"Over-reviewing" of research? An analysis of orthodontic reviews

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Introduction: Research overviews may be undertaken to identify gaps in the literature, evaluate existing systematic reviews (SRs), and summarize evidence. This paper aims to profile overviews that have been conducted in orthodontics and related interventions since 2012 and to evaluate the degree of overlap among these overviews. **Methods:** Overviews published between January 1, 2012 and June 20, 2023 were identified using an electronic search involving Google Scholar and PubMed. A descriptive summary was produced, and citation matrices were used to evaluate the percentage of overlap between overviews using corrected covered area and covered area. This was classified as slight, moderate, high, or very high. **Results:** A total of 35 overviews were identified across a wide range of topics. Eight overviews included <10 SRs; 21 had 10-20 SRs; and 6 included >20 SRs (median no. of SRs per overview, 15; range, 3-62). Meta-analysis was conducted in only 5 overviews. Overlap between overviews on the same topic ranged from slight (2.7%) to very high (53.8%). **Conclusions:** Almost all overview topics address treatments and their effects, with a wide variation in the number and quality of SRs included. There is considerable overlap in some orthodontic overviews, suggesting unnecessary duplication and research waste. Researchers should be encouraged to focus on primary data collection to add more high-quality data to SRs, which will ultimately enhance the yield from secondary and tertiary orthodontic research. (Am J Orthod Dentofacial Orthop 2024;165:385-98)

Systematic reviews (SRs), which combine data from high-quality clinical studies into a meta-analysis, are regarded as providing the best evidence for the clinical effectiveness of health care interventions. However, the certainty of any findings relies on the extent of good quality primary research data. The number of published SRs in orthodontics has increased considerably in recent years. Specifically, between January 1, 2000 and August 31, 2020, 322 published reviews were identified in 5 major orthodontic journals namely the American Journal of Orthodontics and Dentofacial Orthopedics, The Angle Orthodontist, European Journal of Orthodontics, Journal of Orthodontics, and Orthodontics and Craniofacial Research and the Cochrane Database of Systematic Reviews.[1] A meta-analysis was reported in only 109 of these (34%), with a median of 5 studies combined in each review.[1] The yield from the preponderance of orthodontic SRs has been questioned, particularly given the relatively modest accumulation of high-quality randomized controlled trials compared with other health care fields.[2] This raises a question regarding the priority that is given to the publication of orthodontic SRs, as there is potentially a greater need for the collection of high-quality primary data to ultimately populate future reviews.

As the volume of SRs has risen in health care, so too has the publication of overviews, with an 8-fold increase concerning health interventions reported in the past 2 decades.[3] Overviews use explicit, systematic methods to identify multiple SRs on a specific research question for the purpose of extracting and analyzing their results.[4] Several alternative terms exist, which include

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umbrella reviews and reviews of reviews,[5] although there are subtle differences between these terms. Three functions for overviews have been described: the identification of gaps in the literature, evaluation of existing SRs, and summarizing evidence.[6] A summary of the evidence in an overview can only be undertaken if the identified SRs meet the following criteria: the included primary trials overlap, the topic aligns with the scope of the overview, the SRs are of high methodologic quality, and the SRs are contemporary.[6]

Concerns have been raised regarding the overlapping and sometimes conflicting content of not only SRs but also of overviews, which by their very nature may be broad.[7] Furthermore, overviews may also lack methodologic rigor[8-10] and can be difficult to locate without an objectively derived and validated search strategy,[11] resulting in a call for enhanced methodologic and reporting guidance.[12]

In line with the typology of reviews described by Grant and Booth,[13] the broad aim of this paper is to provide an "overview" of overviews of SRs in orthodontics and related interventions. Specifically, it aimed to (1) profile overviews that have been conducted in orthodontics and related interventions since 2012 and (2) evaluate the degree of overlap between these.

MATERIAL AND METHODS

Overviews published between January 1, 2012 and June 20, 2023 were identified using an electronic search involving Google Scholar and PubMed. Search terms used included "overviews," "umbrella reviews," "review of systematic reviews," "orthodontics," "oral surgery," "periodontology," "restorative," "prosthodontics," "endodontics," "oral maxillofacial surgery," "dental public health," "dental hygiene," "orofacial pain," "oral medicine," "oral pathology," "paediatric dentistry," "oral radiology," "oral immunology," "gerodontics," "oral microbiology," "special care dentistry," "dental materials," "dental psychology," and "regenerative dentistry."

A descriptive summary was produced, and citation matrices were used to evaluate the percentage overlap area.[14] The index publication, or index case, is the first time a primary publication occurs. The covered area (CA) is ascertained through the division of the total number of included publications in an overview (regardless of their overlap) by the product of the number of index publications (rows in a citation matrix) and the number of included overviews (columns in a citation matrix). As CA may be overly affected by 1 review in an overview containing a large number of primary publications compared with other included reviews, the use of corrected covered area (CCA) has been proposed.[14] The CCA accounts for this effect by subtracting the number of index publications from both the total number of included publications and the product of rows and columns in the citation matrix.[14]

For the purpose of addressing overlap between overviews, in this paper, the index publication or index case refers to the first time an SR publication occured. CCA was classified according to Pieper et al[14] as follows: slight (0-5), moderate (6-10), high (11-15), and very high (>15).[14]

RESULTS

A total of 36 overviews were initially identified (Table I),[15-49] with 1 of these subsequently excluded as it involved a review of randomized controlled trials rather than SRs.[50] Within the included overviews,[15-49] 30 involved reviews of SRs only, and 5 involved reviews of SRs and meta-analyses. Throughout the text, all were referred to as SRs. The 3 journals that published the most orthodontic overviews were the European Journal of Orthodontics, Clinical Oral Investigations, and Journal of Oral Rehabilitation; all of which published 3 orthodontic overviews. In total, 14 overviews were published from Asia, 13 from Europe, 6 from South America, and 2 from Africa.

