RESEARCH ARTICLES

Evaluation of retracted publications in Dentistry: A systematic review

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Abstract

Background: *The objective of retracting flawed publications is to maintain the integrity of scientific literature. Retractions in the dental literature have been on the rise in recent years. Hence, we aimed to review retracted articles related to dentistry.*

Methods: *A search was conducted of the MEDLINE database for retracted articles in the dental literature published between April 1, 1993 and March 31, 2020. The retracted articles and the notices of retraction were reviewed, and the findings are presented.*

Results: *During the selected period, 143 articles were retracted. Redundant publication (n=50, 35%) was the most common reason for retraction, followed by plagiarism (n=43, 30.1%) and data manipulation (n=46, 32.2%). Around 70.6% (n=101) of retracted articles were original articles. Eight (5.6%) of the articles were single authored. The retracted articles have been cited by about 1300 publications, after the date of publication of the retraction notice. The gap between publication and retraction was longer for funded articles than for non-funded articles, and for articles retracted for data manipulation than for articles retracted for other types of misconduct. Twenty-one journals and nine authors retracted two or more papers. The majority of authors of retracted articles (224, 37%) were from India.*

Conclusion: *Our study showed that the retraction of publications due to misconduct such as duplicate publication, plagiarism, data manipulation is a matter of concern and calls for strict measures to curb the menace of research misconduct.*

Keywords: *dentistry, fraudulent data, plagiarism, duplicate publication, retraction, research misconduct.*

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Introduction

The purpose of publishing one's research is to disseminate its findings, validating, expanding or correcting the existing knowledge base. However, in a "publish or perish" environment, academicians are under pressure to publish articles regardless of their scientific credibility [1]. This has resulted in a rise in scientific misconduct in research. Fraudulent publication is a serious threat to the scientific world, with far reaching consequences. The publication of falsehoods as scientific evidence is a waste of resources, causes harm to the patients, damages the reputation of authors and institutions, and erodes trust in research [2].

Research misconduct is defined as fabrication, falsification, or plagiarism, in proposing, performing, or reviewing research, or in reporting research results. Fabrication is making up data and results; falsification is the manipulation of research materials or processes, or changing or deleting data or results such that the research is not accurately represented in the research record. Plagiarism is copying another person's ideas, text or images without giving them appropriate credit [3].

Fraud, when identified in a journal article, can be dealt with by retraction; whereas an error, depending on its magnitude, can either lead to correction of the article or retraction [4]. The grounds for retraction are: evidence of major unintentional editorial/experimental error, or of intentional research misconduct such as redundant publication, plagiarism, fabrication, falsification, copyright violation, unethical research, and/or undisclosed competing interest [4]. Timely retraction of such publications will alert readers of the error or misconduct. The contents of retracted publications are considered to be stricken from the body of scientific work, and the flawed/unreliable information is not to be cited in any publication that follows the retraction notice.

The rise in retraction of publications is observed in every field including dentistry. It is necessary to evaluate the characteristics of retracted publications to understand the causes, raise awareness among readers, and formulate editorial strategies to tackle the problem. Several surveys have evaluated retracted publications in different specialities and the reasons for their retraction [5-7]. A literature search revealed a few publications on retractions in dental literature [8-11]. All these studies were mainly focussed on reasons for retraction and time of retraction

after publication. The primary objective of our research was to evaluate the types of scientific misconduct or errors among the retracted publications in dentistry. The secondary objective was to check any association between funding and scientific misconduct or errors among the retracted publications.

Methods

A search of the MEDLINE/PubMed database was conducted using the search term "dental" with application of filters "retracted publications" and "retraction of publications". The following MeSH terms were used for search: dentistry, fraudulent data, plagiarism, duplicate publication, retraction of publication, and research misconduct. Retraction notices of publications were searched between April 1, 1993, and March 31, 2020.

Both authors independently performed data extraction to minimise the errors. The extracted data variables were relevant to author demographics (eg country of origin of authors, institutions to which the authors belonged, date of publication), study characteristics such as type of study, journal and retraction features (eg reason for retraction, journal name, 5-year journal impact factor (IF), article and retraction notice availability, date of retraction notice, and the number of article citations in Google Scholar). The country of origin of the first author of the retracted article was identified. All unrelated articles such as non-dental publications and non-retracted articles were excluded. The full texts of all the selected articles' retraction notices were downloaded and screened independently by both the authors. Any disagreements between the authors on the reason for retraction were resolved through discussion and consensus. The reason for retraction was identified from the retraction notice in PubMed and on the publisher's website. The reasons for retraction were categorised as: redundant/duplicate publication, plagiarism, data manipulation, authorship disputes, ethical violations, undisclosed conflict of interest, breach of copyright, and cases in which the reasons were not given. The categories were further sub-categorised as follows:

Plagiarism: unspecified or text plagiarism, image plagiarism, and text, image, data plagiarism;

Data manipulation: data fabrication, data falsification, and image manipulation;

Authorship disputes: author not listed, author listed without consent, and other disputes.

