

# The 50 Most Cited Manuscripts by Indian Periodontists: A Citation Analysis of PubMed Database

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## Abstract

**Background:** Personality of a scientific publication enhances after receiving citations which in turn reflect its recognition and impact on science. There are no reported citation analyses of publications in Indian context.

**Objectives:** Analyze citations received by publications of Indian periodontists available with Pubmed database which were published till 1st March, 2012 and to select top-50-cited articles based on Pubmed citations till 15th May, 2012.

**Methods:** Studies were identified by running select search-phrases on Pubmed search. Search inputs included, 'dental', 'oral', etc. A parallel search with above phrases including 'India' was also done for India-specific publications. All publications with available abstracts were analyzed for selected parameters and their citability. The citable articles were then individually searched for citations using various databases, and citations were analyzed.

**Results:** The total number of articles published was 764 out of that citable articles were 585. The total number of Pubmed citations was 1033 for 248 cited articles. The citations received to articles in International journals (2.72 citations/article) were significantly more than National journals (0.67 citations/article). Out of top 50 most cited articles, 38 (76%) were published in journals with impact factors.

**Conclusion:** Although articles without citations outnumbered articles with citations, the articles published by Indian periodontists in international journals were moderately acknowledged by non-Indian authors. The articles published in national journals, to the most part were barely noticed. The articles published in journals with impact factors tend to receive maximum citations and these articles have high probability to top the list of most cited articles.

**Implications:** Developing nations are also progressing in right directions and are catching up with developed nations, albeit to smaller scales. There is a need to publish more and more cutting edge research manuscripts in national and international reputed journals.

*Key Words: Bibliometrics, Citation Analysis, India, Periodontal Research, Periodontists' Publications, Pubmed Database*

## Introduction

In this ever competitive world, it is always a perceived need to remain at the top, not excluding the scientific work and community. With a similar inclination, various [1-5] bibliometric analyses were conducted to ascertain relative value of a publication as a measure of its citations. The number of citations (i.e., how many times a given article is counted in the reference lists of subsequent articles) is seen as a direct measure of the recognition that this publication has had in its scientific field. In some circumstances, it is also used as a measure of quality by granting bodies [5]. Although simple citation measures may more accurately reflect the usefulness of an article to another authors' work, it may not reflect its quality [6]. Wherever appropriate, a reference is used by an author to notify the reader about the observations, statements or results [7] of the consulted material. Various references may also be quoted for sustaining a specific argument and to strengthen the point of view of the author beyond a doubt [8,9].

A scientific paper is a reflection of the literature surrounding it and in turn the scientific literature is based upon myriads of scientific papers published over the years concerning the subject. A reference is the recognition that one document gives to another while a citation is the recognition that one document receives from another. The reality of life is that not everyone may get noticed or recognized, yet there would always be very few who will outshine the mark. The same analogy can be applied to scientific publications. A popular method for measuring the impact on the scientific community of an article or a researcher is the citation rating [10]. The number of citations

an article receives after its publication reflects its recognition in the scientific community [5].

The criticism of the impact factor ratings and citation analyses itself has grown as their influence increases. It may be useful and pertinent to know, the topmost cited articles in one's field, and various 'citation classic' studies [1-5,11,12] might partially answer that question. Till now the sole 'citation classic' study [2] conducted in the field of Periodontology ranked Socransky SS and Haffajee AD's article [13] titled "The Bacterial Etiology of Destructive Periodontal Disease: Current Concepts" as the topmost cited article and thus a classic.

Over the past few decades, research from Indian subcontinent is getting recognized which has developed rapidly both in contents and quality. As of now there is no study on citation analysis in the field of dentistry in the Indian context and also no study on topmost cited articles. This study was designed to explore on the number of citations received to publications by Indian periodontists and thus arrive at a list of top cited articles depending on the Pubmed database.

## Materials and Methods

### Experimental sampling and study design

This was a bibliometric analytical study of publications by Indian periodontists in various Pubmed indexed journals. Analyses of articles for various parameters, citation analysis and author-co-author analysis were part of the study design along with synthesis of top 50 cited articles. The study design did not venture into judging the

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quality of any particular author or study or institute. Analysis of publication trends are presented as a separate article [14] which is available as online first article (ahead of print) in *Scientometrics* (2012 Impact Factor 2.133) with Digital Object Identifier No. DOI 10.1007/s11192-013-1196-0. For detailed methodology of retrieval of articles from Pubmed database and analysis of publications the authors are kindly requested to refer that article.

Publications available on Pubmed database till end of February, 2012 were included for this study. The data search was done on 1st March, 2012, which started at 11.00 a.m. IST (Indian Standard Time) and lasted till 11.15 a.m. IST. Individual searches were done by putting the keywords; dental, oral, periodontal, gingiva, gingival, periodontics, periodontology, periodontia, periodontitis, gingivitis and dental implant. Same search was repeated with every keyword adding one additional keyword as 'India'. The keywords were inputted directly on the designated place at Pubmed webpage (<http://www.ncbi.nlm.nih.gov/pubmed>). The abstracts of all the articles were retrieved from all the keyword categories. Thereafter Periodontology related articles were hand-searched and selected in each category. Inter-category comparisons were made and overlapping articles removed. A library of the abstracts was then made according to the inclusion criteria as below.