For focus and content:

1. Five overviews were published in 2 journals listed in the top-ranked orthodontic journals, namely the European Journal of Orthodontics (n = 3) and the Korean Journal of Orthodontics (n = 2) (https://www.scimagojr.com).
2. There were no Cochrane Collaboration overviews of SRs in orthodontics.
3. Topics covered in the overviews included orthopedic treatment for Class II or III malocclusions (n = 2); adjunctive procedures for accelerated tooth movement (n = 3); orthodontic anchorage, including temporary anchorage devices (n = 3); fixed appliances and the periodontium (n = 2); treatment outcomes and efficiency of self-ligating brackets (n = 1); effectiveness of clear aligner treatment vs fixed appliances (n = 1); iatrogenic effects of orthodontic treatment (demineralization and root resorption) (n = 3); effectiveness of treatments of obstructive sleep apnea (n = 6); rapid maxillary expander and miniscrew-assisted rapid palatal expansion (n = 2); management of temporomandibular disorder (n = 1); condylar form or condylar resorption after orthognathic surgery (n = 4); orthognathic surgery (stability, surgery-first approach, glucocorticoids, and antibiotic prophylaxis; n = 4); and impact of orthodontics or surgical

Table I. Overviews in orthodontics 2012-2023 (June)

First author, y, country, journal, title	*No. of SRs and/or MAs*	*Ballard and Montgomery function*	*Methodologic quality of SRs assessment tool*	*No. of primary studies*	*Meta-analysis; possible? If not, why?*	*Overlap assessed*
D'Anto,[15] Italy *Journal of Oral Rehabilitation* Class II functional orthopaedic treatment: a systematic review of systematic reviews	14	2, 3	3 high, 8 moderate, 3 low, ‡	156	No; reason not given	2 studies in 3 searches
Johal et al,[16] United Kingdom *Sleep and Breathing* Mandibular advancement splint (MAS) therapy for obstructive sleep apnoea—an overview and quality assessment of systematic reviews	8	2, 3	4 high, 3 moderate, 1 low, ‡	338	No; reason not given	No
Bucci et al,[17] Italy *Journal of Oral Rehabilitation* Dental and skeletal effects of palatal expansion techniques: a systematic review of the current evidence from systematic reviews and meta-analyses	12 (8 SRs and 4 MAs)	2, 3	5 high, 7 moderate, ‡	133	No; reason not given	5 RCTs in 3 SRs/MAs 6 RCTs in 2 SRs/MAs
Jamilian et al,[18] Iran *Journal of Orthodontics* Methodologic quality and outcome of systematic reviews reporting on orthopaedic treatment for Class III malocclusion: overview of systematic reviews	14 (11 SRs and 3 MAs)	2, 3	10 high, 3 moderate, 1 low, ‡	160	No; reason not given	No
Tan et al,[19] China *PLoS One* Effects of mandibular setback with or without maxillary advancement osteotomies on pharyngeal airways: an overview of systematic reviews	6	2, 3	3 high, 2 moderate, 1 low, ‡	98	Yes (n = 2)	No
Tan et al,[20] China *PLoS One* How does mandibular advancement with or without maxillary procedures affect pharyngeal airways? An overview of systematic reviews	11	2, 3	2 high, 6 moderate, 3 low, ‡	64	Yes (n = 2)	Overlapping samples in 2 studies

Table I. Continued

First author, y, country, journal, title	*No. of SRs and/or MAs*	*Ballard and Montgomery function*	*Methodologic quality of SRs assessment tool*	*No. of primary studies*	*Meta-analysis; possible? If not, why?*	*Overlap assessed*
Yi et al,[21] China *Journal of Oral Rehabilitation* Effectiveness of adjunctive interventions for accelerating orthodontic tooth movement: a systematic review of systematic reviews	11	2, 3	3 high, 6 moderate, 2 low, ‡	108	No; reason not given	No
Zheng,[45] China *Medicine* Implants for orthodontic anchorage: an overview	23	2	5 high, 15 moderate, 3 low, ‡	666	No; large numbers and complex outcomes	No
Elkordy,[22] Egypt *Seminars in Orthodontics* Do fixed orthodontic appliances adversely affect the periodontium? A systematic review of systematic reviews	19	2, 3	2 high, 8 moderate, 7 low 2 critically low, †	206	No; reason not given	No
Haas Junior,[43] Spain *International Journal of Oral and Maxillofacial Surgery* Hierarchy of surgical stability in orthognathic surgery: overview of systematic reviews	15 (8 SRs, 7 MAs)	2, 3	11 high, 4 moderate, †	148	No; reason not given	No
Niño-Sandoval,[42] Brazil *Brazilian Oral Research* Incidence of condylar resorption after bimaxillary, LeFort I, and mandibular surgery: an overview	5	2, 3	1 high, 1 moderate, 3 low, †, #	54	No; not possible; high heterogeneity	No
Sato,[46] Japan *Japanese Dental Science Review* Review of systematic reviews on mandibular advancement oral appliance for obstructive sleep apnea: the importance of long-term follow-up	27	3	Quality assessment not done	466	No, Reason not given	No

