European Journal of Orthodontics 35 (2013) 244–248
doi:10.1093/ejo/cjs016
Advance Access publication 16 April 2012

Cochrane and non-Cochrane systematic reviews in leading orthodontic journals: a quality paradigm?

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SUMMARY The aims of this study were to assess and compare the methodological quality of Cochrane and non-Cochrane systematic reviews (SRs) published in leading orthodontic journals and the Cochrane Database of Systematic Reviews (CDSR) using AMSTAR and to compare the prevalence of meta-analysis in both review types. A literature search was undertaken to identify SRs that consisted of hand-searching five major orthodontic journals [*American Journal of Orthodontics and Dentofacial Orthopedics*, *Angle Orthodontist*, *European Journal of Orthodontics*, *Journal of Orthodontics and Orthodontics and Craniofacial Research* (February 2002 to July 2011)] and the Cochrane Database of Systematic Reviews from January 2000 to July 2011. Methodological quality of the included reviews was gauged using the AMSTAR tool involving 11 key methodological criteria with a score of 0 or 1 given for each criterion. A cumulative grade was given for the paper overall (0–11); an overall score of 4 or less represented poor methodological quality, 5–8 was considered fair and 9 or greater was deemed to be good. In total, 109 SRs were identified in the five major journals and on the CDSR. Of these, 26 (23.9%) were in the CDSR. The mean overall AMSTAR score was 6.2 with 21.1% of reviews satisfying 9 or more of the 11 criteria; a similar prevalence of poor reviews (22%) was also noted. Multiple linear regression indicated that reviews published in the CDSR ($P < 0.01$); and involving meta-analysis ($\beta = 0.50$, 95% confidence interval 0.72, 2.07, $P < 0.001$) showed greater concordance with AMSTAR.

Introduction

A systematic review (SR) is 'a review that has been prepared using a systematic approach to minimizing biases and random errors which is documented in the Materials and methods section' (Chalmers and Altman, 1995). Bias can compromise the narrative review process due to incomplete identification of existing studies, subjective decisions to include or exclude studies, failure to objectively appraise the strength of the included studies and by subjective synthesis of the results of those studies (Mulrow *et al.*, 1998). While SRs remain susceptible to systemic bias in the review process and organic bias inherent in the included studies, they are less prone to bias than traditional narrative reviews, with greater transparency of the literature search, well-defined selection criteria and consistent quality assessment of included studies (Needleman *et al.*, 2005). Consequently, the SR has become a cornerstone of evidence-based health care.

SRs aim to collect and where possible to combine the results of the best available evidence (Bader and Ismail, 2004). Statistical amalgamation of the results of an SR (meta-analysis) may also be carried out. While this is not essential to the review process, the possibility of quantifying differences in treatment effect or outcome is a useful addition to the process leading to more precise effect estimates. Furthermore, the SR can highlight whether evidence 'gaps' exist and whether findings from individual studies are consistent and generalisable across different populations and settings. Consequently, the SR has become increasingly important in the general dental and orthodontic literature. Moreover, Cochrane SRs have become established as the gold standard based on their robust methodology underpinned by stringent guidelines on their conduct and reporting.

The primacy of SRs places a premium on quality as methodological deficiencies may produce misleading results and amplify or exaggerate effect estimates to the ultimate detriment of clinical care. A number of validated tools to assess the quality of SRs have been developed (Sacks *et al.*, 1987; Oxman, 1994; Shea *et al.*, 2007); the most recent and accepted of these instruments is the AMSTAR tool, which incorporates an 11-item checklist (Shea *et al.*, 2007). The aims of this study were to assess and compare the methodological quality of Cochrane and non-Cochrane SRs published in leading orthodontic journals and the Cochrane Database of Systematic Reviews (CDSR) using AMSTAR and to compare the prevalence of meta-analysis in both review types.

Materials and methods

A literature search was undertaken to identify SRs, which consisted of hand-searching five major orthodontic journals [*American Journal of Orthodontics and Dentofacial Orthopedics*, *Angle Orthodontist*, *European Journal of Orthodontics*, *Journal of Orthodontics and Orthodontics and Craniofacial Research* (February 2002 to July 2011)] and Cochrane Library from January 2000 to July 2011.