### Inclusion criteria

#### A. Selection of publications by Indian periodontists:

1. Articles which are available in Pubmed database as on 1<sup>st</sup> March, 2012 till 11.15 a.m. IST.
2. Articles from Indian institutions only were considered for study.
3. Articles by periodontists of Indian origin who published from India.
4. Journals indexed with Pubmed (at the time of publication of the article) irrespective of their country of origin or subjects were considered.
5. The preface, editorials, messages, letters to the editor, obituaries and organization-related communications were excluded.
6. No mention of authors, institute name or departmental/other affiliation and non retrieval of data apart from topic of the article were excluded.
7. Periodontists whose names are present in Indian Society of Periodontology's (ISP) Life Members List were included irrespective of whether their institute or departmental affiliation is mentioned or not in the abstract.

#### B. Selection of citable articles:

8. Articles with at least available abstract on Pubmed database, articles without abstracts were excluded.

#### C. Selection of citations:

9. Citations for each citable article were searched between 10/05/2012 and 15/05/2012 and only those citations till this date were included.
10. Citations for articles were searched on Google scholar (<http://scholar.google.co.in/>), Bioinfobank library (<http://lib.bioinfo>.

pl/) and journal/publisher websites.

11. Only English language (whether translated or direct) Pubmed citations were considered.

D. Selection of top 50 articles:

12. Articles arranged in descending order as per their Pubmed citations, the top 50 were selected.

13. Pubmed citations only, irrespective of whether they are self-citations or non-self-citations, were considered.

14. When there was a tie between numbers of citations, higher of Google Scholar citations were considered for ranking.

### Data entry and analysis

All the citable articles were entered on Excel datasheets and tabulated according to type of journal, article title, name of authors, type of study, year of publication, name of institute etc.

Again, all the citations to citable articles were then tabulated in Excel datasheets according to name of journal, title of the article, name of authors, publication year, etc.

Then citations were analyzed according to year of publication, type of study, self-citations, year of citation, Google Scholar citations, year wise citations etc. "Number of self-citations" were taken as the number of articles in the reference section to which at least one of the authors had contributed. We expressed most of the results in percentages, proportions and other comparative parameters.

## Results

The total numbers of articles by Indian periodontists are 764, out of which, the number of citable articles considering our inclusion criteria are 585, which are distributed right from 1975 to 2012 and spread across different journal titles. The publication trends and analysis of publications by Indian periodontists is reported in a separate study [14]. The analysis in this study pertains only to citable articles available in Pubmed database by Indian periodontists.

The citable articles according to the inclusion criteria published by Indian periodontists in Pubmed database is 585; out of which 273 (46.67%) are in National journals and 77 of them received a total of 183 citations. Whereas 312 (53.33%) articles are in International journals, out of this 171 articles received 850 citations (*Table 1*). The journals preferred by Indian periodontists seem to be International ones over National journals and the number of cited articles in international journals is significantly more as compared to national journals (68.95% vs. 31.05%). Also, the numbers of citations per article are significantly more for international publications (2.72 vs. 0.67). Publications in International journals with wider appeal and reach are cited much more than local national journals. A greater number of articles (71.8%) remained non-cited among National journals as opposed to only 45.2% non-cited articles in International journals.

The majority (71.07%) of citable publications by Indian periodontists are either of clinical nature or case report/series (*Table 2*). The balance manuscripts belong to review articles (19.79%). The clinical studies attract a 1:1 chance of getting citations, whereas

**Table 1.** Number of cited and non-cited articles as opposed to number of citations and type of journal.

Sr. no.	Type of journal	Total number of articles	Total no. of articles with citations	Total no of articles without citation	Total number of citations in national and international journal	Citations per article
1	National	273 (46.66)	77 (31.05)	196 (58.16)	183 (17.72)	0.67
2	International	312 (53.33)	171(68.95)	141 (41.84)	850 (82.28)	2.72
	Total	585 (100)	248 (100)	337 (100)	1033 (100)	1.76

\*-Values in brackets indicate percentage (%) distribution.

case reports/series, genetic and epidemiological studies have a poor chance of getting cited (1:2.3). A total of 57.61% of articles were never cited, out of that majority among the genetic studies were not cited (73.33%) which is quite surprising. A majority of cited articles (55%) belonged to other studies (animal/*in vitro*) category

with a highest of 2.65 citations/article. Case report/series are the least preferred to be cited (0.8 citations/article). There is no clear co-relation between number of non-cited articles and citations per article. It can be emphasized that, the article which attracts citations early go on receiving citations in the future.