Table I. Continued

First author, y, country, journal, title	*No. of SRs and/or MAs*	*Ballard and Montgomery function*	*Methodologic quality of SRs assessment tool*	*No. of primary studies*	*Meta-analysis; possible? If not, why?*	*Overlap assessed*
Bakdach,[23] Syria *Dental and Medical Problems* Effectiveness of different adjunctive interventions in the management of orthodontically induced white spot lesions: a systematic review of systematic reviews and meta-analyses	13	3	4 moderate, 3 low, 6 critically low, †	122	No; reason not given	No
Barone,[24] Italy *Journal of Stomatology, Oral and Maxillofacial Surgery* Surgery-first orthognathic approach vs conventional orthognathic approach: a systematic review of systematic reviews	10	2	1 high, 1 moderate, 3 low, 5 critically low, †	90	No; could not be conducted	No
Francisco,[25] Portugal *Journal of Clinical and Experimental Dentistry* Condylar form alteration on skeletal Class II patients that underwent orthognathic surgery: an overview of systematic reviews	4	3	2 moderate, 2 low, †	118	Yes (n = 4)	No
Mheissen,[26] Syria *Journal of Orthodontics* The effectiveness of surgical adjunctive procedures in the acceleration of orthodontic tooth movement: a systematic review of systematic reviews and meta-analysis	14	2, 3	5 moderate, 7 low, 2 critically low, †	118	Yes (n = 4)	No
Ramírez-Ossa,[27] Colombia *Journal of Evidence-Based Dental Practice* An umbrella review of the effectiveness of Temporary Anchorage Devices and the factors that contribute to their success or failure	17 (7 SRs and 10 MAs)	1, 3	12 high, 5 moderate, †	444	No; reason not given	No

Table I. Continued

First author, y, country, journal, title	*No. of SRs and/or MAs*	*Ballard and Montgomery function*	*Methodologic quality of SRs assessment tool*	*No. of primary studies*	*Meta-analysis; possible? If not, why?*	*Overlap assessed*
Yassir et al,[28] Iraq *European Journal of Orthodontics* The impact of labial fixed appliance orthodontic treatment on patient expectation, experience, and satisfaction: an overview of systematic review	9	3	5 moderate, 2 low, 2 critically low, †	158	No; not possible; qualitative data	No
Bravo,[31] Chile *British Journal of Oral and Maxillofacial Surgery* Effectiveness of glucocorticoids in orthognathic surgery: an overview of systematic reviews	3	3	1 moderate, 2 very low, ¶	19	No, reason not given	The citation matrix showed 4 overlapping studies
Gil et al,[49] Brazil *British Journal of Oral and Maxillofacial Surgery* Antibiotic prophylaxis in orthognathic surgery: an overview of systematic reviews	4 SRs; 2 MAs	2	All high, †	49	No; reason not given	No
Sardana,[30] China *International Journal of Paediatric Dentistry* Prevention of demineralization during multi-bracketed fixed orthodontic treatment: an overview of systematic reviews	29	3	2 high, 4 moderate, 4 low, 19 critically low, †, §	128	No; reason not given	CCA determined a slight (2.8%) overlap
Yassir,[29] Iraq *European Journal of Orthodontics* Orthodontic treatment and root resorption: an overview of systematic reviews	28	3	1 high, 19 moderate, 3 low, 5 critically low, †	379	No; not possible; high heterogeneity	No
Barone,[33] Italy *Korean Journal of Orthodontics* Incidence and management of condylar resorption after orthognathic surgery: an overview	10	2, 3	7 low, 3 critically low, †	218	No; could not be performed	No

Table I. Continued

First author, y, country, journal, title	No. of SRs and/or MAs	Ballard and Montgomery function	Methodologic quality of SRs assessment tool	No. of primary studies	Meta-analysis; possible? If not, why?	Overlap assessed
Cremona,[32] Malta *European Journal of Orthodontics* Quality-of-life improvement, psychosocial benefits, and patient satisfaction of patients undergoing orthognathic surgery: a summary of systematic reviews	12	3	6 moderate, 2 low, 4 critically, low, †	228	No; limited availability of interventional studies	No
Abd El-Ghafour,[36] Egypt *Evidence-based Dentistry* Is maxillary expansion effective in treatment of obstructive sleep apnoea syndrome? A systematic review of systematic reviews	14	3	1 high, 2 moderate, 5 low 6 critically low, †	163	No; not possible because of high heterogeneity	No
Gasparro,[35] Italy *Japanese Dental Science Review* Effectiveness of surgical procedures in the acceleration of orthodontic tooth movement: findings from systematic reviews and meta-analyses	28	3	12 high, 8 moderate, 1 low 7 critically low, †	322	No; reason not given	No
Mukhopadhyay,[41] India *Journal of Indian Orthodontic Society* An umbrella review of systematic reviews with or without meta-analysis assessing treatment outcomes and efficiency of self-ligating brackets	16	2, 3	10 low ROB, 6 unclear ROB, §	165	No; reason not given	CCA determined low (14%) overlap
Togninalli,[37] Switzerland *Journal of Stomatology, Oral and Maxillofacial Surgery* Condylar resorption following mandibular advancement or bimaxillary osteotomies: a systematic review of systematic reviews	10	2, 3	All low, †	180	No; reason not given	No

