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# Methodological quality of network meta-analysis in dentistry: a meta-research

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**Abstract:** This meta-research aimed to provide an overview of the methodological quality and risk of bias of network meta-analyses (NMA) in dentistry. Searches for NMA of randomized clinical trials with clinical outcomes in dentistry were performed in databases up to January 2022. Two reviewers independently screened titles/abstracts, selected full texts, and extracted the data. The adherence to PRISMA-NMA reporting guideline, the AMSTAR-2 methodological quality tool, and the ROBIS risk of bias tool were assessed in the studies. Correlation between the PRISMA-NMA adherence and the AMSTAR-2 and ROBIS results was also investigated. Sixty-two NMA studies were included and presented varied methodological quality. According to AMSTAR-2, half of the NMA presented moderate quality (n = 32; 51.6%). The adherence to PRISMA-NMA also varied. Only 36 studies (58.1%) prospectively registered the protocol. Other issues lacking of reporting were data related were data related to the NMA geometry and the assessment of results consistency, and the evaluation of risk of bias across the studies. ROBIS assessment showed a high risk of bias mainly for domains 1 (study eligibility criteria) and 2 (identification and selection of studies). Correlation coefficients between the PRISMA-NMA adherence and the AMSTAR-2 and ROBIS results showed moderate correlation (rho < 0.6). Overall, NMA studies in dentistry were of moderate quality and at high risk of bias in several domains, especially study selection. Future reviews should be better planned and conducted and have higher compliance with reporting and quality assessment tools.

**Keywords:** Network Meta-Analysis; Evidence-Based Dentistry; Translational Science, Biomedica.

## Introduction

Systematic reviews of health interventions aim to identify, evaluate, and synthesize high-quality data to answer a specific clinical question.[1] They are considered the most robust evidence to assess the benefits and harms of health interventions and to develop clinical practice guidelines.[2] Randomized controlled trials (RCTs) are routinely conducted to provide high-quality, evidence-based data to guide clinical decisions. However, single RCTs are rarely powerful and robust enough to provide

conclusive answers to clinical questions, so meta-analysis methods have been used to combine data from similar trials to achieve enough power.

Standard direct pairwise (head-to-head) comparisons of RCTs are performed in 'traditional' meta-analyses. They typically compare two treatment options directly, either two active treatments or an active treatment versus a placebo. The simplicity of this approach contrasts with the complex nature of treatments in healthcare.[3] Nonetheless, for many clinical conditions, there are more than two potential interventions. Also, conducting multi-arm RCTs with more than three comparisons is often considered too complex and expensive. Therefore, not all potential interventions are directly compared, which restricts the ability to compare them in practice for a particular condition. In addition, other limitations may occur, such as when few RCTs are available and there are different interventions, increasing the chance of inconsistency in the results. Also, meta-analyses that include only a few RCTs may not have enough statistical power to detect a true difference between treatments, leading to inconclusive results and hindering the decision-making process.[4] In this way, approaches that allow comprehensive comparisons across multiple treatment options and rank these interventions are encouraged.

Nevertheless, the scientific community has seen considerable advances in standards, methods, and systems for planning, conducting, and reporting systematic reviews and trustworthy clinical practice guidelines.[5,6] One of these new statistical methodologies is network meta-analysis (NMA), which allows comparing multiple treatments simultaneously,[7,8] overcoming some limitations of the traditional pairwise meta-analysis[9]

The NMA takes into account a larger body of evidence by analyzing the results of primary studies through direct head-to-head comparisons and indirect comparisons conducted by one or more common comparators to estimate the relative effectiveness of all interventions and their ordering.[10] From this perspective, the NMA has proven to be an interesting tool to assess the efficacy of different interventions for a health condition that have not been directly compared in primary studies.

However, there are challenges and concerns associated with conducting an NMA, such as complex statistics, the assumption that all interventions included in the "network" are equally applicable to all populations and contexts of the studies included, and the fact that ranking may be misleading as it does not highlight the absolute effects of the interventions. The reliability of the rankings requires consideration of the geometry and strength of the network.[11]

Despite some concerns, the NMA is undeniably attractive because it can answer the primary concern of researchers and clinicians "what is the best available intervention?" since it allows estimating an hierarchy of interventions.[12] Not surprisingly, NMA publications have shown a marked increase in recent years[13] and have become increasingly popular in dentistry. But what are the methodological qualities of these studies? With their potential and limitations in mind, this investigation should shed light on the concept of NMA and its potential use to promote evidence-based dentistry. This meta-research study aimed to assess and provide an overview of the methodological quality and risk of bias of network meta-analyses in dentistry.

## Methodology

This report followed the recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement. The study protocol was registered on the OSF Register Website (doi 10.17605/OSF.IO/4VX3Y), and post hoc changes were made, including no limitation on publication in recent years, and additional statistical analyses were performed on the correlation between PRISMA-NMA adherence and AMSTAR-2 and ROBIS results.

The research question was: "What is the methodological quality and risk of bias of network meta-analyses in clinical dentistry?" This study evaluated adherence of NMA to reporting guidelines applying the PRISMA-NMA checklist,[14] assessed the methodology quality of the NMA reviews with the A MeaSurement Tool to Assess Systematic Reviews (AMSTAR-2) tool,[15] and assessed the risk of bias

of the studies with the Risk Of Bias In Systematic reviews (ROBIS) tool.[16] As a secondary aim, the study investigated the correlation between the results of these different tools (AMSTAR-2 and ROBIS) and adherence to the PRISMA-NMA guideline.

## Search strategy

A systematic electronic search was performed on January 28th, 2022, with no restriction on language, date, or publication status in the following databases: PubMed/MEDLINE, EMBASE, Science Direct, Scopus, and Web of Science. The search strategy considered a combination of medical subject headings (MeSH) and free-text terms. The search strategies for all databases are shown in Table 1.

Additionally, the grey literature was searched on OpenGrey (opengrey.eu) and a hand search of the reference lists of potentially included NMA systematic reviews on clinical outcomes in dentistry was performed to identify any additional studies.

## Eligibility criteria

The titles/abstracts of potentially eligible studies were initially evaluated. Systematic reviews with network meta-analysis (NMAs) that compared three or more interventions in randomized clinical trials (RCTs), with clinical objectives and measurable outcomes in dental sciences were considered eligible studies.

Manuscripts that met the inclusion criteria were fully assessed. NMA studies with only one author, studies with subjective or non-clinical outcomes (*e.g.*, patient-reported pain, measurements from biopsies, etc.), NMA studies that included both RCT and non-randomized or quasi-randomized trials, NMA studies published in predatory journals (based on the list published at the website https://predatoryjournals.com/journals/), and/or NMA studies that did not provide a complete description of the NMA review process were excluded.

## Study selection procedure

Duplicates were independently identified by two reviewers (AFM and PDMA) and removed from the records using the Rayyan Website Program.[17] Using the same software, these two reviewers independently, in duplicate and blind, rated each citation as "included" or "excluded" according to the eligibility criteria. Citations could also be classified as "maybe" when data were insufficient to make

**Table 1.** Search strategies for all databases.

| Search terms | Search strategies | Number of citations |
|---|---|---|
| PubMed/MEDLINE | ((Teeth OR Tooth OR Dental) OR Dentistry OR Root OR Periodont*) AND ("Network meta-analysis" OR "Network Meta-Analyses" OR "Multiple Treatment Comparison Meta-Analysis" OR "Multiple Treatment Comparison Meta Analysis" OR "Mixed Treatment Meta-Analysis" OR "Meta-Analyses, Mixed Treatment" OR "Meta-Analysis, Mixed Treatment" OR "Mixed Treatment Meta Analysis" OR "Mixed Treatment Meta-Analyses" OR "Bayesian meta-analysis" OR "Bayesian meta-analyses") | 464 |
| EMBASE | ('teeth'/exp OR teeth OR 'tooth'/exp OR tooth OR 'dental'/exp OR dental OR 'dentistry'/exp OR dentistry OR 'root'/exp OR root OR periodont*) AND ('network meta-analysis'/exp OR 'network meta-analysis' OR 'network meta-analyses'/exp OR 'network meta-analyses' OR 'multiple treatment comparison meta-analysis' OR 'multiple treatment comparison meta analysis' OR 'mixed treatment meta-analysis' OR 'meta-analyses, mixed treatment' OR 'meta-analysis, mixed treatment' OR 'mixed treatment meta analysis' OR 'mixed treatment meta-analyses' OR 'bayesian meta-analysis' OR 'bayesian meta-analyses') | 257 |
| Science Direct | (teeth OR tooth OR dental OR dentistry) AND ("Network meta-analysis" OR "Multiple Treatment Comparison Meta-Analysis" OR "Mixed Treatment Meta-Analysis" OR "Bayesian meta-analysis") | 373 |
| Scopus | (teeth OR tooth OR dental OR dentistry) AND ("Network meta-analysis" OR "Multiple Treatment Comparison Meta-Analysis" OR "Mixed Treatment Meta-Analysis" OR "Bayesian meta-analysis") | 112 |
| Web of Science | ((teeth OR tooth OR dental) OR (dentistry) OR (root) OR (periodont)) AND ("Network meta-analysis" OR "Multiple Treatment Comparison Meta-Analysis" OR "Mixed Treatment Meta-Analysis" OR "Bayesian meta-analysis") | 96 |

a decision and a full-text analysis was required. When the abstract provided unclear information, the study was selected for full-text assessment to avoid excluding potentially eligible articles. Then, the two reviewers independently assessed and duplicated the full-text articles that met the inclusion criteria. Discrepancies in title/abstracts screening or in full texts were solved through a discussion and consensus between the two reviewers with the help of a third reviewer (TKT). For equal NMAs identified in more than one study, only the most recent study was included.

### Data extraction

A standardized data extraction table was used to collect the data. Two reviewers (AFM and PDMA) discussed the data to be collected to ensure consistency during the extraction process. Then, the two reviewers independently and in duplicate extracted the data from each included study using predesigned coded sheets. The following information was extracted: a) study identification: author's name, year of publication, and country of corresponding authors; b) journal name, the 2020 impact factor of the journal, the number of citations of the paper on the Web of Science Platform (as of March 30th, 2022), and the corresponding dental area: (Oral Rehabilitation, Oral Surgery, Oral Pain, Oral Pathology, Pediatric Dentistry, Orthodontics, Periodontology, Implantodontology, Dental Materials, Cariology, and Endodontic); c) databases used, language restriction applied, and date of searching; d) number of reviewers and the calibration results; e) PICO question; f) number of included studies; g) main results - ranking probability, and measures of effects; h) reporting guideline used and registration of the study protocol; i) risk of bias tool used; j) certainty of evidence - GRADE; and k) declaration of conflicts of interest, and funding reported. Discrepancies were resolved through discussion with a third reviewer (TKT) and consensus .

### Training

The two reviewers (AFM and PDMA) were trained in tool application (PRISMA, AMSTAR-2, and ROBIS) by the studying and discussion of the tools' explanations and by the practical application on three of the included NMA.

### Assessment of reporting adherence

The PRISMA Extension Statement for reporting of systematic reviews incorporating NMA of health care interventions (PRISMA-NMA)[14] was applied to assess the reporting of general components and key methodological components of the included studies. It includes a 32-item checklist and a flow diagram: 27 general items and five new NMA items. The extension adds five new items (S1-5) that authors should consider when reporting an NMA: geometry of the network (S1), assessment of inconsistency (S2), presentation of network structure (S3), summary of network geometry (S4), and exploration for inconsistency (S5). Using this tool, it was assessed whether key methodological and general components were reported (yes) or not (no).

### Methodological quality assessment

The AMSTAR-2 tool checklist[15] was used to assess the methodological quality of the included systematic reviews with NMA. For the 16 domains, the questions are worded so that a "Yes" answer denotes a positive result. If no information was available, the item was rated as "No", denoting a negative result. Additionally, a "partial Yes" answer was used to identify partial adherence to the standard.

Rating of overall confidence in the results of the review was: a) High: no weakness or one non-critical weakness; b) Moderate: more than one non-critical weakness; c) Low: one critical flaw with or without non-critical weaknesses; and d) Critically low: more than one critical flaw with or without non-critical weaknesses.

### Risk of bias assessment

The risk of bias of the included NMAs was assessed using the ROBIS tool.[16] The tool is completed in 3 phases: a) assess relevance (optional - not applied in this study), b) identify concerns with the review process, and c) rate the risk of bias in the review. The signaling questions for phases 2 and 3 were answered as "Yes", "Probably Yes", "Probably No", "No", and "No Information". The subsequent level of concern

about each domain's bias was rated as "low," "high," or "unclear". If the answers to all signaling questions for a domain are "Yes" or "Probably Yes", then the level of concern was rated as low. The potential for concern was considered if any signaling question was answered "No" or "Probably No".

### Synthesis of results

Initially, the inter-reviewer agreement for study selection was calculated (Kappa coefficient). Afterwards, a descriptive synthesis of the data was performed considering the adherence to the PRISMA-NMA checklist, the assessment of the methodology quality by the AMSTAR tool, and the risk of bias by the ROBIS tool. Finally, the correlation coefficient between those different reporting guidelines and tools was investigated. The analyses were performed with the Jamovi program (The jamovi project, 2021, version 2.3, Computer software, https://www.jamovi.org). For these analyses, the tools were adapted as follows:

a. PRISMA-NMA - each item on the checklist received a score of 1 if the item was reported and a score of 0 if the item was not reported in the study; then the maximum total score could be 32.
b. AMSTAR-2 - each tool item received a score of 1 if the item provided a yes result, a score of 0.5 if the item provided a partial yes result, and a score 0 if the item provided a no result; then the maximum total score could be 16.
c. ROBIS - each item of the tool received a score of 1 if the domain was rated as low, a score of 0.5 if the domain was rated as unclear, and a score of 0 if the domain was rated as high; then the maximum total score could be 5.

## Results

### Studies selection

In total, 1,971 publications were retrieved. After eliminating duplicates, 1,409 studies remained, of which 1,260 were excluded after screening the title and abstract. Thus, 149 articles were reviewed for eligibility by assessing the full text, and 87 were excluded (Table 2). Finally, 62 NMA studies were included[18-79]. Figure 1 summarizes the study selection process. The kappa coefficient for the inter-reviewer agreement was 0.87 for title/abstracts and 0.83 for full text.