**Table 2.** Number of citations as per types of studies/ publications.

Sr. no.	Type of study	Total no of articles	No of articles with citations	No of articles without citations	No of citations for articles	Citations per article
1	Clinical studies	280 (47.86)	140 (50.00)	140 (50.00)	624 (60.40)	2.23
2	Reviews	116 (19.79)	45 (38.79)	71 (61.21)	180 (17.42)	1.55
3	Case Report/Series	136 (23.21)	42 (30.88)	94 (69.12)	109 (10.55)	0.80
4	Genetic studies	15 (2.56)	4 (26.67)	11 (73.33)	31 (3.00)	2.06
5	Pilot studies	8 (1.36)	3 (37.5)	5 (62.5)	16 (1.55)	2
6	Epidemiology studies	10 (1.71)	3 (30.00)	7 (70.00)	20 (1.94)	2
7	Other studies (Animal/ In-vitro)	20 (3.41)	11 (55.00)	9 (45.00)	53 (5.13)	2.65
	Total	585 (100)	248 (42.39)	337 (57.61)	1033 (100)	1.76

\*-Values in brackets indicate percentage (%) distribution.

**Table 3.** Self-citation analysis.

Sr. no.	Type of citation	Number of citations	Number of articles	Citations per article
1	Self-citations	91 (8.81)	44 (17.74)	2.06
2	Other citations	942 (91.19)	204 (82.26)	4.57
	Total	1033 (100)	248 (100)	4.16

\*-Values in brackets indicate percentage (%) distribution.

**Table 4.** Top 50 articles according to Pubmed citations by Indian periodontists. Note that the articles are arranged in reference format but not included in references list at the end of the article. Where there is a tie between numbers of citations, Google Scholar citations are considered for ranking.

Overall rank	Name of the article	No. of pubmed citations	No of self-citations	No of citations without self-citations	Rank without self-citation
1.	Tarannum F, Faizuddin M. Effect of periodontal therapy on pregnancy outcome in women affected by periodontitis. J Periodontol 2007 Nov;78(11):2095-103.	33	0	33	1
2.	Rai B, Kharb S, Jain R, Anand SC. Biomarkers of periodontitis in oral fluids. J Oral Sci 2008 Mar;50(1):53-6.	26	2	24	2
3.	Faizuddin M, Bharathi SH, Rohini NV. Estimation of interleukin-1beta levels in the gingival crevicular fluid in health and in inflammatory periodontal disease. J Periodontol Res 2003 Apr;38(2):111-4.	23	0	23	3
4.	Somayaji BV, Jariwala U, Jayachandran P, Vidyalakshmi K, Dudhani RV. Evaluation of antimicrobial efficacy and release pattern of tetracycline and metronidazole using a local delivery system. J Periodontol 1998 Apr;69(4):409-13.	19	0	19	4
5.	Chawla TN, Nanda RS, Kapoor KK. Dental prophylaxis procedures in control of periodontal disease in Lucknow (rural) India. J Periodontol. 1975 Aug;46(8):498-503.	18	0	18	5
6.	Anand PS, Nandakumar K, Shenoy KT. Are dental plaque, poor oral hygiene, and periodontal disease associated with Helicobacter pylori infection? J Periodontol 2006 Apr;77(4):692-8	17	0	17	6
7.	Misra V, Mehrotra KK, Dixit J, Maitra SC. Effect of a carbon dioxide laser on periodontally involved root surfaces. J Periodontol 1999 Sep;70(9):1046-52.	17	0	17	7
8.	Das SJ, Newman HN, Olsen I. Keratinocyte growth factor receptor is up-regulated in cyclosporin A-induced gingival hyperplasia. J Dent Res. 2002 Oct;81(10):683-7.	16	0	16	8
9.	Pradeep AR, Shetty SK, Garg G, Pai S. Clinical effectiveness of autologous platelet-rich plasma and Peptide-enhanced bone graft in the treatment of intrabony defects. J Periodontol 2009 Jan;80(1):62-71.	15	3	12	14
10.	Sunitha Raja V, Munirathnam Naidu E. Platelet-rich fibrin: evolution of a second-generation platelet concentrate. Indian J Dent Res. 2008 Jan-Mar;19(1):42-6.	14	0	14	9
11.	Singal P, Gupta R, Pandit N. 2% sodium fluoride-iontophoresis compared to a commercially available desensitizing agent. J Periodontol 2005 Mar;76(3):351-7.	14	0	14	10
12.	Kenkre AM, Spadigam AE. Oral health and treatment needs in institutionalized psychiatric patients in India. Indian J Dent Res 2000 Jan-Mar;11(1):5-11.	13	0	13	11
13.	Kishore A, Mehrotra KK, Saimbi CS. Effectiveness of desensitizing agents. J Endod 2002 Jan;28(1):34-5.	13	0	13	12