Table I. Continued

First author, y, country, journal, title	*No. of SRs and/or MAs*	*Ballard and Montgomery function*	*Methodologic quality of SRs assessment tool*	*No. of primary studies*	*Meta-analysis; possible? If not, why?*	*Overlap assessed*
Tran,[40] United Kingdom *International Journal of Oral and Maxillofacial Surgery* Management of temporomandibular disorders: a rapid review of systematic reviews and guidelines	62	3	3 high, 51 moderate, 2 low 6 critically low, †	886	No; reason not given	No
Ventura,[39] Portugal *Journal of Clinical Medicine* Miniscrew-Assisted Rapid Palatal Expansion (MARPE): an umbrella review	4	2, 3	1 high, 1 low, 2 critically low, †	25	No; reason not given	No
Yassir,[34] Iraq *Korean Journal of Orthodontics* Which anchorage device is the best during retraction of anterior teeth? An overview of systematic reviews	14	2, 3	2 high, 9 moderate, 1 low, 2 critically low, †	144	No; lack of primary data	No
Yassir,[38] Iraq *Clinical Oral Investigations* Clinical effectiveness of clear aligner treatment compared to fixed appliance treatment: an overview of systematic reviews	18	3	1 high, 17 moderate, †	180	No; not possible because of a lack of primary data; high heterogeneity	No
Rocha,[44] Brazil *Clinical Oral Investigations* Efficiency of maxillomandibular advancement for the treatment of obstructive apnea syndrome: a comprehensive overview of systematic reviews	12	2	6 high, 6 moderate, †, #	321	No; reason not given	No
Di Spirito,[48] Italy *Dentistry Journal* Periodontal management in periodontally healthy orthodontic patients with fixed appliances: an umbrella review of self-care instructions and evidence-based recommendations	17	2, 3	5 low, 12 critically low, †	160	No; not possible; high heterogeneity	No

Table I. Continued

First author, y, country, journal, title	*No. of SRs and/or MAs*	*Ballard and Montgomery function*	*Methodologic quality of SRs assessment tool*	*No. of primary studies*	*Meta-analysis; possible? If not, why?*	*Overlap assessed*
Ribeiro,[47] Brazil *Clinical Oral Investigations* Impact of malocclusion treatments on oral health-related quality of life: an overview of systematic reviews	15	2, 3	2 high, 1 moderate, 3 low, 9 critically low, †	340	Yes (n = 4)	No

Note. Overview functions from Ballard and Montgomery[32]: 1, Identify gaps in the literature in which multiple comparable studies may exist but a research synthesis has not been performed; 2, Compare and contrast existing systematic reviews; and 3, Provide a summary of evidence from existing systematic reviews, with or without synthesis.
MAs, meta-analyses; *RCT*, randomized controlled trial; *ROB*, risk of bias.
†A Measurement Tool to Assess Systematic Reviews, version 2; ‡A Measurement Tool to Assess Systematic Reviews; §Risk of Bias in Systematic Reviews; ¶Grading of Recommendations, Assessment, Development, and Evaluations; #Glenny scale.

treatment or both on oral health–related quality of life or psychological outcomes (n = 3).

4. Eight overviews included <10 SRs; 21 had 10-20 SRs; and 6 included >20 SRs (median no. of SRs per overview, 15; range, 3-62[31,40]). The overview with the least number of SRs addressed the effectiveness of glucocorticoids in orthognathic surgery,[31] whereas the overview with the greatest number of SRs dealt with the management of temporomandibular disorder.[40]
5. With regard to the Ballard and Montgomery[6] justification for overviews, 18 overviews aimed to summarize evidence and evaluate existing SRs. Twelve aimed to summarize evidence only; 4 considered the evaluation of existing SRs only; and 1 overview aimed to identify gaps in the literature and summarize the evidence.

For methodologic quality:

1. A Measurement Tool to Assess Systematic Reviews, version 2 (AMSTAR-2) was used most commonly to assess methodologic quality (n = 24), followed by AMSTAR (n = 8), Risk of Bias in Systematic Reviews (n = 2), Glenny scale (n =2) and Grading of Recommendations, Assessment, Development, and Evaluations (n = 1). One overview used both AMSTAR-2 and the Risk of Bias in Systematic Reviews. Both overviews that used the Glenny scale did so in conjunction with AMSTAR-2.
2. Across all overviews in which quality assessments were carried out, 99 (20%) SRs were deemed to be of high quality, 209 (42%) of moderate quality, 85 (17%) of low quality, and 94 (19%) of critically low quality. Approximately 2% were deemed to have a low risk of bias, and 1% had an unclear risk of bias.
3. One overview included 19 (65%) SRs of critically low quality, which addressed the prevention of demineralization during multibracketed fixed appliance orthodontic treatment.[30]
4. The overview with the greatest number of high-quality SRs (n = 12) was related to temporary anchorage devices, whereas the following topics each had only 1 SR rated as high-quality: Surgery-first vs a conventional orthognathic approach, root resorption, maxillary expansion in the treatment of obstructive sleep apnea, clear aligner treatment compared with fixed appliance treatment, condylar resorption after orthognathic surgery, and miniscrew-assisted rapid palatal expansion.
5. Meta-analysis was conducted in only 5 overviews addressing the following: (1) the effectiveness of surgical adjunctive procedures in the acceleration of orthodontic tooth movement (4 of 14 SRs)[26]; (2) the effect of a mandibular setback with or without maxillary advancement osteotomies on the pharyngeal airway (2 of 6 SRs)[19]; (3) the effect of mandibular advancement with or without maxillary procedures on the pharyngeal airway (2 of 11 SRs)[20]; (4) Condylar form alteration in skeletal Class II orthognathic surgery patients (all 4 SRs)[25]; and (5) the impact of treatment of malocclusion on oral health–related quality of life (4 of 15 SRs).[47]

