, marginal integrity, caries adjacent to restoration, material fracture, anatomical shape, color match, surface texture, retention, postoperative hypersensitivity	Similar longevity
Magno et al., 2016	Journal of Adhesive Dentistry	No	Yes	No	Silorane-based composite vs methacrylate-based composite	RCTs	Marginal adaptation and discoloration, restoration loss, secondary caries, and postoperative hypersensitivity	Similar performance
	The Open Dentistry Journal	No	Yes	No		Prospective clinical control trial (randomized)		Similar failure rate

(Continues)

TABLE 1 (Continued)

Author/Year	Journal	Updated SR	Prospective register of Protocol	Use of PRISMA Statement	Comparison	Design of included studies	Outcomes	Conclusion
Mickenautsch and Yengopal, 2015					High-viscosity glass-ionomer vs Hybrid resin composite restoration		Fracture, wear, secondary caries, retention loss	
Monsarrat et al., 2017	Dental Materials	No	No	Followed the PRISMA to identify any study…	Ormocer vs conventional composite restoration	RCTs, CCTs	Need to repair, remove or replace the restoration	Better clinical behavior of conventional composite restoration
Moraschini et al., 2015	Journal of Dentistry	No	No	The methodology followed the PRISMA	Amalgam vs resin composite	RCTs, CCTs, retrospective/prospective cohort studies	Failure of restoration, secondary caries and fractures	Composite resin restorations have less longevity and higher number of secondary caries compared to amalgam. In relation to fracture, there is no difference
Opdam et al., 2014	Journal of Dental Research	No	No	The PRISMA was followed whenever possible	Composite restorations	Longitudinal (prospective and retrospective)	Caries, tooth/restoration fracture, endodontic pain, extraction, other - annual failure rate	Annual failure rate of 1.8% after 5 years and 2.4% after 10 years
Rasines Alcaraz et al., 2014	Cochrane Database of Systematic Reviews	No	Yes	Not reported but the SR presents specific methodology	Amalgam vs composite resin	RCTs	Failure/survival rate, secondary caries, restoration fracture	Favors amalgam
Schwendicke et al., 2016	Journal of Dental Research	No	No	No	Directly placed restorative materials	RCTs	Need to repair or replace the restoration	Conventional or bulk fill composite seem suitable

SR, Systematic review; RCT, Randomized controlled trial; CCT, Controlled clinical trial.
[a]Data according to the reported in the SR.

TABLE 2 Critical appraisal of SRs included

	AMSTAR 2 item																
Author	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Rating overall confidence in the results of the review
Angeletaki et al., 2016	Yes	No	No	Partial Yes	Yes	No	Partial Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	Critically low
Afrashtehfar et al., 2017	Yes	No[a]	Yes	No[a]	Yes	No	Partial Yes	Yes	Yes/No[a]	Yes	Yes/Yes	No[a]	Yes	Yes	No	No	Critically low
Antony et al., 2008	Yes	No	No	No	No	No	No	No	No	No	NA	NA	No	Yes	NA	No	Critically low
Ástvaldsdóttir et al., 2015	Yes	No	No	Partial Yes	Yes	No	Yes	Yes	Yes/No	No	No/No	No	Yes	Yes	No	Yes	Critically low
Beck et al., 2015	Yes	No	No	No	No	No	No	Yes	No/No	No	No/No	No	No	No	No	No	Critically low
da Veiga et al., 2016	Yes	Partial Yes	No	Yes	Yes	Yes	Partial Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Low
Grivas et al., 2014	Yes	No	No	No	No	No	No	Partial Yes	No/No	No	NA	NA	Yes	Yes	NA	No	Critically low
Heintze et al., 2012	Yes	No	No[a]	No[a]	No	No	No	Partial Yes	No/No	No	No/No	No	No	No	No	No	Critically low
Magno et al., 2016	Yes	Partial Yes	Yes	Partial Yes	Yes	Yes	Partial Yes	Yes	Yes	No	Yes	No	Yes	Yes	No	No	Low
Mickenautsch and Yengopal, 2015	Yes	Yes	No	Partial Yes	Yes	Yes	Yes	Yes	Partial Yes[a]	No	Yes	Yes	Yes	Yes	NA	Yes	Moderate
Monsarrat et al., 2017	Yes	No	No[a]	Partial Yes	No	No	No	Partial Yes	Yes/No	Yes	Yes/No	Yes	Yes	Yes	No	No	Critically low
Moraschini et al, 2015	Yes	No	Yes	Partial Yes	Yes	No	No	Yes	No/Yes	No	Yes/No	No	Yes	Yes	Yes	No	Critically low
Opdam et al., 2014	Yes	No	Yes	No	Yes	No	No	Partial Yes	No/No	No	No/No[a]	No	No	Yes	No	Yes	Critically low
Rasines Alcaraz et al., 2014	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	NA	Yes	High
Schwendicke et al., 2016	Yes	No	Yes	Partial Yes	Yes	Yes	Yes	Yes	Yes	No[a]	Yes	No	Yes	Yes	Yes	Yes	Low