14.	Pradeep AR, Karthikeyan BV. Peri-implant papilla reconstruction: realities and limitations. <i>J Periodontol</i> 2006 Mar;77(3):534-44.	13	0	13	13
15.	Karthikeyan BV, Pradeep AR. Leptin levels in gingival crevicular fluid in periodontal health and disease. <i>J Periodontal Res</i> 2007 Aug;42(4):300-4.	13	1	12	15
16.	Laxman VK, Annaji S. Tobacco use and its effects on the periodontium and periodontal therapy. <i>J Contemp Dent Pract</i> 2008 Nov 1;9(7):97-107.	12	0	12	16
17.	Karthikeyan BV, Pradeep AR. Gingival crevicular fluid and serum leptin: their relationship to periodontal health and disease. <i>J ClinPeriodontol</i> 2007 Jun;34(6):467-72.	12	0	12	17
18.	Sharma CG, Pradeep AR. Gingival crevicular fluid osteopontin levels in periodontal health and disease. <i>J Periodontol</i> 2006 Oct; 77(10): 1674-80.	12	2	10	23
19.	Pradeep AR, Pai S, Garg G, Devi P, Shetty SK. A randomized clinical trial of autologous platelet-rich plasma in the treatment of mandibular degree II furcation defects. <i>J ClinPeriodontol</i> 2009 Jul;36(7):581-8.	12	2	10	24
20.	Prapulla DV, Sujatha PB, Pradeep AR. Gingival crevicular fluid VEGF levels in periodontal health and disease. <i>J Periodontol</i> 2007 Sep; 78(9): 1783-7.	12	1	11	19
21.	Ambili R, Santhi WS, Janam P, Nandakumar K, Pillai MR. Expression of activated transcription factor nuclear factor-kappa B in periodontally diseased tissues. <i>J Periodontol</i> 2005 Jul;76(7):1148-53.	12	0	12	18
22.	Pradeep AR, Thorat MS. Clinical effect of subgingivally delivered simvastatin in the treatment of patients with chronic periodontitis: a randomized clinical trial. <i>J Periodontol</i> 2010 Feb;81(2):214-22.	12	4	8	34
23.	Pradeep AR, Daisy H, Hadge P, Garg G, Thorat M. Correlation of gingival crevicular fluid interleukin-18 and monocyte chemoattractant protein-1 levels in periodontal health and disease. <i>J Periodontol</i> 2009 Sep;80(9):1454-61.	12	2	10	25
24.	Vandana KL, Savitha B. Thickness of gingiva in association with age, gender and dental arch location. <i>J ClinPeriodontol</i> 2005 Jul;32(7):828-30.	11	0	11	20
25.	Pradeep AR, Hadge P, ArjunRaju P, Shetty SR, Shareef K, Guruprasad CN. Periodontitis as a risk factor for cerebrovascular accident: a case-control study in the Indian population. <i>J Periodontal Res</i> 2010 Apr;45(2):223-8.	11	0	11	-21
26.	Saini R, Marawar PP, Shete S, Saini S. Periodontitis, a true infection. <i>Glob Infect Dis</i> 2009 Jul;1(2):149-50.	11	10	1	49
27.	Pradeep AR, Sagar SV, Daisy H. Clinical and microbiologic effects of subgingivally delivered 0.5% azithromycin in the treatment of chronic periodontitis. <i>J Periodontol</i> 2008 Nov;79(11):2125-35.	11	1	10	26
28.	Radhakrishnan S, Anusuya CN. Comparative clinical evaluation of combination anorganic bovine-derived hydroxyapatite matrix (ABM)/cell binding peptide (P-15) and open flap debridement (DEBR) in human periodontal osseous defects: a 6 month pilot study. <i>J IntAcadPeriodontol</i> 2004 Jul;6(3):101-7.	11	0	11	22
29.	Garg N, Singh R, Dixit J, Jain A, Tewari V. Levels of lipid peroxides and antioxidants in smokers and nonsmokers. <i>J Periodontal Res</i> 2006 Oct;41(5):405-10.	10	0	10	27
30.	Deo V, Bhongade ML. Pathogenesis of periodontitis: role of cytokines in host response. <i>Dent Today</i> 2010 Sep;29(9):60-2, 64-6; quiz 68-9.	10	0	10	28
31.	Anil S, Samaranyake LP, Nair RG, Beena VT. Gingival enlargement as a diagnostic indicator in leukaemia. Case report. <i>Aust Dent J.</i> 1996 Aug;41(4):235-7.	10	0	10	29
32.	Pradeep AR, Roopa Y, Swati PP. Interleukin-4, a T-helper 2 cell cytokine, is associated with the remission of periodontal disease. <i>J Periodontal Res</i> 2008 Dec;43(6):712-6.	10	0	10	30
33.	Pereira R, Chava VK. Efficacy of a 3% potassium nitrate desensitizing mouthwash in the treatment of dentinal hypersensitivity. <i>J Periodontol</i> 2001 Dec;72(12):1720-5.	9	0	9	31
34.	Verma S, Bhat KM. Diabetes mellitus--a modifier of periodontal disease expression. <i>J IntAcadPeriodontol</i> 2004 Jan;6(1):13-20.	9	0	9	32
35.	Raja S, Byakod G, Pudukalkatti P. Growth factors in periodontal regeneration. <i>Int J Dent Hyg.</i> 2009 May;7(2):82-9.	9	0	9	33
36.	Abraham S, Kumar MS, Sehgal PK, Nitish S, Jayakumar ND. Evaluation of the inhibitory effect of triphala on PMN-type matrix metalloproteinase (MMP-9). <i>J Periodontol</i> 2005 Apr;76(4):497-502.	9	2	7	39
37.	Mahajan A, Dixit J, Verma UP. A patient-centered clinical evaluation of acellular dermal matrix graft in the treatment of gingival recession defects. <i>J Periodontol</i> 2007;78(12):2348-55.	9	1	8	35
38.	Agrawal AA, Kapley A, Yeltiwar RK, Purohit HJ. Assessment of single nucleotide polymorphism at IL-1A+4845 and IL-1B+3954 as genetic susceptibility test for chronic periodontitis in Maharashtrian ethnicity. <i>J Periodontol</i> 2006;77(9):1515-21.	8	0	8	36
39.	Anil S, Remani P, Vijayakumar T, Hari S. Cell-mediated and humoral immune response in diabetic patients with periodontitis. <i>Oral Surg Oral Med Oral Pathol</i> 1990 Jul;70(1):44-8. B24	8	2	6	46