For overlap overviews, there were a number of overlapping SRs in overviews of similar topics, namely orthodontically-related demineralization, orthodontic tooth movement, obstructive sleep apnea, condylar

Table II. Summary of overlap for each topic overall and within individual overviews for the topics with >2 overviews overlapping

Overview topic	*Overviews with overlap*	*Total no. of SRs*	*Overlapping SRs*	*CCA*	*CA*
Orthodontically-related demineralization	2	31	11	0.355/35.5%****	0.677/67.7%
Orthodontic tooth movement (overall)	3	36	17	0.236/23.6%****	0.490/49.0%
Overview pair[21,26]		24	1	0.042/4.2%*	0.520/52.0%
Overview pair[21,35]		33	6	0.181/18.1%****	0.590/59.0%
Overview pair[26,35]		31	11	0.354/35.4%****	0.677/67.7%
Obstructive sleep apnea (overall)	4	47	9	0.064/6.4%**	0.298/29.8%
Overview pair[19,20]		15	2	0.133/13.3%***	0.567/56.7%
Overview pair[20,44]		17	6	0.353/35.3%****	0.676/67.6%
Overview pair[20,46]		37	1	0.027/2.7%*	0.514/51.4%
Condylar resorption (overall)	4	13	16	0.410/41.0%****	0.558/55.8%
Overview pair[25,33]		10	4	0.400/40.0%****	0.700/70.0%
Overview pair[25,37]		10	4	0.400/40%****	0.700/70.0%
Overview pair[33,37]		13	7	0.538/53.8%****	0.769/76.9%
Overview pair[25,42]		6	3	0.500/50.0%****	0.750/75.0%
Overview pair[33,42]		10	5	0.500/50.0%****	0.750/75.0%
Overview pair[37,42]		10	5	0.500/50.0%****	0.750/75.0%
Anchorage devices (overall)	3	41	12	0.146/14.6%***	0.431/43.1%
Overview pair[27,38]		28	3	0.107/10.7%**	0.554/55.4%
Overview pair[27,45]		30	9	0.300/30.0%****	0.650/65.0%
Overview pair[38,45]		34	2	0.059/5.9%***	0.529/52.9%

Note. Interpretation of CCA: *0-5, slight overlap; **6-10, moderate overlap; ***11-15, high overlap; ****>15, very high overlap.

resorption, and anchorage devices (Table II). The calculated percentage overlap between individual overviews on the same topic ranged from 2.7% (slight;[20,46] obstructive sleep apnea) to 53.8% (very high;[33,37] condylar resorption) (Supplementary Tables I-X).

DISCUSSION

This paper provides a detailed synopsis of overviews of SRs conducted in orthodontics and related interventions, an area not previously investigated in the orthodontic literature. A review of overviews using systematic methodology was not conducted, as SRs have their intrinsic shortcomings. Instead, a broad-brush overview approach was undertaken to summarize the literature.[13] As the typology "overview" permits, comprehensive searching of the literature was not included, and neither were overviews subjected to a quality assessment. In line with recommendations,[13] we included a narrative summary, tabulated findings, and a thematic analysis.

A wide range of topics was identified across the 35 orthodontic overviews. This mirrored the findings from health care more broadly, with significant numbers of overviews published in relation to general surgery (n = 28), addiction medicine (n = 32), and pediatrics (n = 92) between 2000 and 2020.[51] Summarizing evidence was the most common function of the included overviews, similar to that observed in other overviews.[52-54]

Quality was most commonly assessed using AMSTAR-2, which is similar to other evaluations of overviews.[55] Reporting guidelines for overviews (Preferred Reporting Items for Overviews of Reviews) have only recently been developed, which should facilitate assessment of their methodology, as well as comprehension of the validity and clinical relevance of their findings.[56] No Cochrane overview was conducted in orthodontics, presumably because of the weak evidence found in many Cochrane reviews of orthodontic topics.

Considerable variation existed among overviews with regard to the quality of SRs included. Three overviews included only low or critically low or both low and critcially low SRs addressing condylar resorption (n = 2)[33,37] and periodontal management with fixed appliances (n = 1).[49] Conversely, 6 overviews incorporated SRs that were exclusive of high or moderate or both high and moderate quality, which dealt with clear aligner treatment (n = 1), obstructive sleep apnea (n = 1), and orthognathic surgery (n = 4). In the overview by Sardana et al,[30] 23 of the 29 SRs assessed were judged to be low or critically low quality. Indeed, several versions of 1 Cochrane Review were included; the first was published in 2004, updated in 2013, and again in 2019. The 2019 version supersedes all previous versions; therefore, it would seem necessary to include only the latest updated version.