1. Did the research questions and inclusion criteria for the review include the components of PICO?; 2 (critical domains). Did the report of the review contain an explicit statement that the review methods were established prior to the conduct of the review and did the report justify any significant deviations from the protocol?; 3. Did the review authors explain their selection of the study designs for inclusion in the review?; 4 (critical domains). Did the review authors use a comprehensive literature search strategy?; 5. Did the review authors perform study selection in duplicate?; 6. Did the review authors perform data extraction in duplicate?; 7 (critical domains). Did the review authors provide a list of excluded studies and justify the exclusions?; 8. Did the review authors describe the included studies in adequate detail?; 9 (critical domains). Did the review authors use a satisfactory technique for assessing the risk of bias (RoB) in individual studies that were included in the review?; 10. Did the review authors report on the sources of funding for the studies included in the review?; 11 (critical domains). If meta-analysis was performed did the review authors use appropriate methods for statistical combination of results?; 12. If meta-analysis was performed, did the review authors assess the potential impact of RoB in individual studies on the results of the meta-analysis or other evidence synthesis?; 13 (critical domains). Did the review authors account for RoB in individual studies when interpreting/discussing the results of the review?; 14. Did the review authors provide a satisfactory explanation for, and discussion of, any heterogeneity observed in the results of the review?; 15 (critical domains). If they performed quantitative synthesis did the review authors carry out an adequate investigation of publication bias (small study bias) and discuss its likely impact on the results of the review?; 16. Did the review authors report any potential sources of conflict of interest, including any funding they received for conducting the review?

[a]Authors reported different information by e-mail however, it was not found in the article.

The development of SR can be summarized with these steps[29,30]:

1. Select/organize a review team and elaborate a well-structured research question;
2. Develop a study protocol including all steps of SR (see subsequently);
3. Use systematic methods to identify, screen and select studies based on a pre-defined eligibility criteria;
4. Assess the risk of bias of included studies and carry out a data extraction minimizing errors;
5. Synthesize the findings using appropriate methods and evaluate the quality of the body of evidence; and
6. Prepare the final manuscript based on the PRISMA Statement.

Our results demonstrate that in 13 of the 15 included reviews at least two domains were classified as "no" (ie, the report does not contain the item evaluated) including one critical domain. However, all studies reported the elements of PICO question (item 1), only one SR did not describe the included studies in adequate details[16] (item 8) and only two did not provide explanation for, and discussion of, possible heterogeneity of the results[18,21] (item 14).