40.	Sharma A, Pradeep AR. Autologous Platelet-Rich Fibrin in the Treatment of Mandibular Degree II Furcation Defects: A Randomized Clinical Trial. J Periodontol 2011 Oct;82(10):1396-403.	8	7	1	48
41.	Vandana KL, Reddy MS. Assessment of periodontal status in dental fluorosis subjects using community periodontal index of treatment needs. Indian J Dent Res 2007 Apr-Jun;18(2):67-71.	8	0	8	37
42.	Saini R, Marawar P, Shete S, Saini S, Mani A. Dental expression and role in palliative treatment. Indian J Palliat Care 2009 Jan;15(1):26-9.	8	8	0	50
43.	Chandra RV, Jagetia GC, Bhat KM. The attachment of V79 and human periodontal ligament fibroblasts on periodontally involved root surfaces following treatment with EDTA, citric acid, or tetracycline HCL: an SEM in vitro study. J Contemp Dent Pract 2006 Feb 15;7(1):44-59.	8	0	8	38
44.	Pant V, Dixit J, Agrawal AK, Seth PK, Pant AB. Behaviour of human periodontal ligament cells on CO2 laser irradiated dentinal root surfaces: an in vitro study. J Periodontal Res 2004 Dec;39(6):373-9.	8	1	7	40
45.	Bhongade ML, Tiwari IR. A comparative evaluation of the effectiveness of an anorganic bone matrix/cell binding peptide with an open flap debridement in human infrabony defects: a clinical and radiographic study. Contemp Dent Pract 2007 Sep 1;8(6):25-34.	7	0	7	41
46.	Raghavendra M, Koregol A, Bhola S. Photodynamic therapy: a targeted therapy in periodontics. Aust Dent J 2009 Sep;54 Suppl 1:S102-9.	7	0	7	42
47.	Pratibha PK, Bhat KM, Bhat GS. Oral malodor: a review of the literature. J Dent Hyg. 2006 Summer;80(3):8.	7	0	7	43
48.	Vandana KL, Shah K, Prakash S. Clinical and radiographic evaluation of Emdogain as a regenerative material in the treatment of interproximal vertical defects in chronic and aggressive periodontitis patients. Int J Periodontics Restorative Dent 2004 Apr;24(2):185-91.	7	0	7	44
49.	Raja SV. Management of the posterior maxilla with sinus lift: review of techniques. J Oral Maxillofac Surg 2009 Aug;67(8):1730-4.	7	0	7	45
50.	Roshna T, Nandakumar K. Anterior esthetic gingival depigmentation and crown lengthening: report of a case. J Contemp Dent Pract 2005 Aug 15;6(3):139-47.	6	0	6	47

The total number of cited articles were 248 (42.39%), out of which only 43 (17.74%) of the articles cited themselves in their subsequent publications (Table 3). The authors cited their own publications not more than 2.06 times in later publications. The total number of citations per article received to the cited articles is 4.16, which looks quite a good number for an Indian article. Overall, the number of self-citations are very low at 91 (8.81%) from a total of 1033 total citations. Self-citations may not necessarily indicate self-glorification, self-promotion or self-benefit. If a researcher works on a particular topic far more than others, then self-citations on that topic essentially increases. We did not venture much into recognizing reasons for self-citations.