As such, it is conceivable that overviews risk both recycling low-quality primary and secondary evidence and

may conflate the findings of prior secondary research. It is therefore important that, when overviews are deemed appropriate, they are undertaken with rigor and reported accurately. Given the paucity of high-quality primary research, the focus on generating reliable and robust primary research data through well-conducted clinical trials should remain. The complexity that such clinical trials pose in terms of setup; obtaining ethical approval;[57,58] and securing funding, management, and governance,[59] that may vary geographically,[60] could be a factor in accounting for the increase in secondary relative to primary research in recent years. The interruption to clinical practice imposed by the coronavirus disease 2019 pandemic may also have contributed to the pervasion of this nonclinical "armchair" research, accelerating the digression to nonprimary research.[61] A declining number of senior academics in orthodontics is also noteworthy[62] and highlights the importance of combining expertise to allow high-quality primary research to be undertaken, and the conduct of multicentred studies is clearly to be encouraged.

Undertaking good quality clinical research requires an agreed core outcome set, with standardized instruments at standardized time points for data collection. Although broad categories with respect to core outcomes in orthodontic clinical trials have now been established,[63] the next step is to agree on measurement tools for the core domains, with a clear delineation of related timings. Without this, significant progress in terms of producing consistent findings relevant to the systematic collection of high-quality big data from primary studies may be elusive. A starting point could be the establishment of a registry of all orthodontic clinical trials,[64-66] including prospective cohort investigations.

Most published SRs have a "systematic" methodology; however, meta-analysis is frequently precluded in orthodontics because of insufficient trials or trial heterogeneity or both; the conclusions are, therefore, often of a narrative nature. If an SR aims to provide an objective and transparent summary of research data concerning a health care intervention, then the best way to do this is to combine data from several studies in a meta-analysis. This increases the certainty and generalizability of findings through a larger sample size from different settings and populations. SRs without meta-analysis can only provide a narrative summary of the findings with substantially reduced objectivity, certainty, and generalizability. The yield from these reviews is likely to be limited, and their findings must be interpreted with considerable caution as they may provide minimal evidence to inform clinical practice. Repeatedly undertaking meta-analysis in the same manner is likely to produce the same outcome, even if additional trials are added; therefore, using a different method of analysis to correct errors may yield more outcomes that are meaningful.[67] Re-analysis of meta-analyses has been undertaken in orthodontics and pediatric dentistry to examine small study effects and publication bias[68,69] and to explore the magnitude and possible associations of statistical heterogeneity in orthodontic meta-analyses.[70] However, it would appear that re-analysis of the evidence from the primary studies has not been undertaken. Data from prospective observational cohort studies, despite their challenges, may also lend themselves to this form of re-analysis.

At present, no standardized approach exists to address the overlap of primary studies among SRs, and further work is required in this area.[14] Overlap is impacted by the breadth of the research question, characteristics of the primary studies, and choice of methodology, which in turn relies on the numbers of SRs and their included primary studies.[14] Similar to the overlap of primary studies in SRs, the overlap of SRs may also occur in overviews. The use of both CCA and CA was undertaken in this manuscript as they evaluate different concepts, the former having a greater reliance on the number of primary publications compared with the number of reviews, whereas for the latter, the opposite applies, and it has much higher correlations than that observed for CCA.[14]

The use of both CCA and CA in assessing the overlap among overviews has been used previously within overviews[71,72] but has not yet been applied in reviews of overviews. With regard to this paper, the topic of condylar resorption had the greatest percentage overall overlap (41%), followed by orthodontically-related demineralization (35.5%), orthodontic tooth movement (23.6%), and anchorage devices (14.6%), and the least percentage overall overlap was related to obstructive sleep apnea (6.4%). According to Pieper et al,[14] a high proportion of overlap "more than likely" indicates that reviews have been duplicated unnecessarily, leading to a significant waste of time and resources. Furthermore, the authors emphasized that SRs should only be undertaken when the review is not up-to-date or had a markedly different research objective.[14] This problem is not unique to orthodontics.[73] The responsibility to focus on the delivery of high-quality prospective primary studies, which may ultimately give rise to more meaningful secondary and tertiary orthodontic research, continues to pertain.

Recommendations for future research include the following:

1. Overviews should ideally meet the criteria laid down by Ballard and Montgomery,[6] being reported

according to the newly-developed Preferred Reporting Items for Overviews of Reviews reporting guidelines.[56]
2. The existence of overlap among SRs should be assessed, whether narrative in format or inclusive of meta-analyses, to inform the priority for conduct and subsequent publication of overviews.[14,74,75]
3. For SRs to be of real value, those with justifiable meta-analyses should be prioritized. It seems reasonable that this should include a minimum of 4 studies, provided these have sufficient homogeneity.[76]
4. The international agreement and finalization of a core outcome set for clinical trials is clearly important to facilitate the amalgamation of research findings from several trials in robust meta-analyses.
5. Re-analysis of meta-analyses should be considered in SRs, in which errors are identified in the analysis.
6. It would seem prudent to leave a hiatus of at least 5 years before an overview is updated to allow for the generation of sufficient, high-quality primary research data that make a meaningful contribution to the evidence base for clinical practice.

CONCLUSIONS

1. Almost all overview topics address treatments and their effects, with a wide variation in the number and quality of SRs included.
2. There is considerable overlap in some orthodontic overviews, suggesting unnecessary duplication and research waste.
3. Researchers should be encouraged to focus on primary data collection to add more high-quality data to SRs, which will ultimately enhance the yield from secondary and tertiary orthodontic research.