3.2 | Prospective register of protocol

A SR protocol is a document presenting a work plan of the study, including its rationale and the details of the methodology and, as described previously, it is an important component of the SR process; it ensures research integrity and transparency of the review.[13] When protocols are available, they allow readers to identify deviations from it and the completed SR, identifying possible sources of bias, especially reporting bias.[31] Also, a prospective register of the SR protocol may avoid duplicate studies and reduce the waste of money and time.[2]

Researchers have estimated that more than 8 000 SRs are indexed in MEDLINE annually, and most of these studies do not report any information on SR registration or if the protocol is publicly available.[3] Siontis et al., suggested that most of meta-analyses published have overlapping meta-analysis.[32] In a number of situations, the overlap of meta-analyses is related to a necessary updating or independent replication (which is desirable); however, it may be related to pressure on academics to publish as part of their promotion and tenure portfolio. Another important factor contributing to duplicate SRs is that until 2011, there was no database in which researchers could identify protocols of ongoing SRs.[33] The international prospective register of systematic reviews (PROSPERO) was launched in 2011.[34] The database is open to all researchers planning a SR and to search for ongoing or completed studies and all steps of registration are online and free of charge. In 2017, the PROSPERO registration reached 30 000 registrations and in 2017, the database received more than 1.75 million page views.[35]

In 2018, Ge et al. evaluated the differences in reporting and methodological quality between prospectively registered and unregistered SRs and the findings demonstrated that prospective registration could indirectly improve the methodological quality of SRs ensuring that the methodology used is reproducible and the adherence to the research protocol could help to avoid bias. In contrast, there was no impact in reporting quality.[36] Moreover, estimates by Tsujimoto et al. showed there was a small proportion of prospective registers of SRs published in high-impact journals.[37] In dentistry, the estimates of Sideri et al. provided evidence that a small percentage of orthodontic SRs were registered, demonstrating that more initiatives should be encouraged by dental journals, researchers, educators, funding agencies and peer reviewers.[10]

Regarding the examples in Table 1, various important factors should be highlighted. Five SRs compared clinical performance of composite resin and amalgam,[14,16,21,25,27] and among these, one compared only class II restorations[21] and another composite resin, amalgam, and single crowns.[14] Three SRs compared direct and indirect composite resin restorations[15,19,20] and four SRs assessed clinical performance of composite resin restorations.[17,18,26,28] Two SRs compared composite resins with different compositions[22,24] and one compared glass ionomer cement and direct composite restorations.[23] Among the 15 SRs chosen, only the SR of Beck et al. was an update of a previous study[18] while only four studies reported the prospective register of protocol—approximately 27%,[19,22,23,27] demonstrating a low proportion of prospective registers of SRs in dentistry and justifying why a great number of duplicated studies in this area were performed and published. In addition, one part of item 2 of AMSTAR 2 is related to justification of deviation from the protocol. Even the SR of Magno et al.,[22] reported the protocol registration, evaluating the available protocol in the PROSPERO, we identified unexplained differences in the inclusion criteria between the protocol and the final report.

3.3 | Can I include any type of study design in a SR?

The aim of SRs is to collect and synthesize all studies addressing a specific question and when the primary studies included are randomized controlled trials testing interventions, they present the highest level of evidence.[1] Although most methodological discussions and books were developed to provide guidance about conducting a SR of randomized controlled trials, the structured process to collect, identify, and synthesize data can be used to carry out SRs of any other study design, including preclinical animal and in vitro studies.[38]

Initiatives like The Collaborative Approach to Meta-Analysis and Review of Animal Data from Experimental Studies (CAMARADES; www.camarades.info) and the SYstematic Review Centre for Laboratory animal Experimentation (SYRCLE; www.umcn.nl/Research/Departments/cdl/SYRCLE) research group were established to train, support, and promote SRs of preclinical studies. Recently, the Cochrane Collaboration has advocated in favor of SRs of preclinical animal studies and highlighted the importance of this type of work as well as the use of Cochrane methodology as the starting point to conduct preclinical SRs.[38] In addition, SRs of animal studies can also be registered in PROSPERO database.

In restorative dentistry, many in vitro studies are performed and a great number of SRs considering this type of study design have been published.[39–41] The appropriate use of SRs and meta-analysis of in vitro studies can help in situations of conflicting data, providing more reliable conclusions when clinical studies present little evidence or simply cannot be conducted ethical reasons. In these cases, a pool of in vitro data could help identifying gaps in the literature and generating hypothesis to (or not to) conduct clinical studies based on the performance of materials/techniques in laboratorial tests.