Out of 1033 citations, 65 (6.29%) belong to Indian journals and 968 (93.71%) belong to journals other than Indian. Out of 968 international citations, 135 (13.95%) were by Indian authors and 833 (86.05%) were by International authors. Whereas, out of 65 citations in Indian journals, 5 (7.69%) were by international authors and 60 (92.31%) were by Indian authors. In total, international citations to articles published by Indian periodontists are 838 (81.12%). Out of 585 citable articles, 248 (42.4%) articles were cited. Further analyses show that, an average of 3.38 international citations were received per cited article, which shows the extent of international recognition of an article published by Indian periodontist.

We identified the top 50 or 'classic' articles by Indian periodontists receiving maximum citations (Table 4). Analysis of the top 50 articles by Indian periodontists showed that, majority of them (19/50, 38%) were published in Journal of Periodontology (JOP), and out of top 10 articles 6 belonged to the same journal (Table 5). Amongst all periodontology journals JOP is ranked second internationally, if we consider the impact factors and also the topmost in number of articles published per year. In other words, we can say that the numbers of citations received to articles by Indian periodontists published in

JOP are higher than other journals. Clinical studies form the main component of the top 50 articles, at a whopping 60%. Majority of the articles (32/50, 64%) were published between 2005 and 2009, and the oldest one in 1975. Analyses of self-citations of the top 50 articles show that, there were no changes in ranking for first 8 articles, after that various changes were noted. Two articles (overall rank no. 26 and 42, both by Saini et al.) were very conspicuous for their self-citations, as one received 10 self-citations out of 11 and the other all 8 self-citations, respectively. Their subsequent rank without self-citations became 49th and 50th, respectively. If we rank all the citable articles minus their self-citations, three articles (the above discussed two and another at overall rank no. 40) may have to be excluded from the list of top 50 articles.

An unprecedented number of articles (12/50, 24%) by Pradeep AR are in top 50 publications by Indian periodontists (Table 6). A quarter of the share belongs to him with an average of 12.08 citations/article, but the maximum citations/article was received by Faizuddin M at an average of 28 for his 2 articles. Out of his 12 articles, Pradeep AR was at first author position for 7 articles, second author for 4 articles and the remaining one at third position.

Analysis of the top 50 articles also reveals that majority of them (38/50, 76%) were published in journals with impact factors (Table 5). It is desirable for authors to have some instrument to measure the quality of their publication. In search of such methodology, Eugene Garfield has created Impact Factor (IF), which is essentially a measure of the citations of scientific journals. Impact factors of specific journals are calculated by taking the number of all current citations to source manuscripts published in that journal over the previous 2 years and dividing by the total number of articles published in the same journal during the same period. In short, it is a ratio between citations and citable articles. It may be construed that, although debated, impact factor is a relative measurement of a

**Table 5.** The analysis of top 50 articles by Indian periodontists.

Sr. no.	A. Journal			B. Study type		C. Publication year	
	Name of journal	No of articles	Impact Factor	Study type	No of articles	Year	No of articles
1	J of Periodontology	19	2.479	Clinical	30	2009	8
2	J Periodontal Research	6	2.128	Review	12	2007	7
3	J Contemporary Dental Practice	4	-	Other (animal/ invitro)	3	2006	7
4	Indian J Dental Research	3	0.665	Case report	2	2008	5
5	J Clinical Periodontology	3	3.933	Genetic	1	2005	5
6	J International Academy of Periodontology	2	-	Epidemiologi-cal	1	2004	4
7	Australian Dental J	2	1.496	Pilot	1	2010	3
8	J Oral Sciences	1	1.89			2002	2
9	J Dental Research	1	3.773			2011	1
10	Global Infectious Diseases	1	-			1998	1
11	Dental Today	1	-			1990	1
12	International J Dental Hygiene	1	-			2003	1
13	Indian J Palliative Care	1	-			2000	1
14	Oral Surgery Oral Medicine Oral Pathology	1	-			2001	1
15	J Oral Maxillofacial Surgery	1	1.58			1999	1
16	International J Periodontics Restorative Dentistry	1	1.345			1996	1
17	J Dental Hygiene	1	-			1975	1
18	J of Endodontics	1	2.953				
	Total	50			50		50

**Table 6.** Analysis of authors in top 50 articles who have authored at least 2 papers.

Name of author	No of papers	No of citations	Citations per article					
				first	second	third	fourth	fifth
Pradeep AR	12	145	12.08	7	4	1		
Dixit J	4	44	11		2	2		
Nandakumar K	3	35	11.67		1	1	1	
Karthikeyan BV	3	38	12.67	2	1			
Garg G	3	39	13			2	1	
Vandana KL	3	26	8.67	3				
Raja S	3	30	10	3				
Saini S	2	19	9.5				2	
Anil S	2	18	9	2				
Bhat KM	2	19	9.5		2			
Bhongade ML	2	17	8.5	1	1			
Daisy H	2	23	11.5		1	1		
Faizuddin M	2	56	28	1	1			
Hadge P	2	23	11.5		1	1		
Marawar PP	2	19	9.5		2			
Mehrotra KK	2	30	15		2			
Pai S	2	27	13.5		1		1	
Saini R	2	19	9.5	2				
Shete S	2	19	9.5			2		
Shetty SK	2	23	11.5		1			1
Thorat MS	2	24	12		1			1

journals' superiority and thus to the quality of an article. The total number of articles amongst top 50 appeared in journals having impact factor more than 2 is 31(62%), which again reiterates the importance of impact factors.