### Studies characteristics

Table 3 summarizes the mains characteristics of the included studies. Regarding the publication date, more than half (n = 35; 56.5%) of the studies was published in the last 2 years (2020-2022)[19,20,22,23,26-29,31,34,37,38,40-42,47-49,51-53,55,56,60,61,64,65,67,69-71,73,77-79] The oldest study was published in 2010[74]. Half of the studies were published in journals within the highest impact factor quartile in Dentistry, Oral Surgery, and Oral Medicine (n = 32; 51.6%). The NMA studies were published in 26 journals, with one quarter of them (n = 16; 25.8%) published in the Journal of Clinical Periodontology[24-26,32,33,35,36,39,40,43,59,62,70,73,74,77] The two main areas addressed by the studies were Periodontology (n = 33; 53.2%),[21-26,29,30,32,35-37,40-44,51,53-56,59,61,67,70-74,77-79] and Implantodontology (n = 8; 12.9%).[18,19,27,33,39,52,62,66] In addition, several countries contributed with NMA studies. The corresponding authors were from Europe (n = 24; 38.7%),[20-22,24-27,29,32,33,35,36,39,40,45,61-64,67,70,74,76,79] Asia (n = 22; 35.5%),[18,19,30,37,38,41,42,46,47,49,54-57,60,66,68,69,71,13,77,78] South America (n = 9; 14.5%),[28,31,34,50-53,58,59] North America (n = 6; 9.7%),[23,43,44,48,72,75] and Oceania (n = 1; 1.6%).[66]

All NMA studies informed having performed a risk of bias assessment of the primary studies. Except for three studies,[46,54,57] all other used the RoB or RoB 2.0 tools (Cochrane Risk-Of-Bias tool for randomized trials) (n = 59; 95.2%). However, it was observed that only 37.1% (n = 23) of the included studies ratted the certainty of generated evidence using the GRADE approach (Grading of Recommendations Assessment, Development, and Evaluation).[18,21,29,31,33,34,37,43,45,47-49,53,55,56,64-66,68,69,1,75,76]

The guideline used to report NMA varied: 28 (45.2%) studies used the PRISMA-NMA,[18-20,22,23,25,27,31,32,34,37,40-42,45,47,48,50-53,58,62,67,69,73,79] 23 (37.1%) used the PRISMA guideline,[21,24,26,28,29,33,36,43,44,49,54-56,59,61,68,68,70-72,75,77,78] 1 (1.6%) used the PRISMA-P,[60] and 1 (1.6%) used the PRISM-IPD.[37] Nine (14.5%) studies did not mention the use of any reporting guideline.[30,39,46,57,63,64,66,74,76]. Regarding the funding source, 31 studies (50%) were founded by private or public sources,[23,26,31-39,41,43-46,49,50,57,59,63,64,70-78]

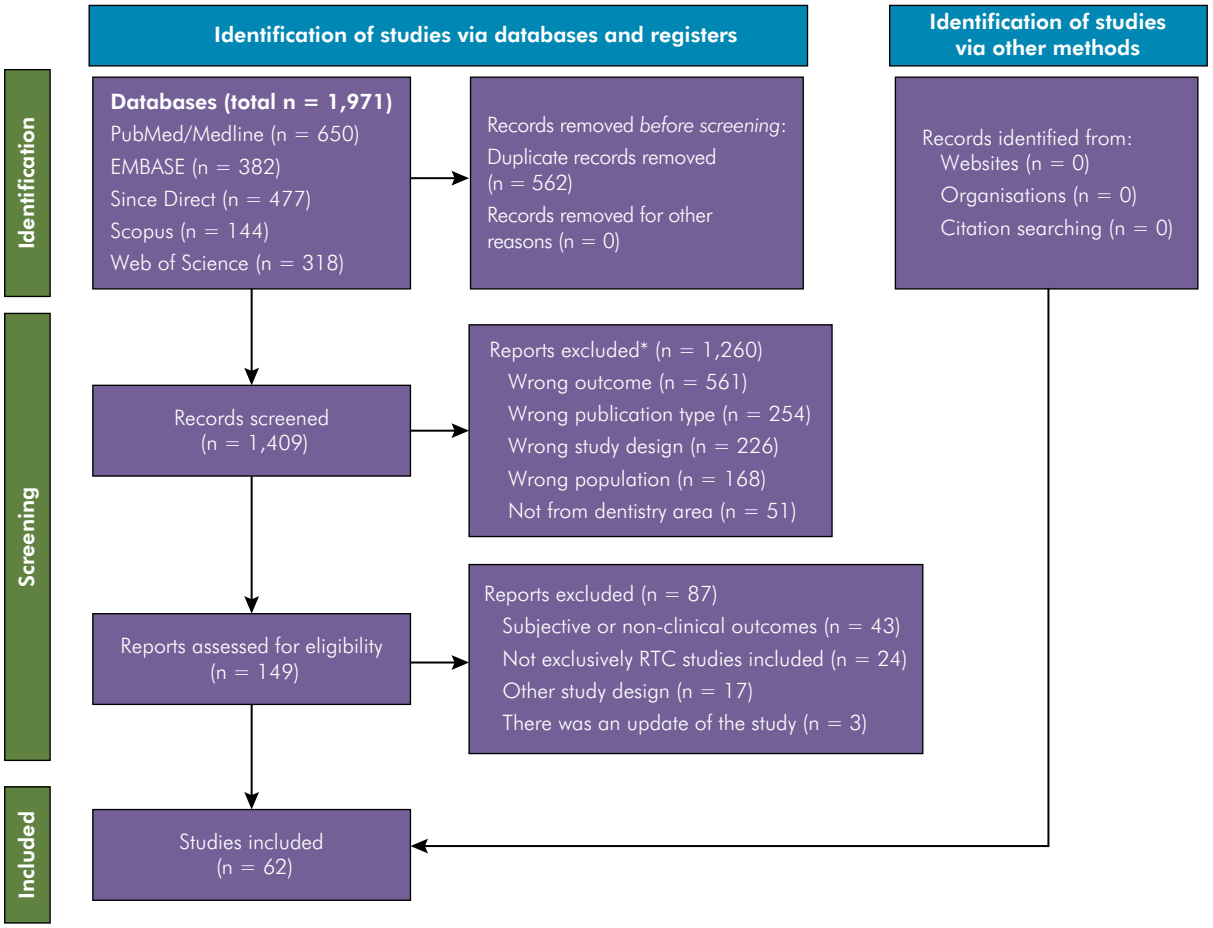


**Figure 1.** PRISMA flow diagram for the identification of relevant studies.

whereas 20 studies (32.3%) were supported by the authors (no funding,[20,21,24,25,27-30,47,51-53,55,56,60,1,65,66,68,79] and 11 studies (17.7%) did not clearly state the funding source.[18,19,22,40,42,48,54,58,62,67,69]

## PRISMA-NMA adherence

Table 4 shows the reporting characteristics considering the 32-items of PRISMA-NMA. Regarding Item 5 (review protocol), 36 studies (58.1%) registered the protocol[18,21,23,26-32,34,37-40,45,47,49-53,55,56,58,59,61,62,65-69,71,72,78], and the main database used for registration was the International Prospective Register of Systematic Reviews (PROSPERO).

The five items added to the PRISMA-NMA extension did not have full adherence. The geometry of the network was reported only by 32.2% (n = 20) of the studies. [19,22,23,25-27,29,32,33,40,49,53,62,66,71-74,76,79] On the other hand, few studies did not report the assessment of inconsistency (29%, n = 18),[20,21,28,32,33,36-39,46,51,54,58,60,66,67,71,75] the network structure (8.1%, n = 5),[36,47,54,59,66] the summary of network geometry (37.1%, n = 23),[19,27,35-37,39,41-43,47,48,50,52,54,55,59,60,66,67,69,70,77,78] and the exploration of inconsistency (35.5%, n = 22).[19-21,27,28,33,37-39,41,44,46,48,54,57,58,60,61,66,69,71,75]

## Methodology quality assessment

Table 5 summarizes the methodological quality assessment for each included study according to the AMSTAR-2. Half of the NMA presented moderate methodological quality (n = 32; 51.6),[18-22,24,28,30,33,36,38-41,43,45,47,48,50,51,54,58,59,62,63,66,67,70-73,78] 17 studies were of low quality (27.4),[25,27,29,32,34,37,44,46,55-57,60,61,66,74,75,77] 10 were of high quality (16.2),[23,26,31,49,52,53,64,65,76,79] and 3 studies were of critically low quality (4.8).[35,42,69] The majority of NMAs clearly stated the PICO question. However, one point was largely unreported: the source of

**Table 2.** List of excluded publications and reasons.

| | Authors | Reference | Reason |
|---|---|---|---|
| 1 | (Abd-Elwahab Radi and Hassaan, 2019) | Abd-Elwahab Radi I, Hassaan A. Which is the best antibiotic prophylaxis protocol to prevent early implant failures? Evid Based Dent 2019;20:105–6. doi:10.1038/s41432-019-0056-z. | Other study design (commentary) |
| 2 | (Akbarzadeh Baghban et al., 2009) | Akbarzadeh Baghban A, Dehghani A, Ghanavati F, Zayeri F, Ghanavati F. Comparing alveolar bone regeneration using Bio-Oss and autogenous bone grafts in humans: a systematic review and meta-analysis. Iran Endod J 2009;4:125–30. | Other study design (systematic review) |
| 3 | (Alkhutari et al., 2021) | Alkhutari A, Alyahya A, Rodrigues Conti P, Christidis N, Al-Moraissi E. Is the therapeutic effect of occlusal stabilization appliances more than just placebo effect in the management of painful temporomandibular disorders? A network meta-analysis of randomized clinical trials. J Prosthet Dent 2021;126:24–32. doi:doi: 10.1016/j.prosdent.2020.08.015. | Subjective or non-clinical outcomes (oral pain) |
| 4 | (Al-Moraissi et al., 2020a) | Al-Moraissi E, Alradom J, Aladashi O, Goddard G, Christidis N. Needling therapies in the management of myofascial pain of the masticatory muscles: A network meta-analysis of randomised clinical trials. J Oral Rehabil 2020;47:910–22. | Subjective or non-clinical outcomes (oral pain) |
| 5 | (Al-Moraissi et al., 2020b) | Al-Moraissi E, Farea R, Qasem K, Al-Wadeai M, Al-Sabahi M, Al-Iryani G, et al. Effectiveness of occlusal splint therapy in the management of temporomandibular disorders: network meta-analysis of randomized controlled trials. Int J Oral Maxillofac Surg 2020b;49:1042–56. | Subjective or non-clinical outcomes (oral pain) |
| 6 | (Al-Moraissi et al., 2020c) | Al-Moraissi E, Alkhutari AS, Abotaleb B, Altairi NH, Del Fabbro M. Do osteoconductive bone substitutes result in similar bone regeneration for maxillary sinus augmentation when compared to osteogenic and osteoinductive bone grafts? A systematic review and frequentist network meta-analysis. Int J Oral Maxillofac Surg 2020c;49:107–20. doi:https://doi.org/10.1016/j.ijom.2019.05.004. | Subjective or non-clinical outcomes (histomorphometric analysis) |
| 7 | (Al-Moraissi et al., 2020d) | Al-Moraissi E, Wolford LM, Ellis E, Neff A. The hierarchy of different treatments for arthrogenous temporomandibular disorders: A network meta-analysis of randomized clinical trials. J Cranio-Maxillofacial Surg 2020d;48:9–23. doi:https://doi.org/10.1016/j.jcms.2019.10.004. | Subjective or non-clinical outcomes (oral pain) |
| 8 | (Ali and Raja, 2020) | Ali K, Raja M. Evidence-based strategies to reduce contamination from aerosolised microbes in dental practice environment. Evid Based Dent 2020;21:80–1. | Other study design (commentary) |
| 9 | (Askar et al., 2017) | Askar H, Tu Y-K, Paris S, Yeh Y-C, Schwendicke F. Risk of caries adjacent to different restoration materials: Systematic review of in situ studies. J Dent 2017;56:1–10. doi:https://doi.org/10.1016/j.jdent.2016.09.011. | Not exclusively RCT studies included (in situ studies) |
| 10 | (Buti et al., 2011) | Buti J, Glenny A-M, Worthington H V, Nieri M, Baccini M. Network meta-analysis of randomised controlled trials: direct and indirect treatment comparisons. Eur J Oral Implantol 2011;4:55–62. | Other study design (critical review) |
| 11 | (Camps-Font et al., 2020) | Camps-Font O, Figueiredo R, Sanchez-Torres A, Cle-Ovejero A, Coulthard P, Gay-Escoda C, et al. Which is the most suitable local anaesthetic when inferior nerve blocks are used for impacted mandibular third molar extraction? A network meta-analysis. Int J Oral Maxillofac Surg 2020;49:1497–507. | Subjective or non-clinical outcomes (oral pain) |
| 12 | (Canellas et al., 2020) | Canellas JV d. S, Ritto FG, Figueredo CM d. S, Fischer RG, de Oliveira GP, Thole AA, et al. Histomorphometric evaluation of different grafting materials used for alveolar ridge preservation: a systematic review and network meta-analysis. Int J Oral Maxillofac Surg 2020;49:797–810. | Subjective or non-clinical outcomes (histomorphometric analysis) |
| 13 | (Cao et al., 2019) | Cao R, Li Q, Wu Q, Yao M, Chen Y, Zhou H. Effect of non-surgical periodontal therapy on glycemic control of type 2 diabetes mellitus: a systematic review and Bayesian network meta-analysis. BMC Oral Health 2019;19:176. doi:10.1186/s12903-019-0829-y. | Subjective or non-clinical outcomes (HbA1c%) |
| 14 | (Caricasulo et al., 2018) | Caricasulo R, Malchiodi L, Ghensi P, Fantozzi G, Cucchi A. The influence of implant-abutment connection to peri-implant bone loss: A systematic review and meta-analysis. Clin Implant Dent Relat Res 2018;20:653–64. doi:10.1111/cid.12620. | Other study design (systematic review) |