AUTHOR CREDIT STATEMENT

Declan T. Millett contributed to conceptualization, methodology, original manuscript preparation, manuscript review and editing, supervision, and project administration; Philip E. Benson contributed to conceptualization, methodology, validation, and manuscript review and editing; Susan J. Cunningham contributed to conceptualization, methodology, and manuscript review and editing; Grant T. McIntyre contributed to conceptualization, methodology, and manuscript review and editing; Aliki Tsichlaki contributed to conceptualization and manuscript review and editing; Farhad B. Naini contributed to manuscript review and editing; Claire Laide contributed to methodology, data curation, validation, and formal analysis; and Padhraig S. Fleming contributed to conceptualization, methodology, and manuscript review and editing.

SUPPLEMENTARY DATA

Supplementary data associated with this article can be found, in the online version, at https://dx.doi.org/10.1016/j.ajodo.2023.10.013.

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Supplementary Table I. Citation matrix for orthodontically-related demineralization

Authors, y	*Bakdach and Hadad*[23]	*Sardana et al*[30]
Derks et al, 2004	X	X
Benson et al, 2005		X
Chadwick et al, 2005	X	X
Rogers et al, 2010	X	X
Benson et al, 2013	X	X
Chen et al, 2013	X	
Wang et al, 2013		X
Gizani 2014		X
Li et al, 2014		X
Gurunathan & Somasundaram. 2015		X
Sonesson et al, 2016	X	
Lapenaite et al, 2016	X	X
Lopatiene et al, 2016		X
Nascimento et al, 2016	X	X
Okada et al, 2016		X
Makhmari et al, 2017		X
Rahimi et al, 2017		X
Lima et al, 2018		X
Raghis et al, 2018	X	X
Sandra et al, 2018		X
Swaraj et al, 2018		X
Benson et al, 2019		X
Imani et al, 2019		X
Parihar et al, 2019		X
Pithon et al, 2019	X	X
Polici et al, 2019		X
Sardana et al, 2019	X	X
Sardana et al, 2019		X
Sardana et al, 2019	X	X
Tasios et al, 2019	X	X
Khan et al, 2020		X

Supplementary Table II. CCA and CA calculations for orthodontically-related demineralization

			CCA		*CA*	
No. of Publications[†]	*No. rows*	*No. columns*	*Proportion*	*Percentage*	*Proportion*	*Percentage*
42	31	2	0.355	35.48	0.677	67.74

[†]Includes duplicates.

Supplementary Table III. Citation matrix for orthodontic tooth movement

Authors, y	*Yi et al*[21]	*Mheissen et al*[26]	*Gasparro et al*[35]
Long et al, 2013	X		X
Long et al, 2015	X		
Gkantidis et al, 2014	X		X
Ge et al, 2014	X		
El-Angbawi et al, 2014	X		
Hoogeveen et al, 2014			X
Kalemaj et al, 2015	X		X
Fleming et al, 2015	X	X	X
Hassan et al, 2015			X
Alfawal et al, 2016		X	X
Almeida et al, 2016	X		
Fernandez-Ferrer et al, 2016	X		X
Patterson et al, 2016	X		X
Hoffman et al, 2017			X
Sonesson et al, 2017	X		
Yi et al[9]		X	X
Ferguson et al, 2018			X
Gil et al, 2018			X
Viwattanatipa and Charnchairerk, 2018		X	X
Zimmo et al, 2018		X	
Dab et al, 2019		X	X
Figueiredo et al, 2019		X	X
Fu et al, 2019		X	X
Kamal et al, 2019		X	X
Khlef et al, 2019			X
Shahabee et al, 2019		X	X
Mheissen et al, 2019		X	X
Mota-Rodriguez et al, 2019			X
Vannala, 2019			X
Al-Khalifa et al, 2020			X
Apalimova et al, 2020		X	X
Darwiche et al, 2020			X
McDonald et al, 2020			X
Dos Santos et al, 2020			X
Rekhi et al, 2020		X	
Sivarajan et al, 2020		X	

Supplementary Table IV. CCA and CA calculations for orthodontic tooth movement

				CCA		*CA*	
Authors	*No. of publications*[†]	*No. of rows*	*No. of columns*	*Proportion*	*Percentage*	*Proportion*	*Percentage*
Overall	53	36	3	0.236	23.6	0.490	49.0
Yi and Mheissen	25	24	2	0.042	4.2	0.520	52.0
Yi and Gasparro	39	33	2	0.181	18.1	0.590	59.0
Mheissen and Gasparro	42	31	2	0.354	35.4	0.677	67.7

[†]Includes duplicates.

Supplementary Table V. Citation matrix for obstructive sleep apnea

Authors, y	*Tan et al*[19]	*Tan et al*[20]	*Rocha et al*[44]	*Sato and Nakajima*[46]
Hoekema et al, 2004				X
Lim et al, 2006				X
Elshaug et al, 2007		X		
Ahrens et al, 2010				X
Caples et al, 2010		X	X	
Holty and Guilleminault, 2010		X	X	
Ahrens et al, 2011				X
Mattos et al, 2011	X	X		
Pirklbauer et al, 2011		X	X	
Alsufyani et al, 2013		X		X
Hsieh and Liao, 2013		X	X	
Iftikhar et al, 2013				X
Okuno et al, 2014				X
Al-Moraissi et al, 2015	X			
Camacho et al, 2015			X	
Canellas et al, 2015	X			
Bratton et al, 2015				X
Fernandez-Ferrer et al, 2015	X			
Guarda-Nardini et al, 2015				X
Knudsen et al, 2015		X		
Saffer et al, 2015				X
Okuno et al, 2016				X
Bartolucci et al, 2016				X
Christovam et al, 2016	X	X		
Rosario et al, 2016		X	X	
Kastoer et al, 2016				X
Serra-Torres et al, 2016				X
Sharples et al, 2016				X
Zaghi et al, 2016		X	X	
Cammaroto et al, 2017				X
He et al, 2017	X			
Iftikhar et al, 2017				X
Kuhn et al, 2017				X
Noller et al, 2017			X	
Sivaramakrishnan and Sridharan, 2017				X
Araie et al, 2018				X
Chen et al, 2018				X
De Vries et al, 2018				X
Gao et al, 2018				X
John et al, 2018			X	
Martins et al, 2018				X
Rojo-Sanchis et al, 2018			X	
Schwartz et al, 2018				X
Zhang et al[10]				X
Bartolucci et al, 2019				X
Camacho et al, 2019			X	
Giralt-Hernando et al, 2019			X	