Another important question is the possibility to include more than one type of study design in the same SR. It is important to take into account certain aspects of inclusion criteria. To test differences in the effectiveness of restorative treatments, ideally the outcome should be measured after long observational times and maintaining the study population under observation during this time is challenging. In 2018, Opdam et al. demonstrated that 60% of prospective clinical studies evaluating direct posterior composite restorations included less than 100 restorations and presented observational time < 5 years, resulting in important limitations related to observational time, low numbers of retained patients turning the study statistically underpowered.[42] Therefore, when conducting SRs on the testing of clinical performance of restorative treatments, it would be advisable to consider the inclusion of retrospective longitudinal and population-based cohort studies and incorporate a sensitive analysis to test the influence of the different study designs in the results Thus, expanding the inclusion criteria may turn possible to reach some sort of conclusion. Although, the inclusion of non-RCT studies may lead to higher risk of bias for the overall results and should be clearly disclosed in the reporting of the SR, it may be possible to come to some sort of conclusion and especially, lead to a "bottom line" instead of a "not enough evidence" conclusion.

In addition, it is important to highlight that the results of the Cochrane review[27] included in our study presented the best classification among SRs evaluated (discussed later) and this fact is not only related to restrict inclusion criteria (RCTs) but due to methodological rigor adopted in Cochranes reviews, a well-structured protocol established prior to the conduct of the review, and that Cochrane reviews typically undergo more intense and frequent peer review throughout the entire process and it may be related to improved quality.

Table 1 features the 15 SRs evaluating clinical performance of direct composite resin restoration in permanent posterior teeth or comparing direct composite resin with other material/techniques|[14–28] Considering the inclusion criteria used, most SRs (11/15) included only prospective studies[15,17–24,27,28]; among them, six included only randomized controlled trials (RCTs), four included RCTs and nonrandomized controlled trials and one included RCTs, nonrandomized controlled trials and prospective observational studies without comparison group (case series), which may lead to a certain degree of limited results, and only three studies included observational studies with longer follow-up times.[14,25,26] Eight SRs included more than one study design[14,17,18,20,21,24–26]; among them, seven performed a type of meta-analysis.[14,17,18,21,24–26] One of the subitems of domain 11 of AMSTAR 2 considers if the author reported separate summary estimates for each study design. In our analysis, only the SR of Afrashtehfar et al. took into account study design reporting separate estimates.[14] Monsarrat et al. reported that sensitivity analysis did not reveal differences between studies designs, however, did not report separate estimates.[24] In addition, Hutton et al. suggested the use of two stage approach to enable the integration of more than one study design in the meta-analysis,[43] however, no included SR used this approach.

3.4 | Use of PRISMA Statement

The value and contributions of SRs to health research are well-established. However, if the included studies are poorly reported, the findings can be unusable or even misleading with a waste of time and resources invested and avoiding the reproducibility of studies. Recent studies have been putting forth that the reporting quality of SRs is inconsistent and suboptimal[44,45]—it is necessary, hence, there be a multistage approach during the presubmission, reviewing, publication, and postpublication stages to improve the reporting and use of reporting guidelines.[2] In this sense, the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA) Statement was published in 2009 (almost 10 years ago) with the objective of enhancing the reporting of SRs of randomized clinical trials however, could be used to help in the reporting of SRs related to other designs as in vitro and preclinical animal studies (discussed earlier).[46] The PRISMA initiative has the following extensions:

1. PRISMA for Abstracts,[47]
2. PRISMA for SRs of Equity,[48]
3. PRISMA for SRs Including Harm Outcomes,[49]
4. PRISMA for Individual Patient Data,[50]
5. PRISMA for Network Meta-analyses,[51]
6. PRISMA-P for Protocols,[13]
7. PRISMA for SRs of Diagnostic Test Accuracy Studies.[52]
8. Other extensions are presently being created including PRISMA Statement for animal studies.