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Continuation

| | | | |
|---|---|---|---|
| 15 | (Castro-Calderón et al., 2021) | Castro-Calderón A, Toledano-Serrabona J, Sánchez-Torres A, Camps-Font O, Sánchez-Garcés MÁ, Gay-Escoda C. Influence of incision on periodontal parameters after apical surgery: a meta-analysis. Clin Oral Investig 2021. | Not exclusively RCT studies included (randomized or non-randomized controlled clinical trials, prospective and retrospective cohort studies) |
| 16 | (Coll et al., 2020) | Coll J, Vargas K, Marghalani A, Chen C, AlShamali S, Dhar V, et al. A Systematic Review and Meta-Analysis of Nonvital Pulp Therapy for Primary Teeth. Pediatr Dent 2020;42:256–461. | Other study design (systematic review) |
| 17 | (de N. Dias et al., 2019) | de N. Dias FJ, Pecorari VGA, Martins CB, Del Fabbro M, Casati MZ. Short implants versus bone augmentation in combination with standard-length implants in posterior atrophic partially edentulous mandibles: systematic review and meta-analysis with the Bayesian approach. Int J Oral Maxillofac Surg 2019;48:90–6. | Other study design (systematic review) |
| 18 | (Faggion et al., 2013) | Faggion CMJ, Chambrone L, Listl S, Tu Y. Network meta-analysis for evaluating interventions in implant dentistry: the case of peri-implantitis treatment. Clin Implant Dent Relat Res 2013;15:576–88. | Not exclusively RCT studies included (randomized controlled trials and controlled trials) |
| 19 | (Fan et al., 2018) | Fan D, Pan J, Cao Y, Liu W, Li C, Liu B. Pre-emptive use of non-steroids anti-inflammatory drugs for a successful inferior alveolar nerve block in patients with irreversible pulpitis: a systematic review and network meta-analysis. Int J Clin Exp Med 2018;11:11567+. | Subjective or non-clinical outcomes (oral pain) |
| 20 | (Fang et al., 2020) | Fang J, Huang B, Ding Z. Efficacy of antifungal drugs in the treatment of oral candidiasis: A Bayesian network meta-analysis. J Prosthet Dent 2020. doi:https://doi.org/10.1016/j.prosdent.2019.12.025. | Subjective or non-clinical outcomes (mycological cure rate) |
| 21 | (Fischoff and Spivakovsky, 2018) | Fischoff D, Spivakovsky S. Are pharmacological treatments for oro-facial pain effective? Evid Based Dent 2018;19:28–9. doi:10.1038/sj.ebd.6401294. | Other study design (commentary) |
| 22 | (Fu and Wang, 2015) | Fu J-H, Wang H-L. Can Periimplantitis Be Treated? Dent Clin North Am 2015;59:951–80. doi:https://doi.org/10.1016/j.cden.2015.06.004. | Other study design (critical review) |
| 23 | (Grender et al., 2020) | Grender J, Adam R, Zou Y. The effects of oscillating-rotating electric toothbrushes on plaque and gingival health: A meta-analysis. Am J Dent 2020;33:3–11. | Other study design (systematic review) |
| 24 | (Grünberg et al., 2017) | Grünberg C, Bauer F, Crispin A, Jakob M, Hickel R, Draenert ME. Effectiveness of dentifrices with new formulations for the treatment of dentin hypersensitivity - A meta-analysis. Am J Dent 2017;30:221–6. | Other study design (systematic review) |
| 25 | (Homaj et al., 2018) | Homaj M, Janion M, Siudak Z. Safety of dental extractions in patients on single and dual antiplatelet therapy a meta-analysis. Kardiol Pol 2018;76:23–4. | Other study design (abstract) |
| 26 | (M. Hu et al., 2019) | Hu M, Chen J, Pei X, Han J, Wang J. Network meta-analysis of survival rate and complications in implant-supported single crowns with different abutment materials. J Dent 2019;88:103115. doi:https://doi.org/10.1016/j.jdent.2019.04.007. | Not exclusively RCT studies included (randomized controlled trials, controlled clinical trials, and cohort studies) |
| 27 | (M.-L. Hu et al., 2019) | Hu M-L, Zheng G, Lin H, Yang M, Zhang Y-D, Han J-M. Network meta-analysis on the effect of desensitizing toothpastes on dentine hypersensitivity. J Dent 2019;88:103170. doi:https://doi.org/10.1016/j.jdent.2019.07.008. | Subjective or non-clinical outcomes (oral pain) |
| 28 | (Koletsi et al., 2020) | Koletsi D, GN B, Eliades T. Interventions to Reduce Aerosolized Microbes in Dental Practice: A Systematic Review with Network Meta-analysis of Randomized Controlled Trials. J Dent Res 2020:22034520943574. | Subjective or non-clinical outcomes (microbial count) |
| 29 | (Kong et al., 2020) | Kong Y, Lei Y, Li S, Zhang Y, Han J, Hu M. Network meta-analysis of the desensitizing effects of lasers in patients with dentine hypersensitivity. Clin Oral Investig 2020;24:1917–28 | Subjective or non-clinical outcomes (oral pain) |
| 30 | (Kuhn et al., 2017) | Kuhn E, Schwarz EI, Bratton DJ, Rossi VA, Kohler M. Effects of CPAP and Mandibular Advancement Devices on Health-Related Quality of Life in OSA: A Systematic Review and Meta-analysis. Chest 2017;151:786–94. doi:10.1016/j.chest.2017.01.020 | Subjective or non-clinical outcomes (quality of life) |

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| 31 | (Ladewig et al., 2018) | Ladewig N, Tedesco T, Gimenez T, MM B, DP R. Patient-reported outcomes associated with different restorative techniques in pediatric dentistry: A systematic review and MTC meta-analysis. PLoS One 2018;13:e0208437. | Subjective or non-clinical outcomes (patient-reported outcomes) |
| 32 | (Larocca de Geus et al., 2020) | Larocca de Geus J, Nogueira da Costa JK, Wambier LM, Maran BM, Loguercio AD, Reis A. Different anesthetics on the efficacy of inferior alveolar nerve block in patients with irreversible pulpitis: A network systematic review and meta-analysis. J Am Dent Assoc 2020;151:87-97. e4. doi:https://doi.org/10.1016/j.adaj.2019.09.002. | Subjective or non-clinical outcomes (oral pain) |
| 33 | (Liang et al., 2020) | Liang M, Lian Q, Kotsakis GA, Michalowicz BS, John MT, Chu H. Bayesian Network Meta-analysis of Multiple Outcomes in Dental Research. J Evid Based Dent Pract 2020. doi:10.1016/j.jebdp.2020.101403. | There was an update of the study (re-analysis of Kotsakis et al. 2018) |
| 34 | (Lin et al., 2013) | Lin P, Cheng Y, Chu C, Chien K, Lin C, Tu Y. In-office treatment for dentin hypersensitivity: a systematic review and network meta-analysis. J Clin Periodontol 2013;40:53–64. | Subjective or non-clinical outcomes (oral pain) |
| 35 | (Liu et al., 2018) | Liu C, Wang Y, Pan W-L, Yu C-H, Huang J-Y, Hua C-G. [Relationship between initial archwire materials and pain at the initial stage of orthodontic treatment: a systematic review and network Meta-analysis]. West China J Stomatol 2018;36:296–300. doi:10.7518/hxkq.2018.03.013. | Subjective or non-clinical outcomes (oral pain) |
| 36 | (Machado et al., 2020) | Machado V, Botelho J, Mascarenhas P, Mendes JJ, Delgado A. A systematic review and meta-analysis on Bolton's ratios: Normal occlusion and malocclusion. J Orthod 2020;47:7–29. doi:10.1177/1465312519886322. | Not exclusively RCT studies included (observational studies) |
| 37 | (Maran et al., 2018) | Maran B, Ziegelmann PK, Burey A, Matos TP, Loguercio AD, Reis A. A network meta-analysis of different light-activation to dental bleaching. Abstr Acad Dent Mater Annu Meet 04-06 Oct 2018 - Porto Galinhas, Brazil 2018;34:e73. | Other study design (abstract) |
| 38 | (Martins et al., 2020) | Martins C, Firmino R, Riva J, Ge L, Carrasco-Labra A, Brignardello-Petersen R, et al. Desensitizing Toothpastes for Dentin Hypersensitivity: A Network Meta-analysis. J Dent Res 2020;99:514–22. | Subjective or non-clinical outcomes (oral pain) |
| 39 | (Moradpoor et al., 2017) | Moradpoor OH, Raissi S, Bardideh E. Reconstructing root treated teeth using post and core - A Systematic Review. Biosci Biotechnol Res Commun 2017;10:19–24. | Not exclusively RCT studies included (randomized clinical trials and cohort studies) |
| 40 | (Nagendrababu et al., 2019a) | Nagendrababu V, Pulikkotil S, Jinatongthai P, Veettil S, Teerawattanapong N, Gutmann J. Efficacy and Safety of Oral Premedication on Pain after Nonsurgical Root Canal Treatment: A Systematic Review and Network Meta-analysis of Randomized Controlled Trials. J Endod 2019a;45:364–71. doi:https://doi.org/10.1016/j.joen.2018.10.016. | Subjective or non-clinical outcomes (oral pain) |
| 41 | (Nagendrababu et al., 2019b) | Nagendrababu V, Pulikkotil SJ, Suresh A, Veettil SK, Bhatia S, Setzer FC. Efficacy of local anaesthetic solutions on the success of inferior alveolar nerve block in patients with irreversible pulpitis: a systematic review and network meta-analysis of randomized clinical trials. Int Endod J 2019b;52:779–89. doi:10.1111/iej.13072. | Subjective or non-clinical outcomes (oral pain) |
| 42 | (Pandis et al., 2014) | Pandis N, Fleming PS, Spineli LM, Salanti G. Initial orthodontic alignment effectiveness with self-ligating and conventional appliances: a network meta-analysis in practice. Am J Orthod Dentofac Orthop Off Publ Am Assoc Orthod Its Const Soc Am Board Orthod 2014;145:S152-63. doi:10.1016/j.ajodo.2013.12.016. | Not exclusively RCT studies included (randomized clinical trials and controlled clinical trials) |
| 43 | (Papageorgiou et al., 2016) | Papageorgiou S, Papageorgiou P, Deschner J, Götz W. Comparative effectiveness of natural and synthetic bone grafts in oral and maxillofacial surgery prior to insertion of dental implants: Systematic review and network meta-analysis of parallel and cluster randomized controlled trials. J Dent 2016;48:1–8. | Subjective or non-clinical outcomes (histomorphometric analysis) |
| 44 | (Pulikkotil et al., 2018) | Pulikkotil SJ, Nagendrababu V, Veettil SK, Jinatongthai P, Setzer FC. Effect of oral premedication on the anaesthetic efficacy of inferior alveolar nerve block in patients with irreversible pulpitis - A systematic review and network meta-analysis of randomized controlled trials. Int Endod J 2018;51:989–1004. doi:10.1111/iej.12912. | Subjective or non-clinical outcomes (oral pain) |

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| 45 | (Rajendra and Spivakovsky, 2016) | Rajendra A, Spivakovsky S. Antibiotics in aggressive periodontitis, is there a clinical benefit? Evid Based Dent 2016;17:100. doi:10.1038/sj.ebd.6401197. | Other study design (commentary) |
| 46 | (Rossi et al., 2021) | Rossi M, de Oliveira M, Vidigal M, de Andrade Vieira W, Figueiredo C, Blumenberg C, et al. Effectiveness of anesthetic solutions for pain control in lower third molar extraction surgeries: a systematic review of randomized clinical trials with network meta-analysis. Clin Oral Investig 2021;25:1–22. | Subjective or non-clinical outcomes (oral pain) |
| 47 | (Salanti et al., 2009) | Salanti G, Marinho V, Higgins JP. A case study of multiple-treatments meta-analysis demonstrates that covariates should be considered. J Clin Epidemiol 2009;62:857–64. | Other study design (critical review) |
| 48 | (Sandhu et al., 2016) | Sandhu SS, Cheema MS, Khehra HS. Comparative effectiveness of pharmacologic and nonpharmacologic interventions for orthodontic pain relief at peak pain intensity: A Bayesian network meta-analysis. Am J Orthod Dentofac Orthop 2016;150:13–32. doi:https://doi.org/10.1016/j.ajodo.2015.12.025. | Subjective or non-clinical outcomes (oral pain) |
| 49 | (Sandhu et al., 2017) | Sandhu SS, Piepho H-P, Khehra HS. Comparing the effectiveness profile of pharmacological interventions used for orthodontic pain relief: an arm-based multilevel network meta-analysis of longitudinal data. Eur J Orthod 2017;39:601–14. doi:10.1093/ejo/cjw088. | Subjective or non-clinical outcomes (oral pain) |
| 50 | (Sankaran and Sonis, 2021) | Sankaran S, Sonis S. Network meta-analysis from a pairwise meta-analysis design: to assess the comparative effectiveness of oral care interventions in preventing ventilator-associated pneumonia in critically ill patients. Clin Oral Investig 2021;25:2439–47. | Subjective or non-clinical outcomes (VAP) |
| 51 | (Sarkis-Onofre et al., 2019) | Sarkis-Onofre R, Marchini L, Spazzin AO, Santos MBF Dos. Randomized Controlled Trials in Implant Dentistry: Assessment of the Last 20 Years of Contribution and Research Network Analysis. J Oral Implantol 2019;45:327–33. doi:10.1563/aaid-joi-D-18-00276 | Other study design (bibliometric review) |
| 52 | (Schenkel et al., 2016) | Schenkel A, Peltz I, Veitz-Keenan A. Dental cavity liners for Class I and Class II resin-based composite restorations. Cochrane Database Syst Rev 2016;10:CD010526. | Other study design (systematic review) |
| 53 | (Schwendicke et al., 2018a) | Schwendicke F, Blunck U, Tu Y-K, Göstemeyer G. Does Classification of Composites for Network Meta-analyses Lead to Erroneous Conclusions? Oper Dent 2018;43:213–22. doi:10.2341/16-344-LIT. | Subjective or non-clinical outcomes (dental materials) |
| 54 | (Schwendicke and Göstemeyer, 2017) | Schwendicke F, Göstemeyer G. Cost-effectiveness of root caries preventive treatments. J Dent 2017;56:58–64. doi:10.1016/j.jdent.2016.10.016. | Subjective or non-clinical outcomes (cost-effectiveness) |
| 55 | (Schwendicke et al., 2018b) | Schwendicke F, Göstemeyer G, Stolpe M, Krois J. Amalgam Alternatives: Cost-Effectiveness and Value of Information Analysis. J Dent Res 2018b;97:1317–23. doi:10.1177/0022034518782671 | Subjective or non-clinical outcomes (cost-effectiveness) |
| 56 | (Schwendicke et al., 2015a) | Schwendicke F, Jäger A, Paris S, Hsu L, Tu Y. Treating pit-and-fissure caries: a systematic review and network meta-analysis. J Dent Res 2015;94:522–33. doi:10.1177/0022034515571184. | Not exclusively RCT studies included (randomized or nonrandomized clinical trials) |
| 57 | (Schwendicke et al., 2015b) | Schwendicke F, Blunck U, Paris S, Göstemeyer G. Choice of comparator in restorative trials: A network analysis. Dent Mater 2015b;31:1502–9. | Subjective or non-clinical outcomes (dental materials) |
| 58 | (Schwendicke et al., 2015c) | Schwendicke F, Paris S, Tu Y-K. Effects of using different criteria for caries removal: A systematic review and network meta-analysis. J Dent 2015c;43:1–15. doi:https://doi.org/10.1016/j.jdent.2014.10.004 | Not exclusively RCT studies included (randomised or non-randomised clinical trials) |
| 59 | (Schwendicke et al., 2015d) | Schwendicke F, Tu Y-K, Hsu L-Y, Göstemeyer G. Antibacterial effects of cavity lining: A systematic review and network meta-analysis. J Dent 2015d;43:1298–307. doi:10.1016/j.jdent.2015.07.001 | Subjective or non-clinical outcomes (reduction in bacterial numbers) |
| 60 | (Sivaramakrishnan et al., 2021) | Sivaramakrishnan G, Alsobaiei M, Sridharan K. Powered toothbrushes for plaque control in fixed orthodontic patients: a network meta-analysis. Aust Dent J 2021;66:20–31. | Not exclusively RCT studies included (randomized clinical trials or non-randomized prospective clinical studies) |