Reports of SRs were considered eligible for inclusion if they met the following criteria: 'systematic review' and/or 'meta-analysis' were used in the title or abstract, or it was clear in the main text that an SR had been carried out. Narrative reviews, surveys, historical reviews and case reports with extensive literature reviews were excluded. Features common to a methodologically robust SR were identified and used as inclusion criteria for selection of reviews (Sequeira-Byron *et al.*, 2011). These comprised: a focused research question, a comprehensive search, clearly defined study inclusion/exclusion criteria, transparent and reproducible selection of studies, a full assessment and reporting of the methodological quality of the included studies, independent data extraction and plausible analysis and synthesis of data (Sander and Kitcher, 2006). Articles to be included had to involve orthodontic treatment but reviews of diagnostic tests were excluded. Two authors (PSF and JS) screened potentially relevant articles independently and any disagreements were resolved by discussion with a further author (NP) to reach a consensus. Complete articles were obtained for each potentially relevant study.

Methodological quality of the included reviews was gauged using the AMSTAR tool. This checklist involves 11 key methodological criteria. These criteria include (Shea *et al.*, 2007):

- Provision of a priori design
- Duplicate study selection and data extraction
- Comprehensive literature search
- Publication status used as inclusion criterion
- Listing of included and excluded studies
- Provision of characteristics of included studies
- Assessment and documentation of scientific quality of included studies
- Appropriate use of scientific quality of included studies to formulate conclusions
- Appropriate methods used to combine findings
- Assessment of publication bias
- Stated conflict of interest

According to these criteria, a score of 0 or 1 was given for each criterion. A cumulative grade was given for the paper overall (0–11) based on fulfilment of these 11 criteria. An overall score of 4 or less represented poor methodological quality, 5–8 was considered fair to good and 9 or greater was deemed to be good (CADTH, 2011).

Discrepancies were resolved by discussion. Descriptive statistics on the characteristics of SRs were undertaken initially. The data were analysed using simple and multiple linear regression analyses; the possible associations of SRs' methodological quality (summary AMSTAR score: dependent variable) and independent predictors including journal of publication, time since publication, authorship country of origin, number of authors and inclusion of a meta-analysis were investigated. The level of statistical significance for all tests was pre-specified at 0.05. Statistical analyses were performed with STATA® version 12.0 software (Stata Corporation, College Station, Texas, USA).

Results

In total, 109 SRs were identified in the five major journals and on the CDSR. Of these, 26 (23.9%) were in the CDSR. Four (3.5%) Cochrane reviews that were previously published in regular orthodontic journals were classified as Cochrane reviews only. A summary of SRs in individual specialty journals is given in Table 1, in addition to time since publication, continent of publication, number of authors (more or less than 5) and inclusion of a meta-analysis as part of the published review. The majority of the reviews were published in either *AJO-DO* (31%) or the *Angle Orthodontist* (29%) with relatively few SRs in the *European Journal of Orthodontics* (5.5%), *Journal of Orthodontics* (5.5%) or *Orthodontics and Craniofacial Research* (4.6%).

Performance in respect of the fulfilment of AMSTAR criteria is also outlined in Table 1. Variables considered include: journal of publication, time since publication, continent of publication, number of authors (more or less than 5) and inclusion of meta-analysis as part of the published review. The mean overall AMSTAR score was 6.2 with 21.1% of reviews satisfying 9 or more of the 11 criteria; a similar prevalence of poor reviews (22%) was also noted. Reviews published in the CDSR, published more recently, incorporating a greater number of authors and involving meta-analysis showed greater concordance with AMSTAR. The statistical relationships between Cochrane and non-Cochrane SRs were analysed using uni- and multivariate analyses with Cochrane reviews as the reference group (Table 2). Univariable analysis revealed that journal of publication, number of authors and meta-analysis conduct were significant predictors of the AMSTAR score.

Multivariable analysis confirmed that summary AMSTAR score was related to journal of publication and presence of meta-analysis when all predictors were simultaneously investigated. All the reviews derived from sources other than the Cochrane database demonstrated lower AMSTAR estimate scores (ranging from 2.19 to 4.90 reduced score for the JO and EJO, respectively). SRs published in the specialty journals displayed significantly lower methodological

Table 1 Distribution of summary AMSTAR scores [mean scores (standard deviation, SD)] and percentage of overall scores among the entire sample and stratified by review characteristics and AMSTAR quality score.