Publications with multiple reasons for retraction were considered in multiple categories. The total citations and post-retraction citations of every publication were assessed through Google Scholar.

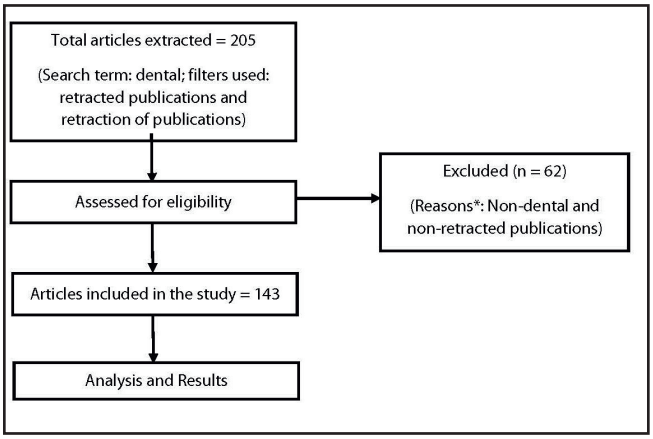
The following data were extracted from each retracted publication: i) type of article (original, review, case report/ series and others); ii) number of authors; iii) country of affiliation of authors; iv) journal name, year and month of publication; v) year and month of retraction in order to assess the time lag; vi) funding information; and vii) Journal Impact Factor determined using the ISI Web of Knowledge (Thomson Reuters) Journal Citations Reports (JCR). We also identified journals which retracted multiple publications, and authors with multiple retractions.

Statistical analysis was performed using SPSS Version 16 (SPSS, Chicago, IL, USA). Descriptive statistics were employed to estimate the frequencies, percentages, interquartile range (IQR), median and mean (standard deviation). The association of funding status of articles with various scientific grounds for retraction was tested using chi-square test. Level of significance was kept at 5%.

Results

A total of 205 articles were retrieved from the MEDLINE database using the search criteria mentioned in the Methods section. Along with the retracted dental articles, the search fetched some non-dental and non-retracted articles. Hence, of the 205 articles, 143 were finally included in the study after excluding non-dental and non-retracted articles [Figure 1].

Figure 1: Flowchart of the search process



**Note: Along with the retracted dental articles, the search on PubMed fetched some non-dental and non-retracted articles, which were excluded.*

Of the 143 retraction notices, 15 (10.5%) notices did not report any specific reasons for retraction. The most common reasons for retraction were: redundant publication (n = 50, 35%), plagiarism (n = 43, 30.1%), and data manipulation (n = 46, 32.2%). Among the 43 plagiarised publications, 13 retraction notices attributed the retraction to plagiarism related to images. Data manipulation was observed in 46 articles, which included data fabrication (18.9%), data falsification (5.6%), and image manipulation (5.6%). Authorship issues and unethical research practices were given as the reason for retraction in 6.3% and 2.1% of the publications, respectively. Conflict of interest was the reason behind the retraction of two articles, and breach of copyright was the reason for retraction of two articles [Table1].

Most of the retracted articles (70.6%) were original articles.

Table 1: Prevalence of different grounds for retraction

Variable	N	%
Redundant publication	**50**	**35.0**
Plagiarism		
Plagiarism (text plagiarism or unspecified)	30	21.0
Image plagiarism	10	7.0
Text, image, data plagiarism	3	2.1
Data manipulation/error		
Data fabrication	27	18.9
Data falsification	8	5.6
Image manipulation	8	5.6
Error in experiment or miscalculation	3	2.1
Authorship disputes		
All authors are not listed	4	2.8
Author are listed without their consent	3	2.1
Not specified	2	1.4
Ethical violations		
Ethics clearance not obtained	1	0.7
Patient consent withdrawn after publication	1	0.7
Informed consent not obtained	1	0.7
Breach of copyright	2	1.4
Conflict of interest	2	1.4
Reasons not known	15	10.5
No free access to retraction notice	5	3.5

Note: The percentages add up to more than 100% because some retraction notices mentioned more than one type of misconduct.