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| 61 | (Sivaramakrishnan et al., 2020) | Sivaramakrishnan G, Alsobaiei M, Sridharan K. Patient preference and operating time for digital versus conventional impressions: a network meta-analysis. Aust Dent J 2020;65:58–69. doi:10.1111/adj.12737. | Subjective or non-clinical outcomes (patient-reported outcome) |
| 62 | (Sivaramakrishnan et al., 2019) | Sivaramakrishnan G, Alsobaiei M, Sridharan K. Interventions for anesthetic success in symptomatic irreversible pulpitis: A network meta-analysis of randomized controlled trials. J Dent Anesth Pain Med 2019;19:323–41. doi:10.17245/jdapm.2019.19.6.323. | Subjective or non-clinical outcomes (oral pain) |
| 63 | (Slot et al., 2020) | Slot D, Valkenburg C, GAF V der W. Mechanical plaque removal of periodontal maintenance patients: A systematic review and network meta-analysis. J Clin Periodontol 2020;47:107–24 | Not exclusively RCT studies included (randomized and controlled clinical trials) |
| 64 | (Tavelli et al., 2021) | Tavelli L, Barootchi S, Avila-Ortiz G, Urban IA, Giannobile W V, Wang H-L. Peri-implant soft tissue phenotype modification and its impact on peri-implant health: A systematic review and network meta-analysis. J Periodontol 2021;92:21–44. | Not exclusively RCT studies included (prospective interventional human studies) |
| 65 | (Tedesco et al., 2018) | Tedesco T, Gimenez T, Floriano I, Montagner A, Camargo L, Calvo A, et al. Scientific evidence for the management of dentin caries lesions in pediatric dentistry: A systematic review and network meta-analysis. PLoS One 2018;13:e0206296. | Not exclusively RCT studies included (prospective clinical studies) |
| 66 | (Tedesco et al., 2020) | Tedesco T, Reis T, Mello-Moura A, Silva G, Scarpini S, Floriano I, et al. Management of deep caries lesions with or without pulp involvement in primary teeth: a systematic review and network meta-analysis. Braz Oral Res 2020;35:e004 | Not exclusively RCT studies included (prospective studies) |
| 67 | (Trimmel et al., 2021) | Trimmel B, Gede N, Hegyi P, Szakács Z, Anna Mezey G, Varga E, et al. Relative performance of various biomaterials used for maxillary sinus augmentation. A Bayesian network meta-analysis. Clin Oral Implant Res 2021;32:135–53. doi:doi: 10.1111/clr.13690. | Subjective or non-clinical outcomes (histomorphometric analysis) |
| 68 | (Trombelli et al., 2020) | Trombelli L, Simonelli A, Quaranta A, YK T, Li H, Agusto M, et al. Effect of Flap Design for Enamel Matrix Derivative Application in Intraosseous Defects. JDR Clin Transl Res 2020:2380084420934731. | Not exclusively RCT studies included (prospective or retrospective; randomized controlled trial, non-RCT, or case series) |
| 69 | (Tu et al., 2012) | Tu Y-K, Needleman I, Chambrone L, Lu H-K, Faggion CMJ. A Bayesian network meta-analysis on comparisons of enamel matrix derivatives, guided tissue regeneration and their combination therapies. J Clin Periodontol 2012;39:303–14. doi:10.1111/j.1600-051x.2011.01844.x. | There was an update of the study (Tsai et al. 2020) |
| 70 | (Vetromilla et al., 2020) | Vetromilla B, NJ O, FL L, Sarkis-Onofre R, FF D, MPJ van der L, et al. Treatment options for large posterior restorations: a systematic review and network meta-analysis. J Am Dent Assoc 2020;151:614-624.e18. | Not exclusively RCT studies included (prospective and retrospective studies) |
| 71 | (Walsh et al., 2010) | Walsh T, Worthington H V, Glenny A-M, Appelbe P, Marinho VC, Shi X. Fluoride toothpastes of different concentrations for preventing dental caries in children and adolescents. Cochrane Database Syst Rev 2010:CD007868. doi:10.1002/14651858.CD007868.pub2. | There was an update of the study (Walsh et al. 2019) |
| 72 | (Wong et al., 2011) | Wong MCM, Clarkson J, Glenny A-M, Lo ECM, Marinho VCC, Tsang BWK, et al. Cochrane reviews on the benefits/risks of fluoride toothpastes. J Dent Res 2011;90:573–9. doi:10.1177/0022034510393346. | Not exclusively RCT studies included (observational studies) |
| 73 | (Wu et al., 2020) | Wu Z, Zhang X, Li Z, Liu Y, Jin H, Chen Q, et al. A Bayesian network meta-analysis of orthopaedic treatment in Class III malocclusion: Maxillary protraction with skeletal anchorage or a rapid maxillary expander. Orthod Craniofac Res 2020;23:1–15. doi:10.1111/ocr.12339. | Not exclusively RCT studies included (randomized controlled trials and nonrandomized clinical trials) |
| 74 | (Yang et al., 2020) | Yang F, Gao Y, Zhang L, Zheng B, Wang L, Sun H, et al. Local anaesthesia for surgical extraction of mandibular third molars: a systematic review and network meta-analysis. Clin Oral Investig 2020;24:3781–800. doi:doi: 10.1007/s00784-020-03490-3 | Subjective or non-clinical outcomes (oral pain) |

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| 75 | (Yousefi et al., 2019) | Yousefi F, Rafiei E, Mahdian M, Mollabashi V, Saboonchi SS, Hosseini SM. Comparison Efficiency of Posteroanterior Cephalometry and Cone-beam Computed Tomography in Detecting Craniofacial Asymmetry: A Systematic Review. Contemp Clin Dent 2019;10:358–71. doi:10.4103/ccd.ccd_397_18 | Not exclusively RCT studies included (studies on dry skulls and patients) |
| 76 | (Zanjir et al., 2019) | Zanjir M, Lighvan NL, Yarascavitch C, Beyene J, Shah PS, Azarpazhooh A. Efficacy and Safety of Pulpal Anesthesia Strategies during Endodontic Treatment of Permanent Mandibular Molars with Symptomatic Irreversible Pulpitis: A Systematic Review and Network Meta-analysis. J Endod 2019;45:1435-1464.e10. doi:https://doi.org/10.1016/j.joen.2019.09.002 | Subjective or non-clinical outcomes (oral pain) |
| 77 | (Zanjir et al., 2020) | Zanjir M, Sgro A, Lighvan NL, Yarascavitch C, Shah PS, da Costa BR, et al. Efficacy and Safety of Postoperative Medications in Reducing Pain after Nonsurgical Endodontic Treatment: A Systematic Review and Network Meta-analysis. J Endod 2020;46:1387-1402.e4. | Subjective or non-clinical outcomes (oral pain) |
| 78 | (Zeng et al., 2019) | Zeng BS, Lin SY, Tu YK, Wu YC, Stubbs B, Liang CS, et al. Prevention of Postdental Procedure Bacteremia: A Network Meta-analysis. J Dent Res 2019;98:1204–10. doi:10.1177/0022034519870466. | Subjective or non-clinical outcomes (positive blood culture) |
| 79 | (Zhang et al., 2020) | Zhang J, Sardana D, Li KY, Leung KCM, Lo ECM. Topical Fluoride to Prevent Root Caries: Systematic Review with Network Meta-analysis. J Dent Res 2020;99:506–13. doi:10.1177/0022034520906384. | Not exclusively RCT studies included (controlled clinical trials) |

funding for the primary studies included in the reviews. Also, the potential impact of risk of bias and publication bias from the primary studies were rarely reported.

## Risk of bias assessment

The results of the risk of bias according to the ROBIS tool from the studies included are depicted in Table 6. In phase 2 of the tool regarding domain 1 (Study eligibility criteria), 34 (54.8) studies presented a high risk of bias,[19-21,24,25,27,29,30,32,33,35,36,39-44,46,48,54-57,60,61,63,64,66,70,73-75,77] and 2 (3.2) studies presented some concerns.[72,78] These results were related to the lack of previous registration of the protocol, lack of adherence to pre-defined objectives and eligibility criteria, and language restrictions (mainly for English language) for eligibility. Regarding domain 2 (Identification and selection of studies), 11 (17.7) studies presented a high risk of bias[18,19,29,37,38,41,43,55,56,68,69] and 28 (45.2) studies presented some concerns.[20-22,24,25,27,30,32,33,35,36,39,44-47,50,54,57-60,63,66,67,70,74,75] These results were due to some NMA studies not assessing the gray literature and not performing a hand search for potentially relevant studies. Regarding domain 3 (Data collection and study appraisal), 8 (12.9) studies presented a high risk of bias[20,28,42,52,54,61,67,69] and 14 (22.6) studies presented some concerns.[29,32,35,39,43,44,46,50,56,57,66,70,73,74] These results were due to the lack of an accurate description of data collection and the lack of clarity about data extraction being performed in duplicate. Regarding domain 4 (Synthesis and findings), 6 (9.7) studies presented a high risk of bias[21,37,39,42,64,69] and 7 (11.3) studies presented some concerns,[19,28,41,60,71,75,77] mainly due to the lack of funnel plot analysis or sensitivity analysis and because biases in primary studies were not considered in the analysis. Regarding domain 5 (Risk of bias in the review), 9 (14.5) studies presented a high risk of bias[21,37,39,42,57,60,66,69,74] and other 9 (14.5) studies presented some concerns,[19,24,32,44,46,55,56,68,77] mainly because the interpretation of findings did not address the limitations of the review, did not consider the certainty of the evidence generated, and because reviewers emphasized the results based on their statistical significance.

## Correlation between PRISMA-NMA adherence and results from AMSTAR-2 and ROBIS tools

The mean score of the PRISMA-NMA checklist, AMSTAR-2 tool, and ROBIS tool for the 62 NMA studies were, respectively, 26.5 ± 3.25 (range 17–32), 12.0 ± 2.02 (range 8.5–16), and 3.42 ± 1.14 (range 1–5). The Shapiro-Wilk test showed that the three guidelines presented non-parametric distribution.

**Table 3.** Characteristics of the included studies (n = 62).

| Author's name/ Year of publication/ Country | Journal/2020Impact factor/Citations/ Dental area | Databases / Language restrictions applied / Date of searching | Number of reviewers of study eligibility/ data extraction/ Calibration | Number of studies included in SR / NMA | Reporting guideline / Registration of the study protocol | Risk of bias tool | Certainty of evidence - GRADE | Declaration of conflicts of interest / Funding report |
|---|---|---|---|---|---|---|---|---|
| Al-Moraissi et al./ 2019/ Yemen[17] | Journal of Oral and Maxillofacial Surgery/ IF: 1.895/ Citations: 8/ Implantodontology | PUBMED, EMBASE, CINAHL, CENTRAL, and SCOPUS/ No restrictions/ March, 2018 | NR/ 2/NR | 20/ 20 | PRISMA-NMA/ PROSPERO CRD42017079866 | RoB | Moderate | NR/ NR |
| Aldhohrah et al./2021/ China[18] | Journal of Prosthetic Dentistry/ IF: 3.426/ Citations: 0/ Implantodontology | PUBMED, EMBASE, CENTRAL, Google Scholar, and hand search/ Only English/ April, 2020 | 2/ 2/ NR | 16/ 16 | PRISMA-NMA/ NR | RoB | NR | NR / NR |
| Askar et al./2021/ Germany[19] | Journal of Dentistry/ IF: 4.379/ Citations: 3/ Dental Materials | PUBMED and hand search/ No restrictions/ March, 2019 | 2/ 1/ NR | 50/ 50 (19 - adhesive strategies, 31 - restorative materials) | PRISMA-NMA/ NR | RoB | NR | None / None |
| Barbato et al./ 2016/ Italy[20] | Journal of Periodontology/ IF: 6.993/ Citations: 27/ Periodontology | PUBMED, CENTRAL, EMBASE, and hand search/ No restrictions/ December, 2014 | 2/ 2/ NR | 16/ 10 | PRISMA/ PROSPERO CRD42012003059 | RoB | Very low to moderate | None/ None |
| Barbato et al./2020/ Italy[21] | Clinical Oral Investigations/ IF: 3.573/ Citations: 8/ Periodontology | PUBMED, CENTRAL, EMBASE, and hand search/ Only English/ March, 2019 | 2/ 2/ Inter-reviewers kappa (94.42%; k= 0.531). | 9/ 9 | PRISMA-NMA/ NR | RoB | NR | None/ NR |
| Barootchi et al./ 2020/ USA[22] | Journal of Periodontology/ IF: 6.993/ Citations: 32/ Periodontology | PUBMED, EMBASE, CENTRAL, LILACS, Web of Science, SCOPUS, grey literature, and hand search/ No restrictions/ August, 2019 | 2/ 2/ Inter-reviewers kappa (titles/ abstracts: k=0.923; full-text: k=0.987) | 105/ 105 | PRISMA-NMA/ PROSPERO CRD42019147343 | RoB | NR | None/ Partially supported by the University of Michigan Periodontal Graduate Student Research Fund |
| Buti et al./2013/ Italy[23] | Journal of Clinical Periodontology/ IF: 8.728/ Citations: 72/ Periodontology | PUBMED, CENTRAL, EMBASE, and hand search/ No restrictions/ June, 2012 | 2/ 2/ NR | 26/ 29 | PRISMA/ NR | RoB | NR | None/ None |
| Cairo et al./2016/ Italy[24] | Journal of Clinical Periodontology/ IF: 8.728/ Citations: 48/ Periodontology | PUBMED, CENTRAL, EMBASE, and hand search/ Only English/ January, 2016 | 3/ 3/ NR | 16/ 16 | PRISMA-NMA/ NR | RoB | NR | None/ None |
| Cairo et al./2020/ Italy[25] | Journal of Clinical Periodontology/ IF: 8.728/ Citations: 19/ Periodontology | PUBMED, COCHRANE, EMBASE, hand search, and grey literature/ No restrictions/ January, 2020 | 2/ 2/ Inter-reviewers kappa (titles/ abstracts: k=0.91; full-text: k=0.96). | 26 /26 | PRISMA/ PROSPERO CRD42020142623 | RoB 2.0 | NR | None/ Partially supported by the University of Michigan Periodontal Graduate Student Research Fund |

