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REVIEW

A flood tide of systematic reviews on endodontic posts: methodological assessment using of R-AMSTAR

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Abstract
Objectives To help the dental practitioner solve a specific clinical problem, systematic reviews (SRs) are seen as the best guide. In addition to the unmanageable quantity of SRs, however, one should be aware of their variable quality. The present review describes the methodological quality of SRs on postendodontic restorations to work out the value of these reviews for the dental practitioner.
Methodology SRs were searched in April 2012, independently and in triplicate. Post survival was used as measure of outcome. The methodological quality of included SRs was assessed with the Revised Assessment of Multiple Systematic Reviews (R-AMSTAR) checklist. Kappa statistics were used to assess reviewer agreement.
Results Three hundred sixty-three papers were retrieved from the initial search. Ten SRs were included. One SR achieved a high R-AMSTAR score, whereas the other nine SRs achieved scores that indicate a substantial lack of methodological quality. Especially the items "grey literature," "combination of findings," "likelihood of publication bias," and conflict of interest" showed low R-AMSTAR scores. The three reviews with the highest R-AMSTAR scores tended to conclude that fewer failures occurred when using nonmetal posts. The reviewer agreement was excellent (kappa ranged from 0.79 to 0.85) in the R-AMSTAR classification.
Conclusion The approach presented revealed a lack of SRs with high methodological quality. Thus, no decisive conclusion can be drawn with respect to this topic. It appears that there is a trend for the superiority of fiber-reinforced posts.
Clinical relevance SRs must be of high methodological quality. This can be achieved by taking into consideration the results of this review. Improved methodological quality would make SRs more supportive for the general practitioner.

Keywords Systematic review · Posts · Survival

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Introduction

When severely destroyed teeth have to be restored, posts are frequently used. Therefore, it is mandatory to assess the survival of different posts, respectively post materials (including fiber-reinforced posts), in clinical settings. The best sources to get this information are systematic reviews (SRs) of randomized controlled trials [1, 2]. In the last decade, numerous SRs on this topic have been published [3–6]. The conclusions of these reviews are heterogeneous with respect to the clinical performance of the posts and the superiority of a specific post material. This results in the uncertainness of the dental clinician when postendodontic treatment has to be planned, especially when the adequate post has to be selected. To overcome this problem, it might be helpful to

assess the quality of the SRs in order to identify SRs presenting the most robust evidence for guiding clinical treatment [7]. This might help the dental practitioner to make more appropriate decisions in daily practice.

Recently, a revised version of the Assessment of Multiple Systematic Reviews (AMSTAR) had been established, allowing a more sophisticated assessment of the methodological quality of SRs using a numeric rating scale.

Thus, the objective of this systematic review was to clarify the methodological quality of systematic reviews assessing the clinical success of fiber-reinforced posts.

Materials and methods

Research question

When formulating the research question, the patient/population, intervention, comparison, and outcome (PICO) approach has been proposed to be used [8]. In the present study, the following parameters were defined:

P Adult patients with permanent teeth and need for a post
I Placement of a fiber post
C Placement of another post (different material)
O Post survival in SRs and, if available, meta-analysis

Additionally, the following research question was defined: Are there differences with respect to the methodological quality of SRs on clinical studies dealing with post placement?

Literature search

Medline database and Cochrane database of systematic reviews (via PubMed) were searched in April 2012 using a search strategy presenting a great sensitivity [9]. The search strategy was the following: ((post* AND (Humans[Mesh] AND (Meta-Analysis[ptyp] OR Review[ptyp])))) AND ((tooth) OR teeth AND (Humans[Mesh] AND (Meta-Analysis[ptyp] OR Review[ptyp]))). Manual searching of the reference lists of included papers was also conducted to retrieve potential systematic reviews.

Inclusion and exclusion criteria

SRs and meta-analyses were included, which were published after 1999 and assessed the survival of posts, respectively, post materials (fiber posts had to be included—this was the reason for the exclusion of SRs published before 2000) in clinical studies. SRs assessing exclusively the mechanical properties of posts, laboratory studies, and studies assessing the performance of metal posts, only, were excluded. All kinds of SRs were included whereas narrative reviews were excluded. SRs were considered to be systematic when the following criteria were fulfilled: The literature search was performed in at least one electronic scientific database (e.g., PubMed [10]) and the keywords that were used to perform the search were presented in the manuscript (to enable reproduction).

Selection of the reviews

The literature search was performed independently and in triplicate by three of the authors (MS, GS, and GK). First, the titles of retrieved potential papers were assessed, and papers that did not meet the inclusion criteria were excluded. Second, the abstracts of selected papers were assessed independently and in triplicate. Finally, the full-text analysis was performed, the results for all three reviewers were compared, and disagreements were resolved by discussion. The reasons for exclusion of papers in the full-text analysis are reported in Table 1.

Data collection

Data extraction was performed independently and in triplicate by the authors. Exclusively data that were related to the measure of outcome (post loss/failure/survival) and that were based on clinical studies were retrieved. In order to be selected, two different post materials (including one fiber-reinforced group at least) had to be included in the SR. Any disagreement between reviewers at this stage was resolved by discussion and consensus.

Methodological assessment of the systematic reviews

The methodological quality of the included SRs was assessed by the use of the Revised AMSTAR (R-AMSTAR, revised version [11]) checklist, which is the revised version of the AMSTAR [12]. Although the AMSTAR has good face and content validity for measuring the methodological quality of systematic reviews and clinical relevance, it fails to reproduce quantifiable assessment of SRs quality [11–13]. The R-AMSTAR overcomes this disadvantage and can successfully quantify the quality of SRs [11]. R-AMSTAR is a validated checklist that comprises 11 items addressing specific, important aspects of an SR. The AMSTAR was developed by an expert panel consisting of clinicians, methodologists, and epidemiologists. The AMSTAR was designed to address several vital criteria when conducting systematic reviews using a checklist. In contrast to AMSTAR, in the R-AMSTAR, each of the checklist items is scored 1–4 (assessed criterion was explicitly met in the SR), “1” (zero or one criteria is met), “4” (all criteria are met). The greater the sum of the numbers, the higher the methodological quality of the reviews.

Table 1 Reasons for exclusion of papers in the full-text analysis

Full text analysis	Included in the review	Reason for exclusion
Goracci and Ferrari [21]	No	Only review articles were included, the results are presented as a narrative review
Al-Omiri et al. [22]	No	No comparison of survival outcomes
Rasimick et al. [6]	*Yes*	
Baba et al. [23]	*Yes*	
Theodosopoulou and Chochlidakis [15]	*Yes*	
No author listed 2009 [24]	No	No systematic review
Cagidiaco et al. [5]	*Yes*	
Dietschi et al. [25]	*Yes*	
Bitter and Kielbassa [3]	*Yes*	
Bolla et al. [4]	*Yes*	
Dietschi et al. [26]	No	No comparison of survival outcomes
Peroz et al. [27]	No	No comparison of survival outcomes
Schwartz and Robbins [28]	No	No systematic review
Bateman et al. [29]	*Yes*	
Fernandes et al. [30]	*Yes*	
Qualtrough and Mannocci [31]	No	No systematic review
Heydecke and Peters [32]	*Yes*	

The references in italics were included in the present assessment

In the present study, a disagreement with respect to the quality rating was solved by majority decision (if two of the three raters had the same rating) or discussion (if all three raters found different ratings).

Calibration of reviewers and agreement of the reviews during assessment

The reviewers were calibrated consisting of independent assessment of one systematic review, randomly selected from a sample of systematic reviews about postendodontic restorations. Prior to the calibration, the items of the R-AMSTAR checklist were intensively discussed to achieve homogeneity in the assessment.

The level of agreement between the reviewers was determined using Cohen's kappa statistic. Agreement was regarded as excellent when the statistic was >0.75, fair to good when it was 0.40–0.75, and poor when it was <0.40 [14].

Results

Search process

In PubMed, initially 363 potential papers were identified. One hundred fifty-eight papers were excluded after the assessment of the titles. In the next step, the abstracts were screened: 166 were not related to the topic, 19 were narrative, and 3 did not include clinical studies. Thus, 17 papers were included in the full text analysis. After full-text assessment, 10 SRs were included. Table 1 gives the reasons for the exclusion of seven papers. Searching the Cochrane database did not generate any other papers. The literature search process is depicted in Fig. 1.

Included reviews

Table 2 gives an overview over the included SRs. Both the study designs and the included primary studies were different for most of the SRs. Many SRs included prospective and retrospective studies; one SR also included other reviews. In average, the SRs included 6±4 prospective studies (min., 1; max., 12) and 4±3 retrospective studies (min., 0; max., 9).

Methodological quality

Interrater agreement of the three reviewers was excellent during the quality assessment using R-AMSTAR (kappa ranged between 0.79 and 0.85).

In Table 3, the mean values and the standard deviations for each R-AMSTAR item are shown. A low mean value indicates that most reviews did not achieve a high quality level (highest mean value possible, 4; lowest mean value possible, 1). Most SRs provided "a priori" design, i.e., a research question and inclusion criteria (mean: 2.6). In contrast, items such as "status of publication as an inclusion criterion" (mean: 1.3), "were the methods used to combine the findings of studies appropriate" (mean: 1.3), "likelihood of publication bias assessed" (mean: 1.3), and "was the conflict of interest stated" (mean: 1.3) were reported in only

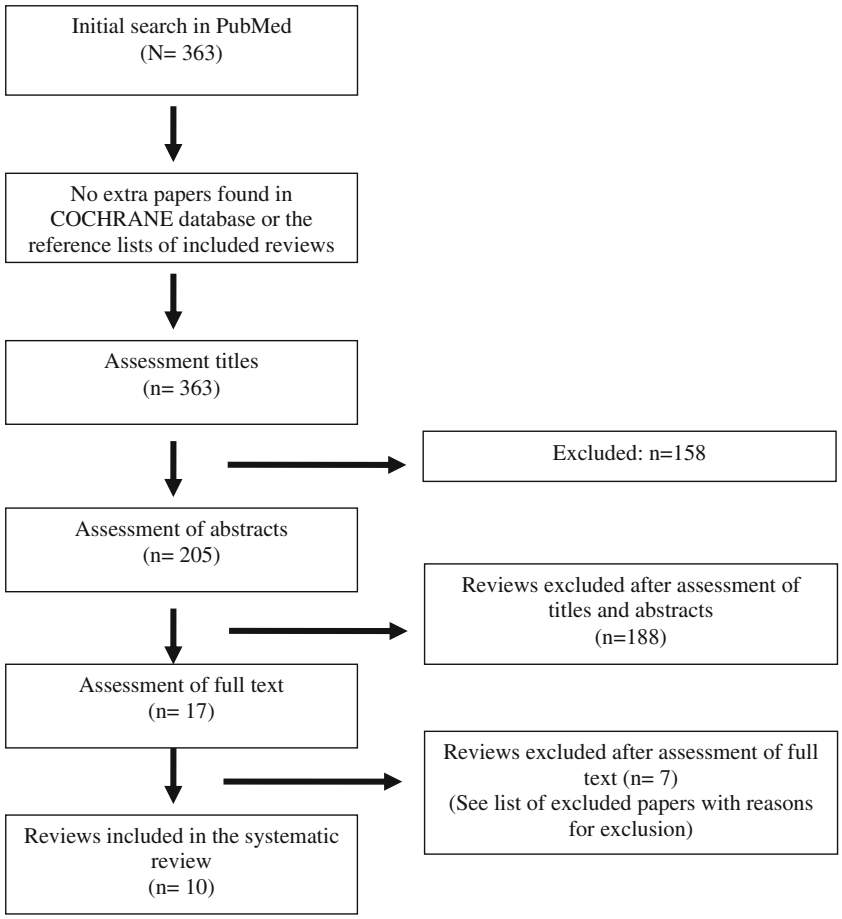

Fig. 1 Flowchart of the systematic review process

one SR, [4] only. The authors of the three SRs that received the highest methodological scores (42 points [4], 25 points [15], and 19 points [5]) concluded that fewer failures occurred when using nonmetal posts. However, two of the authors of these three SRs stated that the evidence is not satisfying

Discussion

In this study, the SR that awarded the highest methodological score [4] included two studies only. The reason for this limitation could be found in the strict inclusion criteria and the limited number of randomized controlled clinical trials. In this review, it was concluded that fewer failures occurred when using nonmetal posts. However, the authors stated that the evidence is not satisfying and the risk for bias is high.

The SR with the second highest methodological score [15] reported that carbon fiber in resin matrix posts are significantly better than metal posts (precious alloy cast dowels). Additionally, glass fiber dowels are significantly better than metal screw dowels. However, carbon fiber dowels are significantly worse than metal dowels. Thus, fiber posts tended to perform better than metal posts in this SR.

The SR with the third highest methodological quality [5] achieved 19 points (possible, 44 points) on the R-AMSTAR scale. The authors concluded that fiber-reinforced posts outperform metal posts, although the evidence cannot be considered as conclusive.

The main outcome of the present review is that the methodological aspects of SRs should be further improved. Considering the date of publication, the SRs included reflect an increase in evidence regarding the clinical performance of different posts during the past decade. Half of the selected SRs were published before 2008, and none of them could present reliable evidence to show a benefit of one type of post over the other with regard to longevity of the restored root canal treated tooth. In contrast, at least two of the five SRs being published 2008 or later conclude that fiber posts might be the best approach to restore endodontically treated teeth with the need for a post. However, even these SRs demanded that the level of evidence for this statement has to be optimized. This demand is emphasized by the present review: Even most of the recent reviews, published in the last 3 years, did not achieve the R-AMSTAR quality score, which is necessary to provide a reliable consensus based on the best available

Table 2 Summary of the characteristics of the systematic reviews included

Authors	Patients	Intervention	Control	Outcome	PICO question presented	Number and type of clinical studies included	Number of non-PubMed publications included	Results	R-AMSTAR rating
Rasimick et al. [6]	Needing a post	Dowel luted with resin cement	Dowel cemented using zinc phosphate of glass ionomer cements	Loss of retention	No	Retrospective studies (n=08), prospective studies (n=07)	0	Loss of retention is the major mode of failure, even for nonmetal dowels luted by resin cement. The type of dowel material did not noticeably influence the overall failure rate	16
Baba et al. [23]	Needing a post	Nonmetallic prefabricated dowels	Any other nonmetallic prefabricated dowel	Failure rates	No	Clinical studies: retrospective studies (n=09), prospective studies (n=12)	0	There is considerable variation in reporting failure percentages	15
Theodosopoulou and Chochlidakis [15]	Needing a post	A post	Any other post	Survival	no	Retrospective studies (n=0), prospective studies (n=10)	0	Carbon fiber in resin matrix dowels are significantly better than precious alloy cast dowels (RCT). Glass fiber dowels are significantly better than metal screw dowels (RCT) and moderately better than quartz fiber dowels (CCT). Carbon fiber dowels are significantly worse than metal dowels (of precious alloy) (RCT). Prefabricated metal dowels are slightly better than cast dowels (RCT), but moderately worse when no collar of the dentin above the gingiva could be achieved (CCT)	*25*
Cagidiaco et al. [5]	Needing a post	Fiber posts	Any other post	Survival	no	Retrospective studies (n=05), prospective studies (n=11)	0	Fiber-reinforced composite posts outperform metal posts, but evidence is not sufficient	*19*
Dietschi et al. [25]	Needing a post	A post	–	Survival	No	Retrospective studies (n=06), prospective studies (n=04), reviews (n=02)		Nonvital teeth restored with composite resin or composite resin combined with fiber posts resisted fatigue tests and currently represent the best treatment option.Clinical literature does not clearly isolate or identify exact parameters critical to success	12
Bitter and Kielbassa [3]	Needing a post	A fiber post	–	Overall failure rate	No	Retrospective studies (n=03), prospective studies (n=07)	0	Most clinical studies investigating survival rates of teeth restored with FRC posts revealed promising results. Evidence-based recommendations are still not possible	14
Bolla et al. [4]	Needing a post	A post	Any other post	Failure rate	No	Randomized clinical trials (n=02)	5	Besides, the fewer failures with type III post and core systems cannot be extended to all non-metal posts. More RCTs are needed to confirm whether fibre-reinforced post and core systems are superior and to clarify the influence of the remaining tooth structure. Well-defined inclusion criteria focusing on the number of dentine walls (two or three) should be used	*42*
Bateman et al. [29]	Needing a post	Fiber post	–	Failure rate	No	Retrospective studies (n=03), prospective studies (n=04)	0	Few clinical studies are available. These studies suggest that fiber posts may be clinically appropriate for the restoration of endodontically treated teeth	13
Fernandes et al. [30]	Needing a post	A post	–	Post selection	No	Unclear	0	Although newer prefabricated post systems have been introduced, published long-term clinical data are not available. The criteria and factors presented in this review may help guide the clinician in selecting the most desirable post system	11
Heydecke and Peters [32]	Needing a post	A cast post	A direct post	Failure	No	Retrospective studies (n=05), prospective studies (n=01)	0	The survival of cast posts ranged between 87.2 % and 88.1 %. For direct posts a survival of 86.4 % after 72 was found…no conclusive evidence favors cast over direct post-and-core restorations or vice versa	15

The R-AMSTAR score for the three SRs showing the highest quality are in italics

Table 3 Assessment of the methodological quality of included systematic reviews by use of the R-AMSTAR checklist

Study	R-AMSTAR items											Score
	a. "A priori" design provided?	b. Duplicate study selection and data extraction?	c. Comprehensive literature search?	d. Status of publication as an inclusion criterion?	e. List of studies (included and excluded)?	f. Characteristics of the included studies?	g. Quality of included studies assessed and documented?	h. Scientific quality used appropriately in formulating conclusions?	i. Appropriate methods used to combine the findings of studies?	j. Likelihood of publication bias assessed?	k. Conflict of interest stated?	
Rasimick et al. [6]	3	1	2	1	1	3	1	1	1	1	1	16
Baba et al. [23]	2	1	**2** (2,2,1)	1	1	3	1	1	1	1	1	15
Theodosopoulou and Chochlidakis [15]	3	2	3	1	4	**3** (3,4,3)	4	2	1	1	1	25
Cagidiaco et al. [5]	3	2	1	1	1	4	2	**2** (2,2,1)	1	1	1	19
Dietschi et al. [25]	2	1	**1** (2,1,1)	1	1	1	1	1	1	1	1	12
Bitter and Kielbassa [3]	**3** (2,3,3)	1	2	**1** (1,1,2)	1	**1** (4,1,1)	**1** (2,1,1)	1	1	1	1	14
Bolla et al. [4]	4	4	3	4	4	4	**4** (4,4,3)	3	4	4	4	42
Bateman et al. [29]	**2** (2,3,2)	1	**2** (2,1,2)	1	1	1	1	1	1	1	1	13
Fernandes et al. [30]	**1** (1,2,1)	1	1	1	1	1	1	1	1	1	1	11
Heydecke and Peters [32]	**3** (3,3,2)	1	2	1	1	*2* (*2*,*4*,*1*)	1	1	1	1	1	15
Mean score	2.6	1.5	1.9	1.3	1.6	2.3	1.7	1.4	1.3	1.3	1.3	18.2
Standard deviation	0.84	0.97	0.74	0.95	1.27	1.25	1.25	0.70	0.95	0.95	0.95	9.28

The bold scores are based on majority decisions (ratings of the three reviewers are given in brackets). The scores in *italics* are based on discussion (ratings of the three reviewers before the discussion are given in brackets)

evidence [11]. For example, some SRs included did not report a comprehensive literature search strategy or the status of publications, which can imply greater risk of publication bias [16–18]. Furthermore, the PICO question, which should be clearly stated [8], is missing in all SRs. However, it can be extracted in most cases when reading the SRs carefully.

Some SRs did not make available a list with the kind of studies included (cohort studies, randomized controlled clinical trials, etc.), which makes it difficult to classify the level of evidence of the primary research. Additionally, "grey literature" [19] (e.g., unpublished observations, dissertations, conference proceedings) was included in one SRs only. Thus, in most SRs, it was precluded to be all-inclusive of the available literature.

Finally, some SRs did not perform methodological assessment of the primary trials included; this lack of information can reduce confidence in the validity of the study results [20]. Therefore, assessment of the methodological quality of SRs with a validated checklist [11, 12] is one means of determining how well-built the SR was, and this may increase our confidence in the results presented in these reviews.

In the SR with the highest R-AMSTAR score, the authors recognize the limitation regarding the primary data; Bolla et al. [4] concluded that "however the quality assessment indicated a high risk of bias. This was due to the method of randomisation being unclear. Perhaps confounding existed. Some inclusion criteria were poorly defined…."

In the present review, exclusively one outcome of interest was used: Clinical post survival/failure rate was chosen. This approach was used because post failure is supposed to be a true endpoint instead of a surrogate endpoint. Other outcomes of interest, for example, aesthetic aspects, may not be indicative of true long-term outcome. But even for failure, authors of primary research used different measures of outcome, for example, "overall failure rate," "cumulative failure rate," and "survival rate" for reporting the findings. However, this great heterogeneity is the reason for the limited possibility to compare the results of the reviews. Furthermore, it is the most important explanation of the authors for not performing meta-analysis in many SRs included in the present work: Of the ten selected SRs, none performed a reliable meta-analysis. The presented results should be taken into consideration when a systematic review (on this topic) is planned.

Conclusion

The approach presented showed that there is a lack of systematic reviews with a high methodological quality on this topic. There seems to be a trend for a better clinical performance of fiber-reinforced posts.

Conflict of interest The authors declare that they have no conflict of interest.

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