Table 2: Characteristics of retracted publications

Variable	N (%)
Article Type	
Original Article	101 (70.6)
Review Article	15 (10.5)
Case Report/Case series	27 (18.9)
Funding	
No	87 (60.8)
Yes	39 (27.3)
Could not find	17 (11.9)
Authors country in each publication	
Single country	115 (80.5)
Multi-country	25 (17.5)
Could not find	3 (2.1)
Institutional affiliation of authors	
Authors from single institution	70 (49)
Authors from multiple institutions	70 (49)
Could not find	3 (2.1)
Number of authors per publication	
Single author	8 (5.6)
Multiple author	135 (94.4)
	Median (IQR)
Time between publication and retraction (months)	**17 (6 to 41)**
Total citations	9 (3 to 27)
Post-retraction citations	5 (2 to 12)

Of 143 retracted publications, 39 (27.3%) had received funding. The median duration for retraction (ie time lag between the publication of an article and its retraction) was 17 (IQR: 6 to 41) months and the median number of citations received by the retracted publications was 9 (IQR: 3 to 27) [Table 2].

The largest proportion of funded articles were retracted due to data manipulation (38.4%) while non-funded articles were retracted mainly because of redundant publication (39%). The time between publication and retraction of funded publications (23 months) was more than it was for non-funded publications (16 months) ($p = 0.050$). The prevalence of plagiarism was higher in non-funded publications (36.7%) than in funded publications (15%) and the difference was significant ($p = 0.014$) [Table 3]. The time interval between publication and retraction was longest for publications retracted due to data manipulation. These publications also received the largest number of citations. Publications with authorship conflicts were retracted sooner (8 months) than those retracted due to other scientific misconduct [Table 3].

Twenty-one journals retracted multiple publications. Six journals retracted multiple publications by the same author. Nine authors were associated with multiple retracted publications, of which one author had 10 retractions [Table 4].

Of the 21 journals with multiple retractions, one journal had IF> 2, seven journals had IF ≥ 2, and 13 journals had no

Table 3: Details of scientific grounds for retraction among funded and non-funded publications, time between publication and retraction, and total post-retraction citations of publications

Scientific grounds		Funding received#			Time between publication and retraction (months)		Total citations	
		Yes (N=39)	No (N=87)	p value	Mean (SD)	Median	Mean (SD)	Median
Plagiarism	Yes	6 (15.4%)	32 (36.8%)	0.014*	30.31 (32.1)	18	19.3 (29)	8
	No	33 (84.6%)	55 (63.2%)					
Redundant publication	Yes	12 (30.7%)	34 (39.1%)	0.330	21.77 (25.5)	15	15.9 (16)	8
	No	27 (69.3%)	53 (40.9%)					
Data manipulation	Yes	15 (38.5%)	26 (29.8%)	0.016*	52.2 (45.8)	31	23.3 (23)	13
	No	24 (61.5%)	61 (70.1%)					
Authorship disputes	Yes	2 (5.1%)	4 (4.5%)	0.335	10 (7)	8	2.67 (2.69)	2
	No	37 (94.9%)	83 (95.6%)					
Time between publication and retraction in funded and non-funded articles (median)		23 months	16 months	0.050*	-	-	-	-

Note: Statistical tests used for finding the values are Fisher's exact test and Mann-Whitney U test; SD = standard deviation;

**indicates significant difference at p ≤ 0.05;*

 # There were 17 publications for which funding details could not be found and hence, they were not included in the comparison.

Table 4: Details of journal impact factor and multiple retractions

Variable	Category	Number	Range
Journal impact factor	**No impact factor**	30	–
	<2	20	–
	≥2	31	–
Journals with multiple retractions		21	2 – 9
Journals with multiple retractions from the same author		06	2 – 9
Authors with multiple retractions		09	2 – 10
Journal with multiple retractions according to impact factors	**No impact factor**	13	2 – 6
	<2	1	–
	≥2	7	2 – 9

impact factor [Table 4].

The majority of authors of the retracted publications were from India (37%), followed by Japan (9%), Spain (8.2%), China (7%) and the US (6.6%) [Table 5].

Discussion

In recent years, retraction of scientific articles has been on the rise. It is observed that the rise in retractions is mainly the result of improved detection of flawed publications [12].