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| Camps-Font et al./ 2021/ Spain[26] | The Journal of Prosthetic Dentistry/ IF: 3.426/ Citations: 0/ Implantodontology | MEDLINE, COCHRANE, SCOPUS, Web of Science, and hand search and grey literature/ Date restrictions/ May, 2020 | 2/ 2/ Inter-reviewers kappa (k=0.88) | 18/ 18 | PRISMA-NMA/ PROSPERO CRD42018099154 | RoB | NR | NR/ None |
| Canellas et al./ 2020/ Brazil[27] | Journal of Cranio-Maxillofacial Surgery/ IF: 2.078/ Citations: 7/ Oral Surgery | PUBMED, COCHRANE, EMBASE, Web of Science, SCOPUS, LILACS, and hand search and grey literature/ No restrictions/ September, 2019 | 2 /NR/ Inter-reviewers kappa (k=0.8) | 37/ 37 | PRISMA/ PROSPERO CRD42020149258 | RoB | NR | None/ None |
| Canullo et al./ 2022/ Italy[28] | Clinical Oral Investigations/ IF: 3.573/ Citations: 0/ Periodontology | PUBMED (Medline), SCOPUS, EMBASE, COCHRANE, hand search and grey literature/ Only English/ April, 2021 | 2/ NR/ Inter-reviewers kappa (k=0.81) | 22/ 11 | PRISMA/ PROSPERO CRD42020218153 | RoB | Low to moderate | None/ None |
| Cao et al./2019/ China[29] | BMC Oral Health/ IF: 2.757/ Citations: 3/ Periodontology | PUBMED, EMBASE, COCHRANE, Web of Science, and hand search/ NR/ June, 2018 | 2/ 2/ NR | 14 /14 | NR/ PROSPERO CRD42018100753 | RoB | NR | None/ None |
| Dreweck et al./ 2021/ Brazil[30] | Clinical Oral Investigations/ IF: 3.573/ Citations: 1/ Dental Materials | PUBMED, EMBASE, CENTRAL, Brazilian Library in Dentistry (BBO), Latin American and Caribbean Health Sciences Literature database (LILACS), SCOPUS, Web of Science, hand search and grey literature/ No restrictions/ November, 2019 | 2/ 3/ NR | 66 / 57 | PRISMA-NMA/ PROSPERO CRD42018112672 | RoB | Low | None/ This study was partially supported by the National Council for Scientific and Technological Development (CNPq) under grants 303332/2017-4 and 308286/2019-7 and Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001 |
| Escribano et al./ 2016/ Spain[31] | Journal of Clinical Periodontology/ IF: 8.728/ Citations: 34/ Periodontology | PUBMED, CENTRAL, and hand search/ NR/ April, 2016 | 2/ 2/ Inter-reviewers kappa (100%, k=1.00; 95%, k=0.86; 80%, k=0.59; 90%, k=0.67). | 83/ 63 | PRISMA-NMA/ Previously published in an SR-MA | RoB | NR | None/ Self-funded by the Etiology and Therapy of Periodontal Diseases Research Group, University Complutense, Madrid, Spain. |

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| Faggion et al./ 2014/ Germany[32] | Journal of Clinical Periodontology/ IF: 8.728/ Citations: 46/ Implantodontology | PUBMED, SCOPUS, CINAHL, DARE, Web of Knowledge, and hand search and grey literature/ No restrictions/ January, 2014 | 2/ 2/ NR | 11/ 11 | PRISMA/ NR | RoB | Very low | None/ YKT is supported by a grant from the National Science Council in Taiwan. All other authors were funded by their institutions. |
| Falci et al/2021/ Brazil[33] | International Journal of Oral & Maxillofacial Surgery/ IF: 2.789/ Citations: 1/ Oral Surgery | PUBMED, CENTRAL, Web of Science, Clinicaltrials.gov, and grey literature/ No restrictions/ May, 2020 | 2/ 2/ NR | 15 / 15 | PRISMA-NMA/ PROSPERO CRD42020160829 | RoB 2.0 | Moderate | None/ This study was financed in part by the CAPES - Brazil (finance code 001), the Research Foundation of the State of Minas Gerais (FAPEMIG), and the National Council for Scientific and Technological Development. |
| Figuero et al./ 2019/ Spain[34] | Journal of Clinical Periodontology/ IF: 8.728/ Citations: 22/ Periodontology | PUBMED, CENTRAL, and hand search/ NR/ January, 2019 | 2/2/ Inter-reviewers kappa (100%, k=1.00; 95%, k=0.86; 80%, k=0.59; 90%, k=0.67). | 53/ 21 (mounthrinses) and 34 (dentifrices) | PRISMA-NMA/ NR | RoB | NR | Declared / Self-funded by the Etiology and Therapy of Periodontal Diseases Research Group, University Complutense, Madrid, Spain. |
| Graziani et al./ 2014/ Italy[35] | Journal of Clinical Periodontology/ IF: 8.728/ Citations: 83/ Periodontology | PUBMED, EMBASE, CENTRAL, and hand search/ No restrictions/ July, 2013 | 2/ 2/ Inter-reviewers kappa (from first to fourth exercise: k=0.85, 0.95, 0.95 and 0.95) | 9/ 4 | PRISMA/ NR | RoB | NR | None/ Self-supported partly by the Unit of Dentistry and Oral Surgery of the University of Pisa and partly by the Italian Ministry of Health and the Tuscan Region. |
| Hu et al./2021/ China[36] | Lasers in Medical Science/ IF: 3.161/ Citations: 1/ Periodontology | PUBMED, EMBASE, Web of Science, CENTRAL, CNKI, and China Biology Medicine database, hand search, and grey literature/ Only English and Chinese/ December, 2019 | 2/ 2/ Inter-reviewers kappa (title/ abstract k=0.94; full-text k=0.96) | 11/ 11 | PRISMA-IPD/ PROSPERO CRD42019145195 | RoB | Low | None/ Supported by the National Natural Science Foundation of China. |

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| Hu et al./2020/ China[37] | Clinical Oral Investigations/ IF: 3.573/ Citations: 5/ Orthodontics | PUBMED, COCHRANE, EMBASE, Web of Science, SCOPUS, China National Knowledge Infrastructure (CNKI), Chongqing VIP Information database, Wanfang database, the Chinese Biomedical Literature Database, and hand search/ Only English and Chinese/ March, 2020 | 2/ 2/ NR | 36/ 16 | PRISMA-NMA/ PROSPERO CRD42019116852 | RoB | NR | None/ Supported by the National Natural Science Foundation of China and the Applied and Fundamental Research Program funded by the Department of Science and Technology of Sichuan Province. |
| Iocca et al./2017/ Italy[38] | Journal of Clinical Periodontology/ IF: 8.728/ Citations: 50/ Implantodontology | PUBMED, CENTRAL, and EMBASE/ Only English/ January, 2016 | 2/ NR/ Inter-reviewers kappa (titles/ abstracts k=0.863) | 6/ 6 | NR/ PROSPERO CRD42016033094 | RoB | NR | None/ Self-funded by the Authors and their institutions. |
| Jepsen et al./2020/ Germany[39] | Journal of Clinical Periodontology/ IF: 8.728/ Citations: 16/ Periodontology | PUBMED, COCHRANE Oral Health Group specialist trials, EMBASE, hand search, and grey literature/ Only English/ December, 2018 | 2/ 2/ Inter-reviewers kappa (k > 0.8) | 19 /19 | PRISMA-NMA/ PROSPERO CRD42019124466 | RoB | NR | None/ NR |
| Jia et al./2020/ China[40] | Lasers in Medical Science/ IF: 3.161/ Citations: 12/ Periodontology | PUBMED, COCHRANE, Web of Science, Science Direct, Wan Fang, and China National Knowledge Infrastructure (CNKI) database/ Only English and Chinese/ September, 2018 | 2/ 2/ NR | 25/ 25 | PRISMA-NMA/ NR | RoB | NR | None/ Supported by the Hospital of Stomatology Hebei Medical University. |
| Jia et al./2022/ China[41] | Lasers in Medical Science/ IF: 3.161/ Citations: 0/ Periodontology | PUBMED, Science Direct, Ovid, Web of Science, Cochrane Library, China National Knowledge Infrastructure, Wan Fang databases, and hand search/ Only English and Chinese/ January 2020 | 2 / researchers/ NR | 37 / 37 | PRISMA-NMA/ NR | RoB | NR | None/ NR |
| John et al./2017/ USA[42] | Journal of Clinical Periodontology/ IF: 8.728/ Citations: 26/ Periodontology | PUBMED and EMBASE/ Only English/ July, 2014 | 4/ 8/ NR | 74/ 74 | PRISMA/ NR | RoB | Moderate | None. Dr. Michalowicz has received research support from Ora-Pharma and Atrix Laboratories in the past./ Drs. Chu, John & Kotsakis were supported by R03 DE024750. |

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| Kotsakis et al./2018/ USA[43] | Journal of Periodontology/ IF: 6.993/ Citations: 25/ Periodontology | PUBMED, EMBASE, Web of Science, and hand search/ Only English/ April, 2015 | 2/ 2/ Inter-reviewers kappa (titles/abstracts k=0.85; full-text k=0.80) | 22/ 22 | PRISMA/ NR | RoB | NR | Declared/ Drs. Chu, John & Kotsakis were supported by NIDCR. |
| Krois et al./2018/ Germany[44] | Journal of Dentistry/ IF: 4.379/ Citations: 11/ Dental Materials | PUBMED, CENTRAL, EMBASE, and hand search/ No restrictions/ NR | 2/ 2/ NR | 15/ 13 | PRISMA-NMA/ PROSPERO CRD42018080895 | RoB | Moderate to high | Declared/ Supported by the authors and their institution. |
| Lin et al./2014/ Taiwan[45] | Journal of Dentistry/ IF: 4.379/ Citations: 55/ Paediatric Dentistry | PUBMED, COCHRANE, Science-Direct, Web of Science, ClinicalKey, and hand search/ No restrictions/ December, 2012 | 3/ 3/ NR | 37/ 22 | NR/ NR | Quality assessment: randomization, allocation concealment, blinding, intention to treat, and sample size calculation. | NR | None/ Partly supported by a grant from the National Science Council in Taiwan. |
| Loo et al./2021/ Malaysia[46] | Oral Diseases/ IF: 3.511/ Citations: 1/ Oral Pathology | PUBMED, CENTRAL, EMBASE, and hand search/ No restrictions/ December, 2018 | 2/ 2/ NR | 20/ 20 | PRISMA-NMA/ PROSPERO CRD42018112449 | RoB | Low | None/ None |
| MacDonald et al./2021/ Canada[47] | Orthodontics and Craniofacial Research/ IF: 1.455/ Citations: 1/ Orthodontics | PUBMED, CENTRAL, EMBASE, CINAHL, SCOPUS, World Health Organization International Clinical Trials Registry Platform (WHO ICTRP), ClinicalTrials.gov trials registries, hand search, and grey literature/ Only English/ April, 2020 | 2/ 2#/ NR | 19/ 19 | PRISMA-NMA/ NR | RoB | Low | None/ NR |
| Manchanda et al./2022/ Hong Kong[48] | Journal of Dentistry/ IF: 4.379/ Citations: 2/ Cariology | PUBMED, EMBASE, SCOPUS, LILACS, CINAHL, Web of Science, Cochrane Library, hand search and grey literature/ No restrictions/ July, 2020 | 2/ 2/ Inter-reviewers kappa (k=0.807) | 24/ 10 | PRISMA/ PROSPERO CRD42020186163 | RoB 2.0 | Very low to moderate | None/ This review was funded by the Research Grants Council, Hong Kong (General Research Fund: 17106318). |
| Maran et al./2019/ Brazil[49] | Clinical Oral Investigations/ IF: 3.573/ Citations: 12/ Dental Materials | PUBMED, COCHRANE, Brazilian Library in Dentistry, LILACS, SCOPUS, Web of Science, Current Controlled Trials, hand search, and grey literature/ No restriction/ March, 2018 | 3/ 3/ NR | 28/ 18 | PRISMA-NMA/ PROSPERO CRD42017078743 | RoB | NR | None/ Partially supported by the National Council for Scientific and Technological Development from the Brazilian Government and CAPES from the Brazilian Ministry of Education. |