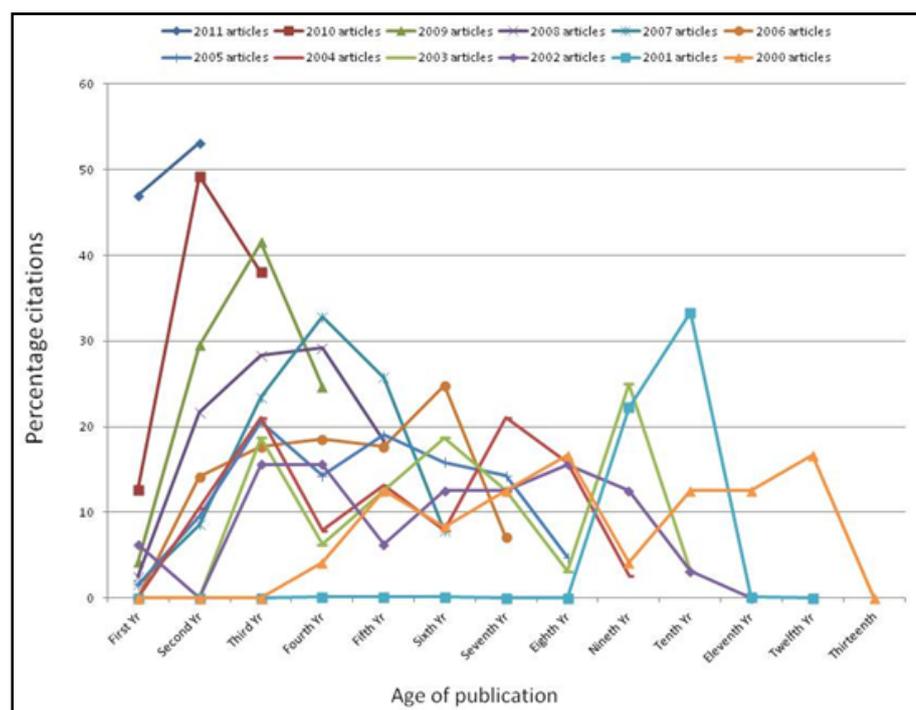
A total of 49 (19.76%) cited articles have been produced by Government Dental College (GDC), Bangalore, which is really a great feat comprising almost 20% of all cited articles (Table 7). These 49 articles received a total of 263 Pubmed citations, which are slightly less than 5 times the next ranked institute. The maximum

citations/article received to an institution is MR Ambedkar Dental College and Hospital, Bangalore with its sole article receiving 33 citations and also topping the list of top 50 articles. Both institutions belong to Karnataka State, India.

Publications start receiving citations as early as first year of their publication but they peak in second and third year, later on a decrease is observed (Figure 1). There is no linear decrease in citations throughout but an observable decrease happens from fourth year onwards.

**Table 7.** The top 20 institutions in India receiving citations to their articles.

Sr. No.	Name Of Institute	Total citations in Pubmed	No. of articles	Citations per article
1	Government Dental College, Bangalore, Karnataka	263	49	5.37
2	Government Dental College, Trivandrum, Kerala	57	8	7.12
3	King George's Medical College, Lucknow, Uttar Pradesh	56	6	9.34
4	College of Dental Sciences, Davangere, Karnataka,	55	13	4.23
5	Rural Dental College, Loni, Maharashtra	51	13	3.92
6	Manipal Academy Of Higher Education, Manipal	45	15	3
7	M.R. Ambedkar Dental College and Hospital, Bangalore, Karnataka	33	1	33
8	Meenakshiammal Dental College and Hospital, Maduravoyal, Chennai	32	8	4
9	SDM College of Dental Sciences, Dharwad, Karnataka	32	10	3.2
10	Government Dental College, Rohtak,	28	3	9.34
11	Ragas Dental College and Hospital, Chennai	25	7	3.57
12	D.A.V. (C) Dental College, Yamuna Nagar, Haryana	24	5	4.8
13	SharadPawar Dental College and Hospital, Sawangi (Meghe), Wardha, Maharashtra	23	5	4.6
14	A. B. Shetty Memorial Institute of Dental Sciences, Mangalore	22	5	4.4
15	Dental prophylaxis procedures in control of periodontal disease in Lucknow (rural) India. (No college name mentioned- but overall rank no. 5 article).	18	1	18
16	Goa Dental College & Hospital, Bambolim, Santa Cruz, Goa	17	2	8.5
17	Regional Dental College, Guwahati	16	1	16
18	Saveetha Dental College and Hospitals, Chennai, Tamil Nadu,	15	2	7.5
19	Bapuji Dental College and Hospital, Davangere, Karnataka	15	5	3
20	Government Dental College and Hospital, Gandhi Medical College, Nagpur, Maharashtra	12	2	6