Considering the included studies, eight of the SRs did not mention the use of PRISMA Statement[16–18,20–23,28] however, it is possible that they used it and did not report this information. Four SRs reported the use of Statement as a methodological guide,[14,15,24,25] one SR reported only the use of PRISMA-P during the development of protocol,[19] one stated that the PRISMA was followed whenever possible[26] and the Cochrane review did not mention but it uses some strategies to improve the reporting during the editorial process.[27]

It is noteworthy to underscore that the PRISMA Statement and its extensions seek to improve the reporting of SRs and were not developed as a methodological guide for SRs. However, only the PRISMA-P extension can be used by systematic reviewers to think about the conduct of their reviews (ie, the protocol). Examples of misinterpretation of the PRISMA Statement are found in Table 1. Afrashtehfar et al. stated: "This systematic review was conducted according to the guidelines of the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) Statement". Angeletaki et al. reported: "This systematic review was based on the guidelines of the PRISMA Statement for reporting Systematic Reviews and Meta Analyses of studies evaluating health-care interventions". Moraschini et al., in 2015, noted: "The methodology of this study followed the recommendations of the Cochrane Handbook for Systematic Reviews of Interventions and PRISMA". All of these examples used the PRISMA Statement as the basis for the methodological aspects of their SR.

An important element of the reporting guidelines is journal endorsement. Regarding SRs, the PRISMA endorsement by journals is recommended through a statement in the instructions to the authors

indicating the journal's support of Statement and recommending authors to use PRISMA resources during the development of the manuscript. Stevens et al. showed that the PRISMA endorsement is associated with more complete reporting.[53] In dentistry, two surveys were conducted investigating the use of reporting guidelines by dental journals and showed that the PRISMA endorsement and implementation is not optimal with considerable room for improvement.[9,54] Furthermore, the authors of both studies indicated that a broad understanding of the employment of reporting guidelines is necessary by dental journal editors, authors, peer-reviewers and dental schools/institutions. It is not only a matter of using a guideline, but truly incorporating it into research practice so that stakeholders, researchers, clinicians, and patients benefit from the transparency of the process.

3.5 | Confidence in the results of SRs

During the conduct of a SR, all steps are important to avoid biases. Flaws in the conduct and reporting can contribute to the failure to translate results of SRs into clinical practice. The AMSTAR 2 allows users to evaluate the impact of important aspects of conduct of SRs in the confidence in the results. In our analysis, most SRs published did not present reliable results. Ten SRs (66.6%) presented more than one critical flaw and the overall confidence in the results were classified as critically low,[14–18,20,21,24–26] the confidence in the results of three SRs were classified as low,[19,22,28] the results of Mickenautsch and Yengopal was classified as moderate[23] and only the results of Rasines Alcaraz et al. was classified as high.[27] We believe that it is important to highlight how seven critical domains, based on AMSTAR 2 tool, can affect seriously the conclusion of SRs and its validity (Box 1).[11]

In addition, it was difficult to compare the included SRs because they present huge differences especially related to inclusion criteria and to outcomes evaluated. For example, five SRs compared amalgam and resin composite restorations[14,16,21,25,27] and they included different studies designs. Among them, two SRs evaluated as outcome failure of restoration, secondary caries and fractures,[25,27] however, Moraschini et al. included more than one study design and Rasines Alcaraz only randomized controlled trials. Also, the SR of Moraschini et al. presented important flaws and the confidence in the results were classified as critically low making difficult to compare the studies.

3.6 | The future is digital

We believe that the future of the SR process involves combining human and machine efforts. The SR process is considered a time-consuming task and although SRs should be reviewed and, if necessary, updated every 2 years (only if new data is available), this takes place for just a small percentage of SRs based on time and resource restrictions.[55] One solution to accelerate the SR process and make it

BOX 1 How seven critical domains can affect seriously the conclusion of SRs and its validity

SR protocol

It ensures integrity and transparency of the review. It is important to identify deviations from a planned protocol in completed studies and identify possible sources of bias, especially reporting bias (discussed previous).