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| Moraschini et al./ 2020/ Brazil[50] | Clinical Oral Investigations/ IF: 3.573/ Citations: 1/ Periodontology | PUBMED, CENTRAL, SCOPUS, EMBASE, LILACS, hand search, and grey literature/ No restriction/ April, 2020 | 2/ 2#/ Inter-reviewers kappa (titles/ abstracts: k=0.97; full-text: k=0.85) | 27/ 27 | PRISMA-NMA/ INPLASY 202060075 | RoB 2.0 | NR | None/ None |
| Moraschini et al./ 2022/ Brazil[51] | International Journal of Oral & Maxillofacial Surgery/ IF: 2.789/ Citations: 0/ Implantodontology | PUBMED, CENTRAL, SCOPUS, LILACS, hand search and grey literature/ No restrictions/ November, 2020 | 2/ 2/ Inter-reviewers kappa (titles/ abstracts: k=0.97; full-text: k=0.85) | 11/ 11 | PRISMA-NMA/ INPLASY 2020100056 | RoB 2.0 | NR | None/ None |
| Muniz et al./2022/ Brazil[52] | Clinical Oral Investigations/ IF: 3.573/ Citations: 0/ Periodontology | PUBMED, EMBASE, Scopus, Web of Science, CENTRAL, and hand search/ No restrictions/ February, 2021 | 2/ 2/ Inter-reviewers kappa (titles/ abstracts: k=0.92; full-text: k=1.00) | 12 / 9 (gingival index) and 8 (plaque index) | PRISMA-NMA/ PROSPERO CRD42021239762 | RoB 2.0 | Low or very low | None/ None |
| Natto et al./2017/ Saudi Arabia-USA[53] | The International Journal of Periodontics & Restorative Dentistry/ IF: 1.513/ Citations: 14/ Periodontology | PUBMED, CENTRAL, Web of Science, Conference Proceedings, Science Direct, and hand search/ Only English/ September, 2016 | 2/ NR/ Inter-reviewers kappa (k=0.87) | 8/ 8 | PRISMA/ NR | CONSORT statement | NR | None/ NR |
| Panda et al./2021/ India[54] | Clinical and Experimental Dental Research/ IF: 1.45/ Citations: 0/ Periodontology | PUBMED, CENTRAL, SCOPUS, EMBASE and hand search/ Only English/ NR | 2/ 2/ NR | 39/ 19 | PRISMA/ PROSPERO CRD42020208010 | RoB 2.0 | Low to moderate | None/ None |
| Panda et al./2022/ India[55] | Journal of Tissue Engineering and Regenerative Medicine/ IF: 3.963/ Citations: 0/ Periodontology | PUBMED, EMBASE, Web of Science, COCHRANE, and hand search/ Only English/ November, 2020 | NR/ 2/ NR | 12/ 12 | PRISMA/ PROSPERO CRD42020213753 | RoB 2.0 | Moderate | None/ None |
| Peng et al./2017/ China[56] | Oral Oncology/ IF: 5.337/ Citations: 9/ Oral Pathology | PUBMED, COCHRANE, Web of Science, WangFang, China National Knowledge Infrastructure, and hand search/ No restriction/ May, 2017 | 3/ 3/ NR | 57/ 57 | NR/ NR | Jadad-Oxford scale | NR | None/ Support from the National Natural Science Foundation of China, the National Natural Science Foundation of China, and the Sun Yat-sem University Clinical Research 5010 Program. |
| Pires et al./2018/ Brazil[57] | Brazilian Oral Research/ IF: 2.674/ Citations: 24/ Pediatric Dentistry | PUBMED, CENTRAL, SCOPUS, TRIP, and hand search/ No restriction/ January, 2017 | 2/ 2/ Inter-reviewers kappa (k=0.96) | 17/ 17 | PRISMA-NMA/ PROSPERO CRD42016035775 | RoB | NR | None/ NR |

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| Rabelo et al./ 2015/ Brazil[58] | Journal of Clinical Periodontology/ IF: 8.728/ Citations: 65/ Periodontology | PUBMED, EMBASE, CENTRAL, hand search, and grey literature/ NR/ December, 2014 | 2/ 2/ NR | 14/ 5 | PRISMA, Cochrane Handbook, and CheckReview/ São Paulo Research Foundation, FAPESP | RoB | NR | None/ Supported by the research grants from Sao Paulo Research Foundation (FAPESP, Brazil) and the National Science Council in Taiwan. |
| Rajesh Kashyap and Shanker Kashyap/2021/ India[59] | Oral Diseases/ IF: 3.511/ Citations: 1/ Oral Surgery | PUBMED, Google Scholar, Science Direct, SCOPUS, COCHRANE, Web of Science, and hand search/ Only English/ January, 2020 | NR/ 2/ NR | 56 / 14 | PRISMA-P/ NR | RoB 2.0 | NR | None/ None |
| Ramanauskaite et al./ 2021/ Lithuania[60] | Photodiagnosis and Photodynamic Therapy/ IF: 3.631/ Citations: 1/ Periodontology | PUBMED, EMBASE, CENTRAL, hand search and grey literature/ Only English/ March, 2021 | 2/ NR/ Inter-reviewers kappa (titles/ abstracts: k=0.94; full-text: k=1.0) | 8/ 8 | PRISMA/ INPLASY202110022 | RoB | NR | None/ None |
| Romandini et al./ 2019/ Italy[61] | Journal of Clinical Periodontology/ IF: 8.728/ Citations: 31/ Implantodontology | PUBMED, SCOPUS, CENTRAL and Web of Knowledge, hand search and grey literature/ No restrictions/ July, 2017 | 2/ 2/ NR | 9/ 8 | PRISMA-NMA/ PROSPERO CRD42015029708 | RoB | NR | None/ NR |
| Schwendicke et al./ 2016/ Germany[62] | Journal of Dental Research/ IF: 6.116/ Citations: 60/ Dental Materials | CENTRAL, PUBMED, EMBASE, and hand search/ No restrictions/ May, 2015 | 2/ 2/ NR | 72/ 72 (36 for cervical lesions and 36 for load-bearing lesions) | NR/ NR | RoB | NR | None/ Funded by the authors and their institutions. FS was supported by a grant from the German Research Foundation. Tu was supported by a grant from the Ministry of Science and Technology in Taiwan. |
| Schwendicke et al./ 2021/ Germany[63] | Cochrane Library/ IF: 9.266/ Citations: 2/ Cariology | PUBMED, EMBASE, CENTRAL, Cochrane Oral Health's Trials Register, Clinicaltrials.gov, WHO Clinical Trials Registry Plataform, and hand search/ No restrictions/ July, 2020 | 2/ 2/ NR | 23/ 11 | NR/ NR | RoB | Low or very low | Declared/ Manchester Academic Health Sciences Centre (MAHSC); National Institute for Health Research (NIHR), UK; Cochrane Oral Health Global Alliance. |

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| Sebastian et al./ 2022/ India[64] | European Journal of Orthodontics/ IF: 3.075/ Citations: 0/ Orthodontics | PubMed, Web of Science, Google Scholar, CENTRAL, Cochrane Database of Systematic Reviews, LILACS, Scopus, EMBASE, MEDLINE (Ovid), EPUB ahead of publications and non-indexed citations, hand search and grey literature/ Date restrictions/ January, 2020 | 2/ 2/ NR | 13/ 9 | PRISMA/ PROSPERO CRD42020157811 | RoB 2.0 | Low | None/ None |
| Sivaramakrishnan and Sridharan/ 2018/ Fiji[65] | Photodiagnosis and Photodynamic Therapy/ IF: 3.631/ Citations: 14/ Implantodontology | PUBMED, CENTRAL, and Google Scholar, and hand search/ Only in English/ May, 2017 | 2/ Unclear/ Inter-reviewers kappa (k=0.86) | 6/ 6 | NR/ PROSPERO CRD42017062714 | RoB | Very low | None/ None |
| Sgolastra et al./2020/ Italy[66] | Journal of Periodontal Research/ IF: 4.419/ Citations: 3/ Periodontology | PUBMED, CENTRAL, EMBASE, and hand search/ No restrictions/ March, 2020 | 2/ NR/ Inter-reviewers kappa (k=0.75) | 21/ 21 | PRISMA-NMA/ PROSPERO CRD42020178621 | RoB 2.0 | NR | None/ NR |
| Sridharan and Sivaramakrishnan/ 2018/ Bahrain[67] | Journal of Clinical Neuroscience/ IF: 1.961/ Citations: 15/ Oral Pathology | CENTRAL and PUBMED/ No restrictions/ NR | 2/ 2/ NR | 21/ 15 | PRISMA/ PROSPERO CRD42017069223 | RoB | Very-low to low | None/ None |
| Sridharan and Sivaramakri/2021/ Bahrain[68] | Australian Dental Journal/ IF: 2.419/ Citations: 2/ Oral pathology | PubMed, Cochrane CENTRAL and hand search/ No restrictions/ October, 2020 | 2/ 2/ NR | 55 / 52 | PRISMA-NMA/ https://osf.io/3qv4h/ ?show=view &view_ only= | RoB | Very low to low | None/ NR |
| Stavropoulos et al./2021/ Switzerland[69] | Journal of Clinical Periodontology/ IF: 8.728/ Citations: 12/ Periodontology | PUBMED, EMBASE, CENTRAL, and hand search/ Only English and German/ April, 2020 | 2/ 2/ NR | 31/ 21 | PRISMA/ NR | RoB | NR | Declared/ Dr. Stavropoulos has received over the years research support, mostly in terms of biomaterials free of charge. Dr. Bertl and Dr. Spineli declare no conflict of interest. Dr. Sculean, Dr. Tonetti and Dr. Cortellini have received over the years research support and lecture fees. |
| Tan et al./2020/ Malaysia[70] | Pharmaceutics/ IF: 6.321/ Citations: 2/ Periodontology | CENTRAL, PUBMED, EMBASE, Web of Science, hand search, and grey literature/ No restrictions/ January, 2020 | 2/ 2/ NR | 43/ 29 | PRISMA and Cochrane Handbook/ PROSPERO CRD42020137115 | RoB 2.0 | Very-low, low, and moderate | None/ Funded by The National University of Malaysia. |

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| Tavelli et al./2019/ USA[71] | Journal of Dental Research/ IF: 6.116/ Citations: 36/ Periodontology | PUBMED, EMBASE, COCHRANE, hand search, and grey literature/ NR/ May, 2017 | 2/ 2/ Inter-reviewers kappa (titles/ abstracts: k=0.87; full-text: k=0.93) | 64/ 60 | PRISMA and Cochrane Handbook , AMSTAR/ PROSPERO CRD42018090449 | RoB | NR | None/ Partially supported by the University of Michigan Periodontal Graduate Student Research Fund. |
| Tsai et al./2020/ Taiwan[72] | Journal of Clinical Periodontology/ IF: 8.728/ Citations: 5/ Periodontology | PUBMED, EMBASE, LILACS, CENTRAL, and grey literature/ NR/ September, 2019 | 2/ 2/ Inter-reviewers weighted kappa (k=0.867) | 60/ 60 | PRISMA-NMA/ NR | RoB | NR | None/ Partly funded by a grant from the Ministry of Science and Technology in Taiwan. |
| Tu et al./2010/ United Kingdom[73] | Journal of Clinical Periodontology/ IF: 8.728/ Citations: 62/ Periodontology | PUBMED, EMBASE, LILACS, CENTRAL, and hand search/ Only English, French and Spanish/ December, 2008 | 2/ 2/ NR | 28/ 28 | NR/ NR | RoB | NR | None/ The first author was funded by the United Kingdom government's Higher Education Funding Council for England (HEFCE) and currently holds a UK Research Council Fellowship. A UK Medical Research Council studentship supports the second author. |
| Urquhart et al./ 2019/ USA[74] | Journal of Dental Research/ IF: 6.116/ Citations: 58/ Cariology | PUBMED, EMBASE, CENTRAL, and hand search/ No restrictions/ June, 2018 | 2/ 2/ NR | 44/ 44 | PRISMA/ NR | RoB | Very-low to high | None/ RLS has received research funding from the NIDCR-NHI. MMN has received research funding from the NIDCR-NIH as well as Colgate-Palmolive. RJW receives research funding from the NIDCR-NIH and training grant funding from the HRSA, and is the editor in chief of the JPHD and is on the board of directors of the AAPHD. MSW is a researcher, consultant, and lecturer for the Colgate Palmolive. DAY has lectured for honoraria sponsored by industry. |

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| | | | | | | | | GJ is currently an employee of GC America. Methodologists from the ADA Center for Evidence-Based Dentistry led the development and authorship of the systematic review in collaboration with the expert panel. The ADA Council on Scientific Affairs commissioned this work. MF receives research funding from NIDCR-NIH and Procter & Gamble and serves as a scientific consultant for DentaQuest, Delta Dental Foundation, Procter & Gamble, Colgate, and 3M. BBN has lectured for honoraria sponsored by industry. DTZ has received consulting fees from Johnson & Johnson for providing lectures, is a consultant for Colgate, and receives research funding from NIH-NIDCR, Johnson & Johnson, GlaxoSmithKline, Novartis Pharmaceuticals, and Church & Dwight. |
| Walsh et al./2019/ United Kingdom[75] | Cochrane Library/ IF: 9.266/ Citations: 112/ Cariology | CENTRAL, PUBMED, EMBASE, hand search, and grey literature/ No restrictions/ August, 2018 | Cochrane Oral Health's Information Specialist conducted systematic searches/ 2/ NR | 96/ 81 | NR/ Published protocol | RoB | Moderate and high | Declared/ Supported by the NIHR, via Cochrane Infrastructure funding to Cochrane Oral Health. |

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| Wang et al./2020/ Taiwan[76] | Journal of Clinical Periodontology/ IF: 8.728/ Citations: 7/ Periodontology | PUBMED, EMBASE, CENTRAL, hand search, and grey literature/ No restrictions/ May, 2020 | 2/ 2/ Inter-reviewers kappa (k=0.890) | 22/ 22 | PRISMA, Cochrane Handbook, and Check Review/ NR | RoB 2.0 | NR | None/ Supported partly by grants from the National Taiwan University Hospital and the Ministry of Science and Technology, Taiwan. |
| Zhao et al./2020/ China[77] | Photodiagnosis and Photodynamic Therapy/ IF: 3.631/ Citations: 3/ Periodontology | PUBMED, EMBASE, CENTRAL, Web of Science, hand search, and grey literature/ NR/ September, 2019 | 2/ 2/ Inter-reviewers kappa (title/abstracts: k=0.88; full-text: k=0.92) | 44/ 44 | PRISMA and Cochrane Handbook/ PROSPERO CRD42020152996 | RoB | NR | None/ Supported by the National Natural Science Foundation of China. |
| Zymperdikas et al./ 2020/ Greece[78] | Journal of Dental Research/ IF: 6.116/ Citations: 1/ Periodontology | 17 databases, hand search, and grey literature/ No restrictions/ August, 2020 | 2/ 2/ NR | 11/ 7 | PRISMA-NMA/ "The protocol was conducted a priori based on the Cochrane Handbook for Systematic Reviews of Interventions 5.1.0 and is available upon request. Not registered." | RoB 2.0 | NR | None/ None |

*Country of the correspondent author; # One reviewer extracted the data and the second reviewer confirmed all extracted data; SR: Systematic review; NMA: network meta-analyses; NR: not reported; RoB: Cochrane risk of bias tool; OR: Odds ratios; RR: relative risks; WMD: Weighted mean difference; CI: confidence intervals; CrI: credibility interval; MD: Mean difference; SD: Standard deviation.