**Figure 1.** Variation of citations for a publication with respect to time from the publication start year.

## Discussion

In this bibliometric study we analyzed the publications by Indian periodontists available with Pubmed database. Every paper's citations in Pubmed database were then analyzed to arrive at a list of top 50 cited articles. We did not restrict ourselves to a set of journals as one of the drawbacks of analyzing a particular journal or all journals on one subject is to miss out important highly cited article(s) published in journal of other subject, e.g. periodontology related article published in a basic sciences journal. In this study we have overcome that drawback by analyzing publications of Indian periodontists irrespective of the journal title.

Our observation for number of citations in international journals

is in accordance with the observations by Ioannidis [15]. He observed that, despite a plethora of available journals, the most influential papers are extremely concentrated in few journals, especially in fields with high citation density. Journal and country also, appear to be the factors most strongly associated with frequency of citation [16]. While investigating one public health issue – child injury prevention, and one clinical topic – coronary artery disease prevention, Filion [16] observed that, in particular, highly-cited articles are predominantly published in high-impact, high-circulation journals.

There may also be differences in the relevance of citation counting between research in clinical and basic sciences. It is reasonable to hypothesize that pure clinicians may read articles and

journals which influence their clinical practice but never cite this work themselves [6]. But our results were favorable for clinical studies as 50% of papers cited were of clinical nature.

We also calculated the non-cited papers as pointed out by Weale et al. [6] that, the number of cited and non-cited articles even in top journals may vary. For the same reason using impact factors for qualitative measurements may be flawed. The top journals should have high percentage of cited articles vis-à-vis very low percentage of non-cited articles. Therefore, non-citation levels should be made available for all journals. They also noted that, utilization of rates denoting non-citations is advantageous as it creates a clear distinction between how citation analysis is used to determine the quality of a journal (low level of non-citation) and an individual article (citation counting) [6].

We identified the top 50 cited articles as classic articles from Indian periodontists but it should not be construed that they are the most important or highly qualitative publications. We were no way involved with the qualitative assessment of the publications in the present study but they may be important. Smith [4] opines that, regardless of which actual paper occupies the top position, the identification of citation trends and citation classics in dentistry provides an interesting look at which research findings, scientific articles and authors have contributed important and citable material to the Australian dental profession over time. They also provide an indication of which direction dental research may be heading towards in future.

Undoubtedly a high percentage of highly cited publications may be exceptionally regarded and have best scientific content; we should also remain aware about the pitfalls of citations. A citation received by an article may be morally appropriate or created with some flawed thinking. For some unknown benefits; we may not cite the one who has influenced our work most significantly [17], mostly to avoid overshadowing of our own research or potential plagiarism issues. 'Incomplete citing' [17] may be attempted in a different form too, where you cite only those publications which may support and solidify your research findings and conveniently you ignore the others (omission bias [18]). By doing this one tries to convince the reader to believe their research findings. Various conscious or unconscious biases for citing have been reported in the literature [5,18]. Few researchers may cite their own publications or that of colleagues/friends/editors/reviewers/members of grant committees /etc. for improving visibility, promotion, academic upliftment or attracting grants. Citing references from own country, region or culture (national and cultural bias [18]) may be consciously attempted by some researchers; which in some way may influence the statistics of country-wise research productivity. The researchers

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who know English may have some conscious or unconscious bias towards referencing English language publications (language bias [18]), and most of the times it is unavoidable. Bias towards own research work and unnecessary and 'premeditated citing' them can also be found in the literature [19]. One more important issue is; as time passes, even true classics are gradually being cited less often because their substance has been absorbed into current knowledge, a phenomenon called "obliteration by incorporation" [1].

We evaluated the top authors and institutes from India producing cited articles; as the number of citations an article receives after its publication not only reflects its impact on the scientific community, but also the impact of the institutions or countries in the field studied [3]. The sum of the citations of an article is logically dependent on its publication year, as citations accumulate over time. Scientific papers usually are not cited until 1 or 2 years after their publication and generally reach a maximum after 3 to 10 years, at which time they continue to be cited, but at a less frequent rate [10]. Our analysis indicated that the citations peak up in 2nd and 3rd year of publication and then gradually decline.

## Conclusion

This analysis of citation rates allows for the recognition of seminal advances in periodontology in the Indian context and gives a historic perspective on the scientific progress of this specialty. In general, original research articles from Indian periodontists appearing in reputed international journals are cited more than non-original studies and publications in Indian journals. Ranking of top publications in a particular subject may express the relative quality and importance of those articles and may also encourage scientists/researchers to produce cutting-edge innovative high-impact studies; getting recognition and visibility may be a sweet by-product.

## Conflicts of Interests

No sources of support and no conflicts of interests.

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