Supplementary Table VI. CCA and CA calculations for obstructive sleep apnea

				CCA		CA	
Authors	*No. of included publications*[†]	*No. of rows*	*No. of columns*	*Proportion*	*Percentage*	*Proportion*	*Percentage*
Overall	56	47	4	0.064	6.4	0.298	29.8
Tan and Tan	17	15	2	0.133	13.3	0.567	56.7
Tan[20] and Rocha	23	17	2	0.353	35.3	0.676	67.6
Tan[20] and Sato and Nakajima	38	37	2	0.027	2.7	0.514	51.4

[†]Includes duplicates.

Supplementary Table VII. Citation matrix for condylar resorption

Author, y	*Francisco et al*[25]	*Barone et al*[33]	*Togninalli et al*[37]	*Niño-Sandoval et al*[42]
Kersey et al, 2003			X	
Gill et al, 2008		X	X	X
De Moraes et al, 2012		X	X	X
Valladares-Neto et al, 2014			X	
Jędrzejewsk et al, 2015		X		
Catherine et al, 2016		X	X	X
Bermell-Baviera et al, 2016	X	X	X	
Mousoulea et al, 2017	X	X	X	X
Veldhuis et al, 2017	X	X	X	
Nunes de Lima et al, 2018	X	X	X	X
He et al, 2019		X		
Vandeput et al, 2019		X		
Verhelst et al, 2020			X	

Supplementary Table VIII. CCA and CA calculations for condylar resorption

				CCA		CA	
Authors	*No. of included publications*[†]	*No. of rows*	*No. of columns*	*Proportion*	*Percentage*	*Proportion*	*Percentage*
Overall	29	13	4	0.410	41.0	0.558	55.8
Francisco and Barone	14	10	2	0.400	40.0	0.700	70.0
Francisco and Togninalli	14	10	2	0.400	40.0	0.700	70.0
Barone and Togninalli	20	13	2	0.538	53.8	0.769	76.9
Niño-Sandoval and Francisco	9	6	2	0.500	50.0	0.750	75.0
Niño-Sandoval and Barone	15	10	2	0.500	50.0	0.750	75.0
Niño-Sandoval and Togninalli	15	10	2	0.500	50.0	0.750	75.0

[†]Includes duplicates.

Supplementary Table IX. Citation matrix for anchorage devices

Authors, y	Ramirez-Ossa et al[27]	Yassir et al[38]	Zheng et al[45]
Labanauskaite et al, 2005			X
Feldmann and Bondemark, 2006		X	
Ohashi et al, 2006			X
Jambi et al, 2007			X
Chen et al, 2009	X		X
Reynders et al, 2009	X		X
Schätzle M, 2009	X		X
Crismani et al, 2010	X		X
Fudalej et al, 2011			X
Li et al, 2011		X	X
Papadopoulos et al, 2011	X	X	X
Alves et al, 2012			X
Feng et al, 2012			X
Marquezan et al, 2012			X
Meursinge Reynders et al, 2012	X		
Papageorgiou et al, 2012	X		X
Tsui et al, 2012	X		X
Alsamak et al, 2013			
Grec et al, 2013			X
Dalessandri et al, 2014	X		X
Jambi et al, 2014		X	
Rodriguez et al, 2014			X
Winsauer et al, 2014			X
Alsafadi et al, 2014			X
Hong et al, 2016	X		X
Leo et al[36]	X		
Yi et al, 2016			X
Antoszewska-Smith et al, 2017	X	X	
Cunha et al, 2017	X		
Diar-Bakirly et al, 2017		X	
Gintautaite and Gaidyte, 2017	X		
Jayaratne et al, 2017		X	
Xu and Xie, 2017		X	
Alharbi et al, 2018	X		
Becker et al, 2018	X	X	
Khlef et al, 2018		X	
Mohammed et al, 2018	X		
Alharbi et al, 2019		X	
Khlef et al, 2019		X	
Liu et al, 2020		X	
Tian et al, 2020		X	

Supplementary Table X. CCA and CA calculations for anchorage devices

				CCA		CA	
Authors	No. of included publications[†]	No. of rows	No. of columns	Proportion	Percentage	Proportion	Percentage
Overall	53	41	3	0.146	14.6	0.431	43.1
Ramírez-Ossa and Yassir	31	28	2	0.107	10.7	0.554	55.4
Ramírez-Ossa and Zheng	39	30	2	0.300	30.0	0.650	65.0
Yassir and Zheng	36	34	2	0.059	5.9	0.529	52.9

[†]Includes duplicates.