**Table 4.** Reporting characteristics of the 32-items of the PRISMA-NMA checklist (n = 62).

| Section | Checklist item | Yes | No |
|---|---|---|---|
| | | n (%) | n (%) |
| Title | 1. SR and NMA in title | 39 (62.9) | 23 (37.1) |
| | 2. Structured summary | 62 (100) | 0 (0) |
| Background | 3. Rationale for the review | 62 (100) | 0 (0) |
| | 4. Objectives (PICO) | 54 (87.1) | 8# (12.9) |
| Methods | 5. Protocol and registration | 36 (58.1) | 26 (41.9) |
| | 6. Eligibility criteria | 61 (98.4) | 1 (1.6) |
| | 7. Information sources | 62 (100) | 0 (0) |
| | 8. Search | 50 (80.6) | 12 (19.4) |
| | 9. Study selection | 61 (98.4) | 1 (1.6) |
| | 10. Data collection process | 56 (90.3) | 6 (9.7) |
| | 11. Data items | 46 (74.2) | 16 (25.8) |
| | 12. Geometry of the network | 20 (32.2) | 42 (67.8) |
| | 13. Risk of bias within individual studies | 62 (100) | 0 (0) |
| | 14. Summary measures | 58 (93.5) | 4 (6.5) |
| | 15. Planned methods of analysis | 58 (93.5) | 4 (6.5) |
| | 16. Assessment of Inconsistency | 44 (71.0) | 18 (29.0) |
| | 17. Risk of bias across studies | 34 (54.8) | 28 (45.2) |
| | 18. Additional analyses | 45 (72.6) | 17 (27.4) |
| Results | 19. Study selection | 59 (95.2) | 3 (4.8) |
| | 20. Presentation of network structure | 57 (91.9) | 5 (9.1) |
| | 21. Summary of network geometry | 39 (62.9) | 23 (37.1) |
| | 22. Study characteristics | 56 (90.3) | 6 (9.7) |
| | 23. Risk of bias within studies | 61 (98.4) | 1 (1.6) |
| | 24. Results of individual studies | 48 (77.4) | 14 (22.6) |
| | 25. Synthesis of results | 60 (96.8) | 2 (3.2) |
| | 26. Exploration for inconsistency | 40 (64.5) | 22 (35.5) |
| | 27. Risk of bias across studies | 31 (50) | 31 (50) |
| | 28. Results of additional analyses | 50 (80.6) | 12 (19.4) |
| Discussion | 29. Summary of evidence | 62 (100) | 0 (0) |
| | 30. Limitations | 52 (83.9) | 10 (16.1) |
| | 31. Conclusions | 61 (98.4) | 1 (1.6) |
| Other | 32. Funding | 54 (87.1) | 8 (12.9) |

#Objective not stated as a PICO structure.

Considering the mean scores, two additional analyses were conducted. First, the studies were stratified based on year of publication up to 2019 (n = 27) and from 2020 onward (n = 35). The stratification was designed to have a similar number of publications in the two strata and to have a reasonable minimum time span (in this case, 4 years) from the launch of the PRISMA-NMA guideline in 2015. The Mann-Whitney U test was used. The mean scores were 25.8 ± 3.02 vs. 27.0 ± 3.37 for PRISMA-NMA (p = 0.100), 11.1 ± 1.76 vs. 12.6 ± 2.00 for AMSTAR-2 (p = 0.008), and 3.26 ± 1.02 vs. 3.54 ± 1.22

**Table 5.** Quality assessment for each included network meta-analysis (AMSTAR 2 checklist) (n = 62).

| Study | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | Overall quality |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Al-Moraissi et al., 2019[17] | Y | N | Y | PY | N | Y | N | Y | Y | N | Y | Y | N | N | Y | N | Moderate |
| Aldhohrah et al., 2021[18] | Y | N | Y | PY | Y | Y | Y | Y | Y | N | Y | N | Y | Y | Y | N | Moderate |
| Askar et al., 2021[19] | Y | N | Y | PY | Y | N | Y | Y | Y | N | Y | N | Y | Y | N | Y | Moderate |
| Barbato et al., 2016[20] | Y | PY | Y | PY | Y | Y | Y | Y | Y | N | Y | N | Y | Y | N | Y | Moderate |
| Barbato et al., 2020[21] | Y | N | Y | PY | Y | Y | Y | Y | Y | N | Y | N | Y | Y | Y | Y | Moderate |
| Barootchi et al., 2020[22] | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | N | Y | Y | N | Y | High |
| Buti et al., 2013[23] | Y | N | Y | PY | Y | Y | Y | Y | Y | N | Y | N | Y | Y | N | Y | Moderate |
| Cairo et al., 2016[24] | Y | N | Y | PY | Y | Y | N | PY | Y | N | Y | N | N | Y | N | Y | Low |
| Cairo et al., 2020[25] | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | N | Y | High |
| Camps-Font et al., 2021[26] | Y | PY | Y | Y | Y | Y | PY | N | Y | N | Y | N | Y | Y | N | Y | Low |
| Canellas et al., 2020[27] | Y | Y | Y | Y | Y | N | Y | Y | Y | N | Y | N | Y | Y | N | Y | Moderate |
| Canullo et al., 2022[28] | Y | Y | Y | PY | Y | N | N | Y | Y | N | Y | Y | Y | Y | N | Y | Low |
| Cao et al., 2019[29] | Y | Y | Y | PY | Y | Y | N | Y | Y | N | Y | Y | Y | Y | N | Y | Moderate |
| Dreweck et al., 2021[30] | Y | Y | Y | Y | Y | Y | Y | PY | Y | N | Y | Y | Y | Y | Y | Y | High |
| Escribano et al., 2016[31] | Y | Y | Y | N | Y | Y | Y | PY | Y | N | Y | N | Y | Y | N | Y | Low |
| Faggion et al., 2014[32] | Y | N | Y | Y | Y | Y | Y | Y | Y | Y | Y | N | Y | Y | Y | Y | Moderate |
| Falci et al., 2021[33] | Y | Y | Y | Y | Y | Y | N | PY | Y | N | Y | Y | Y | Y | Y | Y | Low |
| Figuero et al., 2019[34] | Y | N | Y | N | Y | Y | Y | N | Y | N | Y | N | N | Y | N | Y | Critically low |
| Graziani et al., 2014[35] | Y | N | Y | PY | Y | Y | Y | Y | Y | Y | Y | N | Y | Y | N | Y | Moderate |
| Hu et al., 2021[36] | Y | Y | Y | Y | Y | Y | N | Y | Y | N | Y | N | N | N | Y | Y | Low |
| Hu et al., 2020[37] | Y | Y | Y | PY | Y | Y | Y | Y | Y | Y | Y | N | Y | N | Y | Y | Moderate |
| Iocca et al., 2017[38] | Y | PY | Y | PY | Y | N | Y | PY | Y | N | Y | N | Y | Y | N | Y | Moderate |
| Jepsen et al., 2020[39] | Y | Y | Y | PY | Y | Y | Y | Y | Y | Y | Y | N | Y | Y | Y | N | Moderate |
| Jia et al., 2020[40] | Y | N | Y | PY | Y | Y | N | Y | Y | N | Y | Y | Y | N | Y | Y | Moderate |
| Jia et al., 2022[41] | Y | N | Y | PY | Y | N | N | PY | Y | N | Y | Y | Y | N | Y | Y | Critically low |
| John et al., 2017[42] | Y | N | Y | PY | Y | Y | N | N | Y | N | Y | Y | Y | Y | Y | Y | Moderate |
| Kotsakis et al., 2018[43] | Y | N | Y | PY | Y | Y | N | Y | Y | Y | Y | Y | N | N | N | Y | Low |
| Krois et al., 2018[44] | Y | Y | Y | PY | Y | Y | N | Y | Y | Y | Y | N | Y | Y | Y | Y | Moderate |

Continue

Continuation

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lin et al., 2014[45] | Y | N | Y | PY | Y | Y | N | Y | PY | N | Y | N | N | Y | Y | Y | Low |
| Loo et al., 2021[46] | Y | Y | Y | PY | Y | Y | Y | Y | Y | N | Y | Y | Y | Y | Y | Y | Moderate |
| MacDonald et al., 2021[47] | Y | N | Y | Y | Y | N | Y | Y | Y | N | Y | Y | Y | Y | N | N | Moderate |
| Manchanda et al., 2022[48] | Y | Y | Y | Y | Y | Y | Y | Y | Y | N | Y | Y | Y | Y | Y | Y | High |
| Maran et al., 2019[49] | Y | PY | Y | Y | Y | Y | PY | Y | Y | N | Y | Y | Y | N | N | Y | Moderate |
| Moraschini et al., 2020[50] | Y | Y | Y | Y | Y | N | N | Y | Y | N | Y | Y | Y | N | N | Y | Moderate |
| Moraschini et al., 2022[51] | Y | Y | Y | Y | Y | Y | Y | PY | Y | N | Y | Y | Y | Y | Y | Y | High |
| Muniz et al., 2022[52] | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | High |
| Natto et al., 2017[53] | Y | N | Y | PY | Y | N | N | PY | PY | N | Y | Y | Y | N | Y | N | Moderate |
| Panda et al., 2021[54] | Y | Y | Y | PY | Y | Y | Y | PY | Y | N | Y | N | Y | Y | N | Y | Low |
| Panda et al, 2022[55] | Y | Y | Y | PY | N | Y | N | PY | Y | N | Y | N | Y | Y | N | Y | Low |
| Peng et al., 2017[56] | Y | N | Y | PY | Y | Y | Y | Y | PY | N | Y | N | N | N | Y | Y | Low |
| Pires et al., 2018[57] | Y | PY | Y | PY | Y | Y | N | Y | Y | N | Y | N | Y | N | N | N | Moderate |
| Rabelo et al., 2015[58] | Y | PY | Y | PY | Y | Y | N | Y | Y | N | Y | N | Y | Y | N | Y | Moderate |
| Rajesh Kashyap & Shanker Kashyap, 2021[59] | Y | N | Y | PY | Y | Y | N | Y | Y | N | Y | N | N | Y | N | Y | Low |
| Ramanauskaite et al., 2021[60] | Y | Y | Y | Y | Y | N | N | Y | Y | N | Y | Y | Y | Y | Y | Y | Low |
| Romandini et al., 2019[61] | Y | Y | Y | Y | Y | Y | PY | Y | Y | Y | Y | N | Y | Y | N | Y | Moderate |
| Schwendicke et al., 2016[62] | Y | N | Y | PY | Y | Y | Y | Y | Y | N | Y | N | Y | Y | N | Y | Moderate |
| Schwendicke et al., 2021[63] | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | N | Y | Y | Y | Y | High |
| Sebastian et al., 2022[64] | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | High |
| Sivaramakrishnan and Sridharan, 2018[65] | Y | Y | Y | PY | Y | N | N | Y | Y | N | Y | N | Y | Y | Y | Y | Moderate |
| Sgolastra et al., 2020[66] | Y | Y | Y | PY | Y | Y | PY | Y | Y | N | Y | N | Y | Y | Y | Y | Moderate |
| Sridharan and Sivaramakrishnan, 2018[67] | Y | PY | Y | PY | Y | Y | N | Y | Y | N | Y | N | N | Y | N | Y | Low |
| Sridharan and Sivaramakrishnan, 2021[68] | Y | Y | Y | PY | Y | Y | N | PY | Y | N | Y | N | N | N | N | Y | Critically low |
| Stavropoulos et al., 2021[69] | Y | PY | Y | PY | Y | Y | Y | Y | Y | N | Y | N | Y | Y | N | Y | Moderate |
| Tan et al., 2020[70] | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | N | Y | Y | N | Y | Moderate |

Continue

Continuation

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tavelli et al., 2019[71] | Y | Y | Y | Y | Y | Y | Y | Y | Y | N | Y | N | Y | Y | N | Y | Moderate |
| Tsai et al., 2020[72] | Y | N | Y | PY | Y | Y | PY | Y | Y | N | Y | N | Y | Y | N | Y | Moderate |
| Tu et al., 2010[73] | Y | N | Y | PY | Y | Y | N | PY | Y | N | Y | N | N | Y | N | Y | Low |
| Urquhart et al., 2019[74] | Y | N | Y | PY | Y | Y | Y | Y | Y | N | Y | N | N | Y | N | Y | Low |
| Walsh et al., 2019[75] | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | N | Y | Y | Y | Y | High |
| Wang et al., 2020[76] | Y | N | Y | Y | Y | Y | N | PY | Y | N | Y | N | N | Y | N | Y | Low |
| Zhao et al., 2020[77] | Y | Y | Y | Y | Y | Y | N | Y | Y | N | Y | Y | Y | Y | Y | Y | Moderate |
| Zymperdikas et al., 2020[78] | Y | Y | Y | Y | Y | Y | PY | Y | Y | Y | Y | Y | Y | Y | Y | Y | High |

1.Did the research questions and inclusion criteria for the review include the components of PICO?; 2. 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.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.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.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.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.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.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? N = No, Y = Yes, PY = Partially Yes.