	Category	*N* (%)	AMSTAR score		% Fair*	% Good*
			Mean (SD)	% Poor*		
Overall			6.20 (2.35)	22.0	56.89	21.1
Journal	COCHRANE	26 (23.9)	9.23 (1.4)	0.0	19.2	80.8
	AJODO	34 (31.2)	5.29 (2.0)	29.4	64.7	5.9
	AO	32 (29.4)	5.46 (1.01)	12.5	87.5	0.0
	EJO	6 (5.5)	3.50 (2.0)	83.3	16.7	0.0
	JO	6 (5.5)	5.66 (1.9)	50.0	50.0	0.0
	OCR	5 (4.59)	5.20 (1.9)	40.0	60.0	0.0
Years since publication	≤5	84 (77.1)	6.40 (2.3)	17.9	59.5	22.6
	>5	25 (22.9)	5.52 (2.3)	36.0	48.0	16.0
Authorship country	Europe	66 (60.5)	5.98 (2.6)	30.3	47.0	22.7
	Americas	34 (31.2)	6.32 (1.9)	8.8	76.5	14.7
	Asia	9 (8.3)	7.33 (2.1)	11.1	55.6	33.3
Number of authors	≤5	88 (80.7)	5.82 (2.2)	26.1	58.0	15.9
	>5	21 (19.3)	7.76 (2.12)	4.78	52.4	42.9
Meta-analysis	No	80 (73.4)	5.57 (1.9)	26.23	63.8	10.0
	Yes	29 (21.6)	7.93 (2.6)	10.3	37.9	51.7
Total		109 (100)				

*Proportions were calculated using AMSTAR quality assessment-poor quality score 0 to ≤4, fair quality score 5 to ≤8, good quality score ≥9.

Table 2 Results of univariable and multivariable linear regression of AMSTAR score on journal, time since publication, authorship country, number of authors and meta-analysis conduct, among the 109 systematic reviews.

	Category/unit	Univariable			Multivariable		
		β	95% CI	*P* value	β	95% CI	*P* value
Journal	COCHRANE	Reference			Reference		
	AJODO	−3.93	−4.76, −3.11	$<10^{-3}$	−3.63	−4.45, −2.80	$<10^{-3}$
	AO	−3.76	−4.59, −2.92	$<10^{-3}$	−3.24	−4.10, −2.39	$<10^{-3}$
	EJO	−5.73	−7.16, −4.29	$<10^{-3}$	−4.90	−6.29, −3.52	$<10^{-3}$
	JO	−3.56	−5.00, −2.12	$<10^{-3}$	−2.19	−3.60, −0.78	<0.01
	OCR	−4.03	−5.57, −2.48	$<10^{-3}$	−3.72	−5.23, −2.20	$<10^{-3}$
Time since publication	1 year	−0.08	−0.25, 0.08	NS	−0.10	−0.21, 0.01	NS
Authorship continent	Europe	Reference			Reference		
	Americas	0.33	−0.64, 1.31	NS	0.65	0.00, 1.30	NS
	Asia	1.34	−0.30, 2.99	NS	0.26	−0.79, 1.31	NS
Number of authors	1 person	0.50	0.27, 0.74	$<10^{-3}$	0.10	−0.07, 0.27	NS
Meta-analysis	No	Reference			Reference		
	Yes	2.35	1.44, 3.26	$<10^{-3}$	1.39	0.72, 2.07	$<10^{-3}$

CI, confidence interval; NS, not significant.

quality scores compared to Cochrane reviews ($P < 0.01$); the EJO scored almost 5 units lower in respect of AMSTAR than Cochrane reviews [β = −4.9, 95% confidence interval (CI): −6.29, −3.52, $P < 0.001$].

In the univariable model, increasing the number of authors was associated with an average 0.5 AMSTAR score increase with each additional co-investigator. However, in the multivariable model, this difference did not reach statistical significance (β = 0.10, 95% CI: −0.07, 0.27). Similarly, in the multivariable model, no statistical association was found between continent of publication or time since publication and overall AMSTAR scores.

The adjusted estimate for meta-analysis was almost 1.4 (95% CI: 0.72, 2.07, $P < 0.001$); thus, the inclusion of a meta-analysis in an SR shows an association with the methodological quality of the review with the summary score being on average 1.4 units higher.