In this study, the major reasons for retraction were: redundant publication, plagiarism and data manipulation. Redundant publication was the cause of retraction in about 35% of the articles. Redundant publications may result from the pressure put on researchers/academicians by the current

Table 5: Country-wise distributions of authors of retracted publications (N=604)

Country	World Bank Classification 2020	Number of authors	%
India	Lower-middle income	224	37.1
Japan	High income	54	8.9
Spain	High income	50	8.3
China	Upper-middle income	43	7.1
USA	High income	40	6.6
Brazil	Upper-middle income	36	6.0
Iran	Lower-middle income	25	4.1
Korea	High income	21	3.5
Italy	High income	15	2.5
Pakistan	Lower-middle income	12	2.0
Egypt	Lower-middle income	11	1.8
Taiwan	High income	9	1.5
Greece	High income	8	1.3
Saudi Arabia	High income	7	1.2
UK	High income	7	1.2
Turkey	Upper-middle income	7	1.2
Mexico	Upper-middle income	6	1.0
Qatar	High income	5	0.8
Kenya	Lower-middle income	4	0.7
Nepal	Lower-middle income	3	0.5
Israel	High income	3	0.5
Sri Lanka	Lower-middle income	2	0.3
Canada	High income	2	0.3
Hongkong	High income	2	0.3
Netherlands	High income	2	0.3
Malaysia	Upper-middle income	1	0.2
UAE	High income	1	0.2
Ireland	High income	1	0.2
Serbia	Upper-middle income	1	0.2
Chile	High income	1	0.2
Bahrain	High income	1	0.2

Note: a small percentage of multi-authored articles have authors from more than one country.

system of rewards in the academic world [13]. PhDs and promotions, jobs and funding are awarded on the basis of one's publications [14]. Redundant publication can either be intentional or unintentional error and it may also constitute towards several error/misconducts such as plagiarism, data fabrication, and breach of copyright. Redundant publications may lead to over-estimation in meta-analyses and thus, generate false evidence [15,16].

Plagiarism is another common type of research misconduct and about 30% of the retracted articles in the present study were plagiarised which is almost similar to findings in the previously reported studies [9,10]. Plagiarism includes copying text, images, graphs, and tables without permission/ cross-referencing [17]. There are several software programmes available to detect plagiarism; however, most of them are able to detect only text plagiarism. It becomes challenging to detect image plagiarism. In this study, about 7% retracted articles plagiarised the images.

Lack of English language proficiency of some authors from non-English speaking countries, inadequate skills in scientific writing, the rising open access to published literature, the pressure to publish, and inadequate training of what constitutes plagiarism — are considered major reasons behind the practice of plagiarism [18,19].

Data manipulation, which includes both falsification and fabrication, is considered the most egregious type of research misconduct. Among all, data manipulation is the most difficult type of misconduct to detect. In spite of its being difficult to identify, our study found that nearly 32% publications were retracted because of data manipulation. Similar findings were also observed in retracted publications of other specialities [6, 20, 21].

Our study also revealed that the time taken between publication and retraction was longer (median 31 months) for publications in which data manipulation had taken place as compared to other reasons for retraction (median 18 months). This might be attributed to the fact that data manipulation is more difficult to identify and it takes more time to confirm such kind of misconduct. Publications with data manipulation also received more citations (average 13 citations) compared to publications retracted for other reasons.

It is also observed that data manipulation was more common among funded publications than non-funded publications. Non-funded research was mostly retracted because of plagiarism and redundant publication. One possible explanation is that researchers who receive funding are sufficiently experienced to avoid plagiarism and duplicate publication which are easily detectable but may engage in data manipulation which is more difficult to identify. This hypothesis needs to be investigated further. Similar results were seen in a study conducted by Samuel et al where 25.9% of the retracted articles received funding [9].

Authorship disputes were the reason for retraction of nine (6.3%) publications included in this study. COPE (Committee on Publication Ethics) guidelines do not support the retraction of publications on the ground of an authorship dispute when there is sufficient evidence supporting the validity and reliability of the data in the publication [4]. Editors should resolve these disputes by publishing a correction to the list of authors if there is sufficient evidence that such a change is justified [4].

One of the 143 articles was retracted because the patient had withdrawn consent after the case report was published.

Most retractions resulted from original/research articles (70.6%), followed by case reports/case series (18.9%) and review articles (10.5%). Similar findings have been observed in other studies [11, 22]. The greater proportion of retractions of original articles relating to the high number of publications of this article type or of experimental studies may offer more potential for committing scientific misconduct than any other type of publication.