Comprehensive literature search

Many details are related to literature search as that at least two databases should be searched to checking references of included studies and reporting of full search strategy. It is important that all decisions about literature search should be justified to minimize selection bias.

List of studies excluded and justification

Unjustified exclusion can generate bias in the SRs findings

Assessment of risk of bias from individual studies

Effects of an intervention are related with data of included studies, thus, bias in these studies may produce misleading findings.

Use of suitable methods for statistical synthesis

It is important to justify the methods used. When different studies designs are included in the SR, it is important to report the pooled estimates separately to avoid biases or incorporate a sensitive analysis to test the influence of the study design in the findings. For example, if big cohort studies are combined with small RCTs, the results will be dominated by the data from cohort study, although the results may be precise can be biased.

Considerer the risk of bias of included studies when interpreting/discussing the results

Related to assessment of risk of bias from individual studies domain, it is important to consider a discussion of the impact of risk of bias of included studies in the SR findings.

Assessment of publication bias (PB) and discussion about likely impact on the findings

PB is a type of reporting biases and it is related to publication or non-publication of article based on direction of the results (positive or negative). Efforts to identify PB are associated with a comprehensive literature search, discussion of the possible impact in the interpretation of findings and use of graphical or statistical tests for PB.

more efficient is the use of computer technology during the process.[56] The utilization of technology to automate the SR process is not new, but with advances in technology, a series of articles were recently published discussing the importance of automation of SRs and presenting tools to assist with this process.[57–59] Tsafnat et al. posited that the use of technology can help clinicians such that they always have access to the best evidence available.[56] A recent article highlighted that combining human and machine efforts can render the process more efficient in terms of review tasks, such as team formation, search, eligibility assessment, data extraction, and collection as well as synthesis.[59]

In 2016, Shemilt et al. compared the cost-effectiveness of four approaches to identify eligible studies in SRs and demonstrated that the method used along with the aid of machine-learning algorithms resulted in a workload reduction of 61-64% compared to other approaches.[57] A recent article discussed different approaches to tracking data in data extraction forms and reported a method similar to a global positioning system for geographical location using PDF files and through coordinates, it is possible to link the data extraction form to the location of the data point within the file.[58] In addition, the SR journal has a forthcoming series on automation.

Other important uses of technology are related to implementation of reporting guidelines, such as the PRISMA Statement and its extensions. StatReviewer (statreviewer.com) software can perform an automated review of the reporting integrity of articles. Journals can use the software through their editorial system and the program allows that the manuscripts can be checked to meet the following reporting guidelines: CONSORT 2010,[60] STARD,[61] STROBE,[62] ARRIVE[63], and The Uniform Requirements for Medical Journals (http://www.icmje.org/recommendations/). The inclusion of the PRISMA Statement is currently under evaluation.

3.7 | Limitation of analysis

A few limitations of our analysis should be mentioned. We included only studies written in English and indexed in one database. Screening and data collection were performed by one author and it is possible that we made errors during the process. To ensure, we have correctly extracted the information using the AMSTAR 2 tool, the corresponding authors of included SRs were contacted by email and they were invited to review our assessments.

4 | FINAL REMARKS

We highlighted in this article important aspects of SRs with the aim of improving the quality of conducting and reporting of the SR process that would facilitate reproducibility by interested readers. Nowadays, initiatives like the PRISMA Statement and PROSPERO have an important role in the development of the SR process. Active implementation strategies to encourage adherence to these initiatives among researchers, dental journal editors, funding agencies, and publishers may be a significant facet in the advancement of knowledge. Also, compliance with and awareness of the aspects discussed in this article are essential to maximize the yield from oral health research.

CONFLICT OF INTEREST

DM lead the development of PRISMA, PRISMA-P, and was involved in the development of PROSPERO. The authors do not have any financial interest in the companies whose materials are included in this article.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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