Discussion

There has been a consistent increase over the last 4 years in the number of published Cochrane and non-Cochrane SRs of relevance to orthodontics. In particular, of the 26 Cochrane reviews of orthodontic relevance since 2000, 22

have been published since 2007. A considerable number of titles and protocols for orthodontic SRs are also registered on the Cochrane Library CDSR at present, suggesting that this trend is likely to be maintained. This pattern indicates that the evidence underpinning orthodontic treatment is strengthening. Furthermore, while there is certainly room for improvement in the methodological quality highlighted here, the compliance with AMSTAR criteria compares favourably to similar reviews of dental SRs (Glenny *et al.*, 2003; Sequeira-Byron *et al.*, 2011).

As expected, the quality of Cochrane reviews was significantly better than non-Cochrane SRs. An area of particular concern in relation to non-Cochrane reviews was the failure to register reviews at the outset. Registration of Cochrane reviews is mandatory with publication of a protocol *a priori*. Use of a protocol pre-specifies the objectives and methodology reducing the risk of biased *post hoc* decisions. In addition, registration may obviate duplication of reviews. While registration of SRs in medicine on accepted electronic databases (e.g. PROSPERO, Centre for Reviews and Dissemination, University of York, UK) is increasing (Moher *et al.*, 2007; Clarke and Stewart, 2011), this trend is not mirrored in orthodontics with registration not noted in any non-Cochrane review identified in the present study.

In the present review, a problem with classification arose in respect of risk of bias assessment. Inclusion of a quality assessment is advocated in the AMSTAR guidelines as part of a comprehensive review process. However, QUORUM guidelines (Moher *et al.*, 1999), which were advocated as a template for reporting prior to the advent of PRISMA (Liberati *et al.*, 2009), recommended the use of methodological quality assessment rather than risk of bias assessment. Consequently, where assessment of methodological quality was undertaken, this was taken to be synonymous with risk of bias assessment in the present review. It should be noted, however, that risk of bias assessment is considered best reporting practice presently; this approach should therefore be used until the PRISMA guidance is superseded.

While certainly not essential, a desirable outcome of a systematic literature review is the conduct of quantitative synthesis of the data in the form of meta-analysis. Meta-analysis was undertaken in 27% of the identified reviews. This rather low figure is in keeping with reports from both medical and dental literature (Lau *et al.*, 1997). Interestingly, the adherence to AMSTAR guidelines appeared to be better in those reviews incorporating a meta-analysis. However, it would be inappropriate to suggest a cause–effect relationship between the two, although it may be speculated that the possibility of meta-analysis may reflect a more comprehensive search protocol. In addition, a higher preponderance of meta-analysis among Cochrane reviews was also noted. The mean AMSTAR score noted in reviews incorporating meta-analysis (7.93 ± 2.61) was analogous to that obtained in a review of methodological quality of Endodontic meta-analyses, the latter alluding to mean AMSTAR score of 8.33 (Suebnukarn *et al.*, 2010).

Assuming that these five leading orthodontic journals examined are representative of the quality of SRs within the specialty, this review has confirmed that Cochrane reviews represent the highest form of evidence in orthodontics, with methodological scores consistently higher than those of non-Cochrane reviews. It would therefore be beneficial if clinicians were kept informed of the publication of Cochrane SRs efficiently to inform everyday practice with the highest level of evidence. While efforts have also been made to collate information on SRs (Papadopoulos and Gkiaouris, 2007; Fleming and DiBiase, 2008), these are static documents, which cannot be updated easily. Presently, Cochrane reviews in Dentistry are publicised on the Internet (http://ebd.ada.org/SystematicReviewsCategories.aspx?IndexId=0e4cc614-5ce1-43d8-81ca-49e671937c94, accessed 26 November 2011). A further way to raise awareness of important publications is to consider dual publication of Cochrane reviews both on the Cochrane Web site and leading specialty journals possibly in an electronic format. The majority of Cochrane reviews were published in the Cochrane Databases of Systematic Reviews alone; however, a small number were also published in specialty journals. Given that the awareness of the Cochrane Collaboration remains surprisingly low among orthodontists (Madhavji *et al.*, 2011), prominent electronic alerts to the results of these reviews or indeed dual publication may be worthwhile approaches to increase access to and awareness of best quality evidence in our specialty. Discussion with journal editors to develop an appropriate mechanism to facilitate this, however, is required.

Conclusions

In a cross-sectional study of leading orthodontic specialty journals and the Cochrane database, higher levels of compliance with AMSTAR criteria were reported in both Cochrane SRs and SRs incorporating a meta-analysis.

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