Previous studies [2, 23] show that around 5% to 7% of the retracted articles were single authored, which is consistent with our study (5.6%).

In the majority of multi-authored retracted articles (80.5%), all authors were from the same country. Similar findings were seen in previously conducted research which reported that around 65% of the retracted articles had single nation authorship [24].

Retraction does not always end the life of a publication. In this study, retracted articles were cited a total of 1300 times following the retraction notice. It is the responsibility of authors to scrutinise each article for its authenticity before citing it in their work, to avoid basing their work on untrustworthy data. It is also the responsibility of the journal editors to inform readers of retracted articles in their journal, through prominent placement of the retraction notice on their website, and clearly identifying retracted articles with a watermark. In the present study, 8 articles did not have any retraction notice on the journal website but had it only in the PubMed database. It is recommended that the editorial offices of the journals scrutinise every reference in the submitted article to avoid citing retracted articles, and reduce errors in future publications.

Some authors in our study had multiple retractions to their name. Similar results were seen in a study conducted by Katavik which reported 14 authors having multiple retractions [25]. With the introduction of new journals every day, it will not be easy to identify misconduct across journals, and authors may dare to commit misconduct thinking that their deeds would go unnoticed. Another notable point in the present study is that a number of retracted publications belonged to the same author and were in the same journal. This might be because an author who has already published an article with a particular journal may have an advantage — journal editors and peer reviewers may consider the author to be an expert in the field and therefore be less likely to perform misconduct [23]. Similar results were reported in a study by Foo where 21 authors had more than two publications retracted from the same journal(s) [23].

It was also seen that the majority of the retracted publications were from lower, lower-middle and upper-middle income countries (categorised as per World Bank Classification 2020) such as India, Nepal, Pakistan, Sri Lanka, Kenya, Brazil and Iran [26]. These findings are similar to previous studies, which reported that one-third of the total retractions (25-37%) were from Indian authors [8, 9, 10, 27]. There is some data suggesting that pressure in those countries to publish one's research might play a role [28, 29].

Faggion et al reported the characteristics of retracted publications in the field of dentistry [8]. The majority of retracted articles were original research followed by case reports. These findings are similar to those in our study. The majority of articles (72.5%) in Faggion et al were retracted for misconduct which is less than that in the present study (83.7%). The median time from publication to retraction of the article reported in Faggion et al was 12 months, as compared to 17 months in our study. The study by Faggion et al did not look at retraction by author, country and funding status, and did not present post-retraction citation data, which have been studied in this article.

It is important to know what drives people to commit research misconduct. Possible reasons include career and funding pressures, inadequate training in research integrity, lack of proper supervision or monitoring, lack of serious penalty, and language barriers [30]. These practices can be minimised by taking measures such as imparting training on research integrity, ensuring that policies governing academic research are not only in place but are also followed, and setting up standards for supervision. Also, on part of the editors, authors must be asked to submit "raw data" at the time of manuscript submission that can be scrutinised by the editorial board members for possible misconduct and which will prevent fraudulent publication.

Finally, it is important to distinguish misconduct which is intentional, from error which is unintentional. The strategy of "naming, blaming and shaming" to deal with scientific misconduct is not appropriate for error. It requires an effort to build a system to prevent, detect and limit the effects of errors when they occur. Identifying errors should be viewed as an opportunity to learn and improve rather than as a source of failure or embarrassment [31].

One limitation of our study is that we extracted the articles only from the MEDLINE database. Hence, there is a possibility of under-reporting of the number of retractions since it did not include articles published in non-MEDLINE indexed journals that might have undergone retraction. The other limitation is that we have assessed the citations only through Google Scholar, and no other databases such as Scopus or

Science Citation Index were checked for extracting citations.

To conclude, the findings of this research give deeper insights into the reasons and characteristics of retracted publications related to dentistry. Retraction of publications arising because of scientific misconduct is a serious matter. The scientific misconduct identified in retracted publications could be just the tip of the iceberg; there could be a substantial amount of misconduct which goes undetected. Retraction is not an ultimate solution for publications identified with scientific misconduct. To tackle this problem, we require a holistic approach and the cooperation of all stakeholders, researchers, editors, reviewers, ethics committees, and research institutions. Certain strategies may help to tackle this issue, such as training the researchers to increase their competencies, data sharing during the publication process, and focusing on promoting the quality of publications rather than quantity. Proper dissemination of retraction notices is also crucial to prevent post-retraction citation of these publications.

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