**Table 6.** Risk of bias of included systematic reviews (ROBIS) (n = 62).

| Review | Phase 1 | Phase 2 | | Phase 3 | |
|---|---|---|---|---|---|
| | 1. Study eligibility criteria | 2. Identification and selection of studies | 3. Data collection and study appraisal | 4. Synthesis and findings | 5. Risk of bias in the review |
| Al-Moraissi et al., 2019[17] | ☺ | ☹ | ☺ | ☺ | ☺ |
| Aldhohrah et al., 2021[18] | ☹ | ☹ | ☺ | ? | ? |
| Askar et al., 2021[19] | ☹ | ? | ☹ | ☺ | ☺ |
| Barbato et al., 2016[20] | ☺ | ? | ☺ | ☹ | ☹ |
| Barbato et al., 2020[21] | ☹ | ? | ☺ | ☺ | ☺ |
| Barootchi et al., 2020[22] | ☺ | ☺ | ☺ | ☺ | ☺ |
| Buti et al., 2013[23] | ☹ | ? | ☺ | ☺ | ? |
| Cairo et al., 2016[24] | ☹ | ? | ☺ | ☺ | ☺ |
| Cairo et al., 2020[25] | ☺ | ☺ | ☺ | ☺ | ☺ |
| Camps-Font et al., 2021[26] | ☹ | ? | ☺ | ☺ | ☺ |
| Canellas et al., 2020[27] | ☺ | ☺ | ☹ | ? | ☺ |
| Canullo et al., 2022[28] | ☹ | ☹ | ? | ☺ | ☺ |
| Cao et al., 2019[29] | ☹ | ? | ☺ | ☺ | ☺ |
| Dreweck et al., 2021[30] | ☺ | ☺ | ☺ | ☺ | ☺ |
| Escribano et al., 2016[31] | ☹ | ? | ? | ☺ | ? |
| Faggion et al., 2014[32] | ☹ | ? | ☺ | ☺ | ☺ |
| Falci et al., 2021[33] | ☺ | ☺ | ☺ | ☺ | ☺ |
| Figuero et al., 2019[34] | ☹ | ? | ? | ☺ | ☺ |
| Graziani et al., 2014[35] | ☹ | ? | ☺ | ☺ | ☺ |
| Hu et al., 2021[36] | ☺ | ☹ | ☺ | ☹ | ☹ |
| Hu et al., 2020[37] | ☺ | ☹ | ☺ | ☺ | ☺ |
| Iocca et al., 2017[38] | ☹ | ? | ? | ☹ | ☹ |
| Jepsen et al., 2020[39] | ☹ | ☺ | ☺ | ☺ | ☺ |
| Jia et al., 2020[40] | ☹ | ☹ | ☺ | ? | ☺ |
| Jia et al., 2022[41] | ☹ | ☺ | ☹ | ☹ | ☹ |
| John et al., 2017[42] | ☹ | ☹ | ? | ☺ | ☺ |
| Kotsakis et al., 2018[43] | ☹ | ? | ? | ☺ | ? |
| Krois et al., 2018[44] | ☺ | ? | ☺ | ☺ | ☺ |
| Lin et al., 2014[45] | ☹ | ? | ? | ☺ | ? |
| Loo et al., 2021[46] | ☺ | ? | ☺ | ☺ | ☺ |
| MacDonald et al., 2021[47] | ☹ | ☺ | ☺ | ☺ | ☺ |
| Manchanda et al., 2022[48] | ☺ | ☺ | ☺ | ☺ | ☺ |
| Maran et al., 2019[49] | ☺ | ? | ? | ☺ | ☺ |
| Moraschini et al., 2020[50] | ☺ | ☺ | ☹ | ☺ | ☺ |
| Moraschini et al., 2022[51] | ☺ | ☺ | ☺ | ☺ | ☺ |
| Muniz et al., 2022[52] | ☺ | ☺ | ☺ | ☺ | ☺ |
| Natto et al., 2017[53] | ☹ | ? | ☹ | ☺ | ☺ |
| Panda et al., 2021[54] | ☹ | ☹ | ☺ | ☺ | ? |

Continue

Continuation

| | | | | | |
|---|---|---|---|---|---|
| Panda et al, 2022[55] | ☹ | ☹ | ? | ☺ | ? |
| Peng et al., 2017[56] | ☹ | ? | ? | ☺ | ☹ |
| Pires et al., 2018[57] | ☺ | ? | ☺ | ☺ | ☺ |
| Rabelo et al., 2015[58] | ☺ | ? | ☺ | ☺ | ☺ |
| Kashyap and Kashyap, 2021[59] | ☹ | ? | ☺ | ? | ☹ |
| Ramanauskaite et al., 2021[60] | ☹ | ☺ | ☹ | ☺ | ☺ |
| Romandini et al., 2019[61] | ☺ | ☺ | ☺ | ☺ | ☺ |
| Schwendicke et al., 2016[62] | ☹ | ? | ☺ | ☺ | ☺ |
| Schwendicke et al., 2021[63] | ☹ | ☺ | ☺ | ☹ | ☺ |
| Sebastian et al., 2022[64] | ☺ | ☺ | ☺ | ☺ | ☺ |
| Sivaramakrishnan and Sridharan, 2018[65] | ☹ | ? | ? | ☺ | ☹ |
| Sgolastra et al., 2020[66] | ☺ | ? | ☹ | ☺ | ☺ |
| Sridharan and Sivaramakrishnan, 2018[67] | ☺ | ☹ | ☺ | ☺ | ? |
| Sridharan and Sivaramakrishnan, 2021[68] | ☺ | ☹ | ☹ | ☹ | ☹ |
| Stavropoulos et al., 2021[69] | ☹ | ? | ? | ☺ | ☺ |
| Tan et al., 2020[70] | ☺ | ☺ | ☺ | ? | ☺ |
| Tavelli et al., 2019[71] | ? | ☺ | ☺ | ☺ | ☺ |
| Tsai et al., 2020[72] | ☹ | ☺ | ? | ☺ | ☺ |
| Tu et al., 2010[73] | ☹ | ? | ? | ☺ | ☹ |
| Urquhart et al., 2019[74] | ☹ | ? | ☺ | ? | ☺ |
| Walsh et al., 2019[75] | ☺ | ☺ | ☺ | ☺ | ☺ |
| Wang et al., 2020[76] | ☹ | ☺ | ☺ | ? | ? |
| Zhao et al., 2020[77] | ? | ☺ | ☺ | ☺ | ☺ |
| Zymperdikas et al., 2020[78] | ☺ | ☺ | ☺ | ☺ | ☺ |

☺=low risk; ☹=high risk; ? =unclear risk.

for ROBIS (p = 0.282). Second, the adherence to the PRISMA-NMA guideline was evaluated among the studies that: 0 - did not inform a reporting guideline (n = 9), 1 - followed PRISMA checklist (n = 25), and 2 - followed the PRISMA-NMA (n = 28) guideline. The Kruskal-Wallis test was used. The mean scores were 25.9 ± 2.85, 26.1 ± 3.60, and 27.0 ± 3.07 (p = 0.435).

Finally, the following Spearman's correlation coefficients were found between the guideline and the two tools: PRISMA-NMA vs. AMSTAR-2 rho: 0.586, p < 0.001; PRISMA-NMA vs. ROBIS rho: 0.547, p < 0.001; AMSTAR-2 vs. ROBIS rho: 0.671, p < 0.001, showing a moderate correlation between PRISMA-NMA adherence and methodological quality and risk of bias, as well as a moderate to strong correlation between methodological quality and risk of bias.

## Discussion

This is the first study to evaluate the methodological quality and the risk of bias of NMA in dentistry. The methodological quality assessed by AMSTAR-2 varied among the 62 included studies, and although many were of moderate quality (n = 37, 51.6%), assuming that the systematic review provides an accurate summary of the results of the available studies included in the review, there is still a considerable portion of

studies with methodological flaws based on the critical appraisal tool used (low quality n = 17, 27.4%; critically low quality n = 3, 4.8%). The low score indicates that the review has a critical flaw and may not provide an accurate and comprehensive summary of the available studies that address the question of interest[15]. Moreover, the risk of bias assessment of NMA with the ROBIS tool showed a high risk of bias or concerns mainly for domains 1 and 2 that are related to the methodological aspects. This finding is in line with the methodological quality observed in the AMSTAR-2 instrument. Indeed, in this study, a correlation coefficient of 0.671 was found between AMSTAR-2 and ROBIS, a value that can be considered a moderate to strong correlation. This finding is corroborated by a previous study that also found a strong correlation between AMSTAR-2 scores and overall domain rating in ROBIS.[80]

The present investigation has shown how the NMA approach can be used to improve clinical data interpretation in dentistry. The NMA is a promising approach to provide a comprehensive and up-to-date presentation of the evidence on all available management options for a health condition. Currently, more and more NMA studies are being conducted and an with any new instrument, there is a learning curve in using and interpreting the data. The adherence to reporting guidelines is one of the aspects to be learned.

To better unsure transparency and integrity in research, there is a clear recommendation that all protocols for systematic reviews should be submitted to registry platforms before they begin, with essential information about its design and conduction.[81] Nonetheless, protocols were registered in only 58.1% of the included studies. Indeed, the lack of proper registration of NMAs was one of the main reasons for the high risk of bias observed in domain 1 of the ROBIS tool. A moderate correlation (rho < 0.6) was found between the AMSTAR-2 and ROBIS tools and PRISMA-NMA adherence. It has been shown previously shown that registration of the systematic review protocol or working from a previously established protocol improves the final study report. However, the authors did not observe an association between protocol registration and reduction in outcome reporting bias.[82]

The importance of a comprehensive and sensitive literature search is also well established in systematic reviews, and the adequacy of the literature search is a critical domain in AMSTAR-2.[15,83] A considerable number of the NMA studies included in this review limited the language for study selection and did not perform the gray literature assessment and the hand search for potentially relevant studies, resulting in a selection bias of eligible studies.

Additionally, the studies reviewed here had different methodological and publication characteristics. Besides, 45.2% of the studies did not show aspects aligned with current research integrity practices, such as the use of the most appropriate reporting guideline for systematic reviews with network meta-analyses, the PRISMA extension for NMA.[14] This finding is in accordance with a previous study that examined whether published NMA papers follow reporting recommendations and found that key reporting components of the systematic review process were missing in most of the NMA evaluated.[84] Here, no differences in the mean scores of PRISMA-NMA adherence were found between studies that reported having followed or not followed this guideline. It can be argued that this guideline is relatively new, having been launched in 2015. Nonetheless, only 6 of the included studies were published in 2015 or earlier,[24,33,36,46,59,74] which does not justify the non-adherence to this extension by the other 56 included studies. This finding also raises an alert: reviews shouldn't only report on the application of a guideline, but also pay attention to better adherence to each item.

On the other hand, the similarity among the mean scores for PRISMA-NMA adherence among those 3 categories can be most likely due to the non-adherence in reporting the 5 new items of the PRISMA-NMA extension.[14] As some items of the PRISMA-NMA could not be assessed in some studies included here, it is believed that the results might have been influenced. Overall, the geometry of the network, the assessment of inconsistency in the method section, the presentation of the network structure, a summary of network geometry, and the

exploration for inconsistency in the result section were not clearly examined. The network geometry of an NMA study is crucial as it provides clarity in the presentation of the data. This makes it easier for readers to understand and interpret the quality and integrity of the review. For example, direct and indirect comparisons for a given comparison are shown in a graph when closed connections within the network diagram result in a new geometric figure, such as a triangle. On the other hand, open connections may represent less reliable networks since the results of the comparisons only come from indirect comparisons.[76] In this sense, aspects related to the reporting of statistical analysis are in great need of improvement, especially the description of the methods used to explore the geometry of the treatment network and the potential biases related to it, as well as the methods used to assess inconsistency of direct and indirect evidence. A better description of the NMA statistical methods could be achieved by including a statistician on the author team. Another PRISMA-NMA item with low adherence was the assessment of the risk of bias across studies.

Interestingly, the correlation coefficients between adherence to the PRISMA-NMA checklist and results from AMSTAR-2 and ROBIS tools indicated just a moderate correlation. This can occur because the AMSTAR-2 and ROBIS tools are qualitative in nature and have fewer items/domains, where the absence of a characteristic in the NMA studies can already determine a negative score in that item/domain. This is particularly evident when considering that the cutoff points for the classification of quality/risk of bias in these tools are not linear, but rather are determined by the presence of items/domains considered essential. For example, in the adaptation performed here, a study with a score of 13.5 on the AMSTAR-2 guide was classified as being of a low quality, whereas a study with a score of 8.5 was classified as being of moderate quality (data not shown). From these observations, it can once again be assumed that better adherence to the PRISMA-NMA should be sought when writing NMA manuscripts to improve the reporting quality of these studies. Also, knowledge of the available tools to assess methodological quality and risk of bias, as well as their characteristics, may help authors in this task.

The use of GRADE combined with information synthesis by the NMA facilitates structured evidence summaries. Thus, it is a tool that helps physicians and patients make decisions about health interventions and provide them with certainty of the evidence. In this investigation, only one third of the NMA studies rated the certainty of generated evidence using the GRADE approach. This finding is understandable given the complex application of GRADE for NMA. In this case, the GRADE must consider the certainty of the direct and indirect evidence and their contribution to the network estimate, including local incoherence and imprecision.[85,86]

This study has limitations, including a lack of consideration of the scope of the systematic reviews. In this study, only NMA reporting clinical outcomes that are of great importance to researchers and clinicians were included. Furthermore, clinical outcomes impact evidence-based dentistry, and systematic reviews of studies on healthcare interventions are used extensively for clinical and health policy decisions. Therefore, it is important for users to be able to distinguish between high-quality and low-quality reviews, once the increase in publications of systematic reviews was accompanied by an increase in poorly conducted, poorly reported, and/or unnecessary studies.[87] In this sense, the results of this investigation can contribute to a critical appraisal of available NMAs and help readers better understand the evidence.

This review showed that the number of NMA publications has increase since 2010, with an expressive increase in recent years. NMA is a promising approach to provide a broad, complete, and updated presentation of the evidence regarding all the available intervention options in dentistry. This might well represent a paradigm shift for systematic reviews.[88] However, as with any new knowledge, NMA in dentistry will require overcoming several challenges, such as improving document reporting and methodological quality to reduce the risk of bias, indexing of the study type in databases, and a consensus and discussion on terminology and

standards for conducting and reporting.[13] On the other hand, despite their great relevance, NMAs conduction and extrapolation of results to support clinical practice strongly depends on well-conducted primary studies[87] and a clear and objective prior review protocol. Corroborating these findings, the NMA studies that applied the GRADE assessment had, in general, low to very low certainty of evidence. Therefore, NMAs should only be planned when there is a sufficient body of evidence and sound studies. If these premises cannot be met, it is suggested that appropriate primary studies be conducted.

## Conclusion

Considering methodological aspects, NMA studies in dentistry had moderate quality and a high risk of bias in several domains, especially those related to study selection. The adherence to reporting guideline is also questionable regarding the analysis of the available data. These findings raise doubts about whether systematic reviews of NMA should be conducted without sufficient and adequate evidence and without proper compliance with the criteria proposed in the reporting and quality assessment tools.

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