TOP CITED ARTICLES IN DENTAL TRAUMA; A BIBLIOMETRIC STUDY

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ABSTRACT:

AIM:

Citation analysis describes the impact that different articles in various fields of science have made by counting the number of citations they have received. This study aimed to identify those published articles in medical and dental journals that have exerted the most influence in the field of dental traumatology, as signified by their citation count.

METHODS:

The 100 top-cited articles on dental trauma were identified in August 2014 by using the ISI Web of Science Database and Google Scholar. Search terms used included dental trauma, trauma to tooth/teeth, traumatic dental injuries and dental injuries. The 100 top-cited articles were selected and analyzed with regard to authors, institution, country of origin, publication name, publication year, number of citations, field of study, study design and publishing group. Data was analyzed using SPSS version 19.0.

RESULTS:

The highest number of citations that an article related to dental traumatology received was 480 while the last article in the list had 67 citations. The journal which had the most number of cited articles was Dental Traumatology, with the highest number of top cited articles being published in 2001. The first author who contributed most to the top cited articles was JO Andreason, with seven articles in total. According to the country of origin of the first author, the top-cited list was led by Denmark, with the University Hospital [Rigshospitalet] of Demark producing the highest number of most cited publications in dental traumatology. Forty percent of the studies were based on epidemiology with 70% having an observational study design. