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Literature Review

Spin in the Abstracts of Randomized Controlled Trials in Operative Dentistry: A Cross-sectional Analysis

X Fang • X Wu • C Levey • Z Chen • F Hua • L Zhang

Clinical Relevance

Readers and other stakeholders need to be aware of the existence of spin in RCT abstracts, and appraise the results and conclusions of RCT abstracts critically.

SUMMARY

Objective: To assess the presence and characteristics of spin in recently published RCT abstracts in operative dentistry and to investigate potential factors associated with the presence of spin.

Methods and Materials: The PubMed database was searched to identify parallel-group RCTs published between 2015 and 2019 in the field of operative dentistry, which compared two or more groups and had nonsignificant results for the primary outcome. Two authors evaluated independently the presence and characteristics of spin among these abstracts. Multivariable logistic regression analyses were conducted to identify factors associated with the presence of spin in the Results and the Conclusions sections, respectively.

Results: A total of 77 RCT abstracts were included,

Xiaolin Fang, BDS, MSc, Hubei-MOST KLOS & KLOBM, School & Hospital of Stomatology, Wuhan University, Wuhan, China; Department of Cariology and Endodontics, School & Hospital of Stomatology, Wuhan University, Wuhan, China

Xinyu Wu, BDS, MSc, Hubei-MOST KLOS & KLOBM, School & Hospital of Stomatology, Wuhan University, Wuhan, China

Colin Levey, BMSc, BDS, PhD, School of Dentistry, University of Dundee, Dundee, UK

Zhi Chen, BDS, MSc, PhD, Hubei-MOST KLOS & KLOBM, School & Hospital of Stomatology, Wuhan University, Wuhan, China; Department of Cariology and Endodontics, School & Hospital of Stomatology, Wuhan University, Wuhan, China

*Fang Hua, BDS, MSc, PhD, Centre for Evidence-Based Stomatology, School & Hospital of Stomatology, Wuhan University, Wuhan, China; Division of Dentistry, School of Medical Sciences, Faculty of Biology, Medicine and Health, University of Manchester, Manchester Academic Health Science Centre, Manchester, UK

*Lu Zhang, BDS, MSc, PhD, Hubei-MOST KLOS & KLOBM, School & Hospital of Stomatology, Wuhan University, Wuhan, China; Department of Cariology and Endodontics, School & Hospital of Stomatology, Wuhan University, Wuhan, China

*Corresponding authors: Luoyu Rd 237, Wuhan 430079, China; e-mail: huafang@whu.edu.cn, luzhang2012@whu.edu.cn

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among which 58 (75.3%) showed at least one type of spin. Spin was identified in the Results and Conclusions sections of 32 (41.6%) and 45 (58.4%) abstracts, respectively. 19 RCTs (24.7%) presented spin in both the Results and the Conclusions section of abstracts. The presence of spin in the Results section of abstracts was significantly associated with source of funding (OR=8.10; *p*=0.025) and number of treatment arms was associated with the presence of spin in the Conclusions section of abstracts (OR=5.66; *p*=0.005).

Conclusion: The occurrence rate of spin in the sample of operative dentistry RCTs abstracts is high.

INTRODUCTION

In biomedical research, the randomized controlled trial (RCT) is the scientific gold standard for evaluating effectiveness of healthcare interventions.[1] The precise communication of RCT findings depends on accurate reporting of results.[2] Although relevant reporting guidelines such as CONSORT (CONsolidated Standards Of Reporting Trials) have been published,[3-5] various problems in published reports still exist.[6-8] One of the problems is that many authors have intentionally or unintentionally misrepresented and misinterpreted their findings, which could "spin" study results and mislead readers.[8]

In the medical literature, "spin" has been used to refer to "specific reporting strategies to distort the presentation and interpretation of results."[6] For instance, authors may divert readers' attention from nonsignificant primary outcomes to significant secondary endpoints. Spin was first systematically surveyed by Boutron and others[6] in biomedical literature with a representative sample of RCTs indexed in PubMed in December 2006 with nonstatistically significant primary outcomes. In their research, spin strategies were developed for the identification of spin in RCTs with nonsignificant primary outcomes, and spin was highly prevalent in the abstract's conclusions.[6] Thereafter, several studies found that spin is common in the biomedical literature, and the frequency of spin in abstracts varies (23% to 85%) by different studies.[7,9-15] In the field of dentistry, several studies have assessed the prevalence and type of spin in RCTs amongst high-impact dental research journals, endodontics, periodontology, and oral implantology and found that nearly 30.7%-85% of abstracts were identified as spin.[7,16,17]

Spin in abstracts may be a critical issue, as evidence has shown that abstracts are usually the first and the only part of an article that is accessible to clinicians,[18] and numerous clinicians make medical decisions based solely on the results and conclusions present in abstracts due to time constraints and unavailability of full-text articles.[19] However, to the best of our knowledge, spin has not been assessed in the field of operative dentistry.

Therefore, this study was conducted to (i) assess the existence and characteristics of spin in recently published RCT abstracts in operative dentistry; and (ii) investigate potential factors associated with the presence of spin in abstracts.

METHODS AND MATERIALS

Sample Creation

The PubMed database was searched using a combination of "Dentistry, Operative", "dental caries", "dental amalgam", "composite resins," and "dental cement" (for full search strategy; see Table 1), to identify RCT abstracts published during 2015-2019 in the field of operative dentistry, which compared two or more groups and have had nonsignificant result for the primary outcome(s).[6] Predefined inclusion criteria of RCTs were as follows: human participants, interventions associated with health care, experimental studies, presence of a control group, and random assignment of participants to the study or control group.[20,21] As determined *a priori*, RCTs for which the primary outcome could not be identified were excluded. To identify primary outcomes, the following potential sources were considered in order:[17]

1. Explicitly reported primary outcome(s) in the full text
2. The outcome used in sample size calculation
3. Explicitly reported primary outcome(s) in clinical trial registration
4. Outcome(s) reported in the *Results* section and consistent with the primary/main research objective

Data Extraction

The following information was extracted independently and in duplicate by two authors (XF and XW) from each of the included studies: continent of origin (first author), indexing in the Science Citation Index Expanded (SCIE) database (SCIE-indexed vs others), international collaboration, number of centers, number of treatment arms, trial registration, the topic of each study (materials and procedures), number of authors, statistician involvement, type of financial support, journal, and length of follow-up. Any disagreement was resolved through discussion.

Table 1: *The Search Strategy Used in This Study (Searched on June 29, 2020)*

Electronic Database	Search Strategy	Number of Hits
PubMed	#1 "Dentistry, Operative"[MeSH Terms] #2 dental caries[MeSH Terms] #3 dental amalgam[MeSH Terms] #4 composite resins[MeSH Terms] #5 dental cement[MeSH Terms] #6 #1 OR #2 OR #3 OR #4 OR #5 #7 randomized controlled trial[Publication Type] OR randomized controlled trials[MeSH Terms] OR "random allocation"[MeSH Terms] OR double-blind method[MeSH Terms] OR single-blind method[MeSH Terms]) OR ((single*[Text Word] OR doubl*[Text Word] OR trebl*[Text Word] OR tripl*[Text Word]) AND (mask*[Text Word] OR blind*[Text Word])) OR random*[Text Word] NOT ("review"[Publication Type] OR "meta-analysis"[Publication Type] OR "editorial"[Publication Type] OR "letter"[Publication Type] OR "comment"[Publication Type] OR "Case Reports"[Publication Type] #8 "2015/01/01"[PPDAT]: "2019/12/31"[PPDAT] #9 #6 AND #7 AND #8	1876

Evaluation of Spin

All eligible abstracts were collated into a Word document. Meanwhile, the journal titles, author names, and author affiliations were removed to guarantee blinded assessment of the presence and strategy of spin.[7] Calibration was conducted in iterative rounds of 10 randomly selected abstracts, until the agreement between the assessors (XF and FH) was excellent or better (Cohen κ>0.75). Thereafter, two assessors (XF and FH) evaluated the existence of spin and spin strategies for each included abstract independently and in duplicate. Any disagreement was resolved through discussion with the other authors.

Spin was evaluated in the *Results* section and the *Conclusions* section of the abstracts, respectively. A classification system was adapted from the one used by Boutron and others[6]; types of spin was classified into one of the following strategies:

- Focusing on statistically significant results (secondary endpoints, subgroup analysis, within-group comparison)
- Interpreting statistically nonsignificant results as equivalent
- Claiming benefit for statistically nonsignificant results
- Recommendation to use the treatment
- Focusing on a statistically significant primary outcome when there are several co-primary outcomes
- Verbiage implying numerical significance or "trend towards significance"

Statistical Analyses

Descriptive statistics were used to describe the existence and strategy of spin, as well as the percentage of spin by characteristics. Multivariable logistic regression analyses were conducted to detect the association between the presence of spin in the *Results* and *Conclusion* sections (dependent variables) and the extracted factors, namely continent of origin (first author), SCIE indexing, international collaboration, number of centers, number of treatment arms, the topic of each study (materials and procedures), trial registration, number of authors, statistician involvement, type of financial support, and length of follow-up. The goodness of fit was tested by Hosmer-Lemeshow test. For all statistical analyses, a two-sided p<0.05 was set as the criterion for statistical significance.

RESULTS

Characteristics of Included Abstracts

Figure 1 demonstrates the literature flow of this study. A total of 77 RCT abstracts with statistically nonsignificant results for the primary outcomes were included in this study (Table 2). Table 3 describes the characteristics of included abstracts. Amongst the 77 RCTs, 33 were from South America, followed by Europe (n=18), Asia

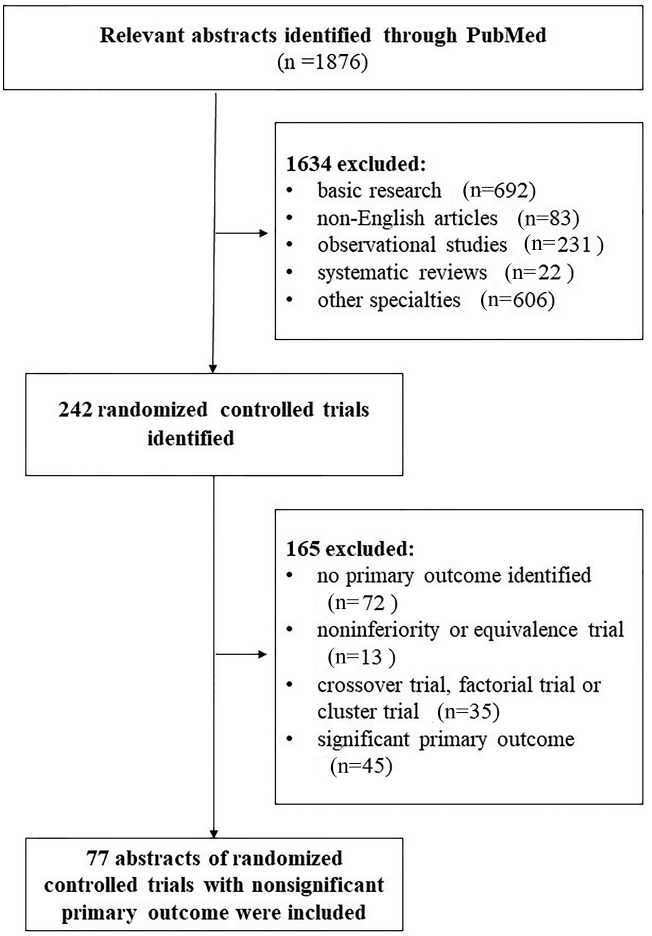

Figure 1. *Flowchart of the included abstracts.*

(n=17), and others (n=9). Most RCTs were indexed in SCIE (79.2%), conducted in a single center (89.6%), focused on dental materials (adhesives, composite resin, amalgam, and others) (63.6%) and without international collaboration (62.3%). Approximately, a third of the RCTs focused on procedures, such as placement techniques, adhesive application modes, different subgingival restorative margin designs, and others. More than half of the RCTs were two-armed trials (50.6%), with the number of authors being four to seven (72.7%). The source of funding was industry in 14 (18.2%) RCTs, other sources in 38 (49.4%), and unreported/unfunded in 25 (32.5%). Only 18 studies reported the involvement of statisticians. The number of RCTs were mainly published in *Journal of Dentistry* (23.4%), *Clinical Oral Investigations* (22.1%), and *Operative Dentistry* (13.0%). More than half of the trials (68.8%) were at 1-3 year length of follow-up, 16 were at less than 1-year follow-up, and only 8 were followed for more than 3 years.

Spin Assessment

Spin was identified in 58 (75.3%) of the 77 included abstracts. Nineteen RCTs (24.7%) presented spin in both the *Results* and *Conclusions* section of abstracts, and more than one type of spin strategy was found in 25 (32.5%) abstracts. Frequencies of each spin strategy are presented in Table 4.

Spin was observed in the *Results* section of 32 (41.6%) abstracts. The most frequent spin strategies in the *Results* section were focusing on significant within-group comparisons for primary outcomes (17, 22.1%) and focusing on a statistically significant primary outcome when there are several co-primary outcomes (10, 13.0%).

The *Conclusions* section of 45 (58.4%) abstracts presented with spin. Claiming equivalence/noninferior/comparable/similar for statistically nonsignificant results was the most common spin strategy in the *Conclusions* section (16, 20.8%), followed by focusing on a statistically significant primary outcome when there are several co-primary outcomes (13, 16.9%) and focusing on only statistically significant results (ie, secondary endpoints, subgroup analysis, and within-group analysis) (11, 14.3%). Other spin strategies identified included claiming benefit with no recognition of the statistically nonsignificant results for the primary outcome (5, 6.5%), acknowledge statistically nonsignificant results for the primary outcome but emphasize the beneficial effect of treatment (4, 5.2%), and recommendation to use the treatment (4, 5.2%).

Predictors of Spin

In the multivariable logistic analyses, RCTs with unreported/unfunded source of funding were significantly more likely to present spin in the *Results* section of abstracts (OR=8.10, 95% CI: 1.31-50.16; p=0.025), and RCTs with more than two treatment arms were significantly more likely to present spin in the *Conclusions* section of abstracts (OR=5.66, 95% CI: 1.71-18.80; p=0.005). Other factors, namely SCIE indexing, international collaboration, number of centers, the topic of each study (materials and procedures), trial registration, number of authors, statistician involvement, continent of origin, and length of follow-up were not significantly associated with the presence of spin (p>0.05) (Table 5).

DISCUSSION

This is the first study to evaluate spin and analyze factors associated with the presence of spin in the field of operative dentistry. We concentrated our analysis on the abstracts of RCTs (with statistically nonsignificant

Table 2: *A List of Included RCTs in the Study*

Serial Number	Title of Article	Journal	Digital Object Identifier (DOI)
1	Bonding performance of simplified adhesive systems in noncarious cervical lesions at 2-year follow-up: A double-blind randomized clinical trial	*Operative Dentistry*	10.2341/18-049-c
2	Clinical, double blind, randomized controlled trial of experimental adhesive protocols in caries-affected dentin	*Clinical Oral Investigations*	10.1007/s00784-018-2615-7
3	An 18-month clinical evaluation of three different universal adhesives used with a universal flowable composite resin in the restoration of noncarious cervical lesions	*Clinical Oral Investigations*	10.1007/s00784-018-2571-2
4	Twenty-four-month clinical performance of different universal adhesives in etch-and-rinse, selective etching and self-etch application modes in NCCL - a randomized controlled clinical trial	*Journal of Applied Oral Science*	10.1590/1678-7757-2018-0358
5	Microcavitated (ICDAS 3) carious lesion arrest with resin or glass ionomer sealants in first permanent molars: A randomized controlled trial	*Journal of Dentistry*	10.1016/j.jdent.2019.07.001
6	Randomized clinical trial of class II restoration in permanent teeth comparing ART with composite resin after 12 months	*Clinical Oral Investigations*	10.1007/s00784-018-2787-1
7	18-month clinical evaluation of a copper-containing universal adhesive in noncarious cervical lesions: A double-blind, randomized controlled trial	*Journal of Dentistry*	10.1016/j.jdent.2019.103219
8	Randomized 36-month follow-up of posterior bulk-filled resin composite restorations	*Journal of Dentistry*	10.1016/j.jdent.2019.05.018
9	Fluoride-releasing effect of a modified resin denture containing S-PRG fillers on salivary fluoride retention: A randomized clinical study	*Caries Research*	10.1159/000490627
10	Retention of moisture-tolerant fluoride-releasing sealant and amorphous calcium phosphate-containing sealant in 6-9-year-old children: A randomized controlled trial	*Journal of Indian Society of Pedodontics and Preventive Dentistry*	10.4103/jisppd.jisppd_173_18
11	Evaluation of the efficacy of calcium silicate vs. glass ionomer cement indirect pulp capping and restoration assessment criteria: a randomised controlled clinical trial-2-year results	*Clinical Oral Investigations*	10.1007/s00784-018-2638-0
12	Esthetic improvements of postorthodontic white-spot lesions treated with resin infiltration and microabrasion: A split-mouth, randomized clinical trial	*Angle Orthodontist*	10.2319/041218-274.1

Table 2: *A List of Included RCTs in the Study (cont.)*

Serial Number	Title of Article	Journal	Digital Object Identifier (DOI)
13	Clinical evaluation of a low-shrinkage resin composite in endodontically treated premolars: 3-year follow-up	*Clinical Oral Investigations*	10.1007/s00784-018-2677-6
14	Atraumatic restorative treatment-ART in early childhood caries in babies: 4 years of randomized clinical trial	*Clinical Oral Investigations*	10.1007/s00784-019-02800-8
15	Effects of orthodontic treatment and different fluoride regimens on numbers of cariogenic bacteria and caries risk: A randomized controlled trial	*European Journal of Orthodontics*	10.1093/ejo/cjy025
16	A randomized controlled clinical trial of glass carbomer restorations in Class II cavities in primary molars: 12-month results	*Quintessence International*	10.3290/j.qi.a42573
17	A clinical and radiographic investigation comparing the efficacy of cast metal and indirect resin onlays in rehabilitation of permanent first molars affected with severe molar incisor hypomineralisation (MIH): A 36-month randomised controlled clinical trial	*European Archives of Paediatric Dentistry*	10.1007/s40368-019-00430-y
18	Comparative evaluation of resin infiltration and remineralisation of noncavitated smooth surface caries lesions: 6-month results	*Oral health & Preventive Dentistry*	10.3290/j.ohpd.a42203
19	An RCT of atraumatic restorative treatment for older adults: 5 year results	*Journal of Dentistry*	10.1016/j.jdent.2019.03.003
20	One-year clinical evaluation of bulk-fill flowable vs. regular nanofilled composite in noncarious cervical lesions	*Clinical Oral Investigations*	10.1007/s00784-018-2509-8
21	Retention and remineralization effect of moisture tolerant resin-based sealant and glass ionomer sealant on noncavitated pit and fissure caries: Randomized controlled clinical trial	*Journal of Dentistry*	10.1016/j.jdent.2019.05.027
22	Clinical follow-up of a fissure sealant placed using different adhesive protocols: A 24-month split-mouth study	*Operative Dentistry*	10.2341/17-055-c
23	Alternative caries management options for primary molars: 2.5-year outcomes of a randomised clinical trial	*Caries Research*	10.1159/000477855
24	Eighteen-month clinical study of universal adhesives in noncarious cervical lesions	*Operative Dentistry*	10.2341/16-320-c
25	MI Varnish and MI Paste Plus in a caries prevention and remineralization study: A randomized controlled trial	*Clinical Oral Investigations*	10.1007/s00784-017-2314-9
26	Influence of surface treatment on the performance of silorane-based composite resin in class I restorations: A randomized clinical trial	*Clinical Oral Investigations*	10.1007/s00784-018-2390-5

Table 2: *A List of Included RCTs in the Study (cont.)*

Serial Number	Title of Article	Journal	Digital Object Identifier (DOI)
27	Effect of dentin roughness on the adhesive performance in noncarious cervical lesions: A double-blind randomized clinical trial	*Journal of Dentistry*	10.1016/j.jdent.2017.09.011
28	Use of casein amorphous calcium phosphate (CPP-ACP) on white-spot lesions: Randomised clinical trial	*Oral health & preventive dentistry*	10.3290/j.ohpd.a39749
29	Selective vs stepwise removal of deep carious lesions in primary molars: 12-months results of a randomized controlled pilot trial	*Journal of Dentistry*	10.1016/j.jdent.2018.07.011
30	Caries arrest by topical fluorides in preschool children: 30-month results	*Journal of Dentistry*	10.1016/j.jdent.2017.12.013
31	Comparison of resin modified glass ionomer cement and composite resin in class II primary molar restorations: A 2-year parallel randomised clinical trial	*European Archives of Paediatric Dentistry*	10.1007/s40368-018-0371-7
32	Efficacy of sealing occlusal caries with a flowable composite in primary molars: A 2-year randomized controlled clinical trial	*Journal of Dentistry*	1016/j.jdent.2018.05.014
33	Microbial load after selective and complete caries removal in permanent molars: A randomized clinical trial	*Brazilian Dental Journal*	10.1590/0103-6440201801816
34	Proximal carious lesions infiltration-a 3-year follow-up study of a randomized controlled clinical trial	*Clinical Oral Investigations*	10.1007/s00784-017-2135-x
35	A randomized controlled trial of caries prevention in dental practice	*Journal of Dental Research*	10.1177/0022034517702330
36	Low-cost GICs reduce survival rate in occlusal ART restorations in primary molars after one year: A RCT	*Journal of Dentistry*	10.1016/j.jdent.2016.12.006
37	Impact of the intermediary layer on sealant retention: A randomized 24-month clinical trial	*Clinical Oral Investigations*	10.1007/s00784-016-1890-4
38	Effectiveness of pretreatment with chlorhexidine in restoration retention: A 36-month follow-up randomized clinical trial	*Journal of Dentistry*	10.1016/j.jdent.2017.02.014
39	Eighteen-month clinical performance of composite resin restorations with two different adhesive systems for molars affected by molar incisor hypomineralization	*Clinical Oral Investigations*	10.1007/s00784-016-1968-z
40	Effectiveness of pit and fissure sealants bonded with different adhesive systems: A prospective randomized controlled trial	*Clinical Oral Investigations*	10.1007/s00784-016-2016-8
41	Influence of adhesive type and placement technique on postoperative sensitivity in posterior composite restorations	*Operative Dentistry*	10.2341/16-010-c

Table 2: *A List of Included RCTs in the Study (cont.)*

Serial Number	Title of Article	Journal	Digital Object Identifier (DOI)
42	No additional benefit of using a calcium hydroxide liner during stepwise caries removal: A randomized clinical trial	*Journal of the American Dental Association*	10.1016/j.adaj.2017.02.019
43	Sealing composite with defective margins, good care or over treatment? Results of a 10-year clinical trial	*Operative Dentistry*	10.2341/14-143-c
44	Can repair increase the longevity of composite resins? Results of a 10-year clinical trial	*Journal of Dentistry*	10.1016/j.jdent.2014.05.015
45	Effect of a chlorhexidine/thymol and a fluoride varnish on caries development in erupting permanent molars: A comparative study	*European Archives of Paediatric Dentistry*	10.1007/s40368-015-0192-x
46	Dentin hypersensitivity treatment of noncarious cervical lesions - a single-blind, split-mouth study	*Brazilian Oral Research*	10.1590/1807-3107BOR-2015.vol29.0045
47	Four-year randomized clinical trial to evaluate the clinical performance of a glass ionomer restorative system	*Operative Dentistry*	10.2341/13-239-c
48	A three-year clinical evaluation of a one-step self-etch and a two-step etch-and-rinse adhesive in noncarious cervical lesions	*Journal of Dentistry*	10.1016/j.jdent.2014.12.009
49	Clinical and radiographic assessment of the efficacy of calcium silicate indirect pulp capping: A randomized controlled clinical trial	*Journal of Dental Research*	10.1177/0022034515571415
50	A prospective randomized clinical trial into the capacity of a toothpaste containing NovaMin to prevent white spot lesions and gingivitis during orthodontic treatment	*Progress in Orthodontics*	10.1186/s40510-015-0095-8
51	Two-year randomized, controlled clinical trial of a flowable and conventional composite in Class I restorations	*Operative Dentistry*	10.2341/15-038-c
52	A new universal simplified adhesive: 36-month randomized double-blind clinical trial	*Journal of Dentistry*	10.1016/j.jdent.2015.07.005
53	Influence of isolation method of the operative field on gingival damage, patients' preference, and restoration retention in noncarious cervical lesions	*Operative Dentistry*	10.2341/14-089-c
54	Efficacy of fluoride varnish and casein phosphopeptide-amorphous calcium phosphate for remineralization of primary teeth: a randomized clinical trial	*Medical Principles and Practice*	10.1159/000379750
55	Effect of pretreatment with chlorhexidine on the retention of restorations: A randomized controlled trial	*Brazilian Dental Journal*	10.1590/0103-6440201300009

Table 2: *A List of Included RCTs in the Study (cont.)*

Serial Number	Title of Article	Journal	Digital Object Identifier (DOI)
56	Five-year evaluation of a low-shrinkage Silorane resin composite material: A randomized clinical trial	*Clinical Oral Investigations*	10.1007/s00784-014-1238-x
57	Randomized *in vivo* evaluation of photodynamic antimicrobial chemotherapy on deciduous carious dentin	*Journal of Biomedical Optics*	10.1117/1.jbo.20.10.108003
58	Six-year clinical performance of etch-and-rinse and self-etch adhesives	*Dental Materials*	10.1016/j.dental.2016.06.003
59	Milk sweetened with Xylitol: A proof-of-principle caries prevention randomized clinical trial	*Journal of Dentistry for Children*	—
60	Long-term effect of Erythritol on dental caries development during childhood: A posttreatment survival analysis	*Caries Research*	10.1159/000450762
61	Anticaries effect of low-fluoride dentifrices with phosphates in children: A randomized, controlled trial	*Journal of Dentistry*	10.1016/j.jdent.2016.04.013
62	Efficacy of a new sealant to prevent white spot lesions during fixed orthodontic treatment: A 12-month, single-center, randomized controlled clinical trial	*Journal of Orofacial Orthopedics*	10.1007/s00056-016-0052-2
63	Nutrient supplementation may adversely affect maternal oral health--a randomised controlled trial in rural Malawi	*Maternal and Child Nutrition*	10.1111/mcn.12204
64	Bilayer technique and nano-filled coating increase success of approximal ART restorations: A randomized clinical trial	*International Journal of Paediatric Dentistry*	10.1111/ipd.12194
65	Randomized clinical trial on arresting dental root caries through silver diammine fluoride applications in community-dwelling elders	*Journal of Dentistry*	10.1016/j.jdent.2016.05.005
66	Comparison of oral health education and fluoride varnish to prevent early childhood caries: A randomized clinical trial	*Caries Research*	10.1159/000446877
67	Quantitative Light-induced Fluorescence-digital as an oral hygiene evaluation tool to assess plaque accumulation and enamel demineralization in orthodontics	*Angle Orthodontist*	10.2319/092415-648.1
68	Periodontal response to two different subgingival restorative margin designs: A 12-month randomized clinical trial	*Clinical Oral Investigations*	10.1007/s00784-015-1616-z
69	Two-year randomized clinical trial of self-etching adhesives and selective enamel etching	*Operative Dentistry*	10.2341/15-130-c
70	Effects of various remineralizing agents on the outcome of postorthodontic white spot lesions (WSLs): A clinical trial	*Progress in Orthodontics*	10.1186/s40510-016-0138-9

Table 2: *A List of Included RCTs in the Study (cont.)*

Serial Number	Title of Article	Journal	Digital Object Identifier (DOI)
71	Anti-microbial efficacy of green tea and chlorhexidine mouth rinses against streptococcus mutans, lactobacilli spp. and candida albicans in children with severe early childhood caries: A randomized clinical study	*Journal of Indian Society of Pedodontics and Preventive Dentistry*	10.4103/0970-4388.175518
72	A randomised controlled trial to measure the effects and costs of a dental caries prevention regime for young children attending primary care dental services: The Northern Ireland Caries Prevention In Practice (NIC-PIP) trial	*Health Technology Assessment*	10.3310/hta20710
73	Controlled, prospective, randomized, clinical split-mouth evaluation of partial ceramic crowns luted with a new, universal adhesive system/resin cement: Results after 18 months	*Clinical Oral Investigations*	10.1007/s00784-016-1779-2
74	Efficacy of 30% silver diamine fluoride compared to atraumatic restorative treatment on dentine caries arrestment in primary molars of preschool children: A 12-months parallel randomized controlled clinical trial	*Journal of Dentistry*	10.1016/j.jdent.2019.07.003
75	Randomized clinical trial on the survival of lithium disilicate posterior partial restorations bonded using immediate or delayed dentin sealing after 3 years of function	*Journal of Dentistry*	10.1016/j.jdent.2019.02.001
76	Effect of refurbishing amalgam and resin composite restorations after 12 years: Controlled clinical trial	*Operative Dentistry*	10.2341/16-267-cr
77	Clinical evaluation of the efficacy of one self-adhesive composite in dental hypersensitivity	*Clinical Oral Investigations*	10.1007/s00784-014-1390-3

primary outcomes) published from 2015 to 2019. Spin was identified in 75.3% abstracts in one form or another, which exceeded the occurrence of spin in most of the studies (30.7%-70%)[11,12,16] but was less than that identified in endodontic RCTs (85.0%).[7] Some explanations for the difference among studies may be RCTs from different specialties, diverse instruments for evaluation of spin (the Boutron instrument or its variations), and some bias in assessment among investigators. The spin strategies manifest in various ways. The most common strategy in the *Results* section was focusing on significant within-group comparisons for primary outcomes rather than between-group comparisons. While claiming equivalence for statistically nonsignificant results was the most frequent spin strategy in the *Conclusions* section. Spin was more prevalent in the *Conclusions* section (58.4%) than *the Results* section (41.6%). Previous studies also reported that the *Conclusion* sections of abstracts were more susceptible to spin than the other sections.[7,10]

Previous studies have assessed whether particular factors were associated with the presence of spin, including financial support, journal impact factor, intervention type, trial phase, trial type, statistician involvement, number of authors, sample size, international collaboration, number of centers, the number of treatment arms, reporting of trial registration, article citations, and the conflict-of-interest disclosures.[10,12,14-17] Amongst these, most of the studies consistently found no factors to be significantly associated with spin,[10,12,14-16] but only one study[17] concluded that multicenter RCTs were less likely to present spin in abstracts. In this study, the presence of spin in the *Results* section of abstracts was significantly associated with source of funding, which was inconsistent with the previous studies.[10,16] Nonindustry-

Table 3: *Characteristics of Included RCT Abstracts (N=77)*

Characteristics	Number of Abstracts n (%)
Topic	
Materials	49 (63.6)
Procedures	28 (36.4)
International collaboration	
Yes	29 (37.7)
No	48 (62.3)
Continent of origin	
Europe	18 (23.4)
Asia	17 (22.1)
South America	33 (42.9)
Others	9 (11.7)
SCIE indexing	
Indexed in SCIE	61 (79.2)
Not indexed in SCIE	16 (20.8)
Funding source	
Industry	14 (18.2)
Other sources	38 (49.4)
Unfunded/Unreported	25 (32.5)
Centers	
Single center	69 (89.6)
Multicenters	8 (10.4)
Number of treatment arms	
Two arms	39 (50.6)
≥Three arms	38 (49.4)
Number of authors	
<4	7 (9.1)
4-7	56 (72.7)
>7	14 (18.2)
Statistician	
Yes	18 (23.4)
No	59 (76.6)
Trial registration	
Yes	50 (64.9)
No	27 (35.1)
Length of follow-up	
<1 year	16 (20.8)
1-3 years	53 (68.8)
>3 years	8 (10.4)
Journal	
Journal of Dentistry	18 (23.4)
Clinical Oral Investigations	17 (22.1)
Operative Dentistry	10 (13.0)
Caries Research	4 (5.2)
Others	28 (36.4)
Total	77(100.0)

sponsored RCTs may lack specialized teams with the involvement of methodological experts and statistician, or they may be exploratory research with small sample sizes due to limited financial support. Therefore, more statistically nonsignificant results may be found, and spin was more likely to occur. It should also be noted that the difference among studies may be explained by different subjects or sampling, and further study should be conducted to draw conclusions. Furthermore, number of treatment arms was associated with the presence of spin in the *Conclusions* section of abstracts. RCTs with more than two arms were more likely to focus only on significant between-group results, which was consistent with the findings that focusing on a statistically significant primary outcome when there are several co-primary outcomes (13, 16.9%) was a common spin strategy in the *Conclusions* section.

Spin in abstracts is particularly crucial, because readers often focus on this concise summary to determine whether the literature is worthy of full-text review. Distorted results can affect researchers'/clinicians' interpretation of the experimental treatment. Boutron and others[22] conducted an RCT to evaluate the impact of spin in abstracts of cancer RCTs on clinicians' interpretation of treatment benefit. When abstracts present with spin, readers considered the treatment as more beneficial to patients (mean difference, 0.71; 95% CI, 0.07-1.35; p=0.030), and clinicians were more interested in reading the full text (mean difference, 0.77; 95% CI, 0.08-1.47; p=0.029). Furthermore, RCTs with spin in abstracts were more likely to be cited compared with those without spin.[17] Spin may not only mislead readers by distorting results but also exert adverse influence on further research.[23] This study might raise awareness among the readers of operative dentistry about spin in published reports.

Manuscripts with statistically significant results are more likely to be published.[24] This common phenomenon may prompt some researchers intentionally or subconsciously to spin results and conclusions in order to attract peer reviewer attention.[8] Reporting guidelines like CONSORT 2010 were developed to help authors improve the reporting quality of manuscripts.[4,20,21] However, guidelines on avoiding spin are not available. Thus, present guidelines need to be expanded to minimize the occurrence of spin. Peer reviewers and editors should be aware of spin in abstract reporting and provided with specific instruments to help identify it in manuscripts. Manuscript authors are supposed to report and interpret results objectively, and so guidelines for authors should also reflect this.

This study has several strengths and limitations. First, 5 years of published RCTs in the field of operative

Table 4: *Frequencies of Spin Strategies in the Results and Conclusions Section (N=77)*

Spin in the Results Section	**N (%)**
Focusing on significant within-group comparisons for primary outcomes	17 (22.1%)
Focusing on significant within- and/or between-group secondary outcomes	9 (11.7%)
Focusing on a statistically significant primary outcome when there are several co-primary outcomes	10 (13.0%)
Verbiage implying numerical significance or "trend towards significance"	2 (2.6%)
Spin in the conclusions section	**N (%)**
Claiming equivalence/noninferior/comparable/similar for statistically nonsignificant results	16 (20.8%)
Claiming benefit with no recognition of the statistically nonsignificant results for the primary outcome	5 (6.5%)
Focusing on only statistically significant results (i.e., secondary endpoints, subgroup analysis, within-group analysis)	11 (14.3%)
Acknowledge statistically nonsignificant results for the primary outcome but emphasize the beneficial effect of treatment	4 (5.2%)
Focusing on a statistically significant primary outcome when there are several co-primary outcomes	13 (16.9%)
Recommendation to use the treatment	4 (5.2%)

Table 5: *Binary Logistic Regression-derived OR and 95% CI, with Presence of Spin in the Results and the Conclusions Sections as the Dependent Variables for the Included 77 Abstracts*

Predictor	**Presence of Spin**			
	In the Results Section[a]		**In the Conclusions Section[b]**	
	OR (95% CI)	***p*-value[c]**	**OR (95% CI)**	***p*-value[c]**
SCIE-indexed journal				
No	Reference		Reference	
Yes	1.99 (0.38, 10.36)	0.414	0.31 (0.05, 1.81)	0.192
Centers				
Single center	Reference		Reference	
Multicenter	1.29 (0.20, 8.21)	0.791	1.11 (0.18, 6.90)	0.914
Number of treatment arms				
Two arms	Reference		Reference	
≥Three arms	1.15 (0.36, 3.71)	0.816	5.66 (1.71, 18.80)	**0.005**
International collaboration				
No	Reference		Reference	
Yes	2.14 (0.57, 8.04)	0.258	0.64 (0.19, 2.22)	0.484
Number of authors	1 author		1 author	
	0.92 (0.67, 1.28)	0.631	1.14 (0.84, 1.54)	0.411
Continent of origin				
Europe	Reference		Reference	
Asia	1.24 (0.17, 9.19)	0.832	2.87 (0.40, 20.76)	0.296
South America	1.79 (0.33, 9.76)	0.499	1.60 (0.38, 6.75)	0.522
Others	2.07 (0.31, 13.81)	0.454	2.01 (0.29, 14.21)	0.483
Statistician				
No	Reference		Reference	
Yes	2.82 (0.68, 11.80)	0.155	1.11 (0.28, 4.37)	0.880

Table 5: *Binary Logistic Regression-derived OR and 95% CI, with Presence of Spin in the Results and the Conclusions Sections as the Dependent Variables for the Included 77 Abstracts (cont.)*

Predictor	Presence of Spin			
	In the Results Section[a]		In the Conclusions Section[b]	
	OR (95% CI)	*p*-value[c]	OR (95% CI)	*p*-value[c]
Topic				
Procedures	Reference		Reference	
Materials	4.76 (0.89, 25.50)	0.068	0.45 (0.11, 1.83)	0.264
Trial registration				
No	Reference		Reference	
Yes	0.99 (0.29, 3.40)	0.984	1.17 (0.34, 4.06)	0.801
Funding source				
Industry	Reference		Reference	
Other sources	1.20 (0.26, 5.63)	0.814	1.47 (0.36, 6.01)	0.594
Unfunded/Unreported	8.10 (1.31, 50.16)	**0.025**	0.78 (0.13, 4.55)	0.781
Length of follow-up				
<1 year	Reference		Reference	
1-3 years	0.26 (0.04, 1.52)	0.135	3.36 (0.57, 19.85)	0.182
>3 years	0.20 (0.20, 1.96)	0.166	7.40 (0.62, 88.67)	0.114

[a] *Model summary: dependent variable coding: [0] no spin in the Results section, [1] with spin in the Results section;* p *(Hosmer and Lemeshow) = 0.676;* R^2 *(Nagelkerke) = 0.353.*

[b] *Model summary: Dependent variable coding: [0] no spin in the Conclusions section, [1] with spin in the Conclusions section;* p *(Hosmer and Lemeshow) = 0.733;* R^2 *(Nagelkerke) = 0.258.*

[c] *Statistically significant* p*-values (<0.05) are provided in bold.*

dentistry were evaluated to provide a comprehensive view of the issues related to the spin in this field. Second, as far as we know, this is the first study to investigate potential factors associated with presence of spin in the *Results* and *Conclusions* sections, respectively. One limitation of this study is that spin was not evaluated in the main text of included RCTs. A recent study assessed spin in the abstract and the full text of dental RCTs, and found 78.7% of the included RCTs presented some type of spin in the main text.[14] However, the small sample size may not be able to provide highly accurate results. Further study is needed to identify spin in the full texts of dental literature.

CONCLUSIONS

The occurrence rate of spin (75.3%) in the sample of operative dentistry RCTs abstracts is high. Source of funding (OR=8.10; p=0.025) and number of treatment arms (OR=5.66; p=0.005) were associated with the presence of spin in the *Results* and the *Conclusions* sections of abstracts, respectively. Readers and other stakeholders need to be aware of the existence of spin in RCT abstracts, and appraise the results and conclusions of RCT abstracts critically.

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Conflict of Interest

The authors of this article certify that they have no proprietary, financial, or other personal interest of any nature or kind in any product, service, and/or company that is presented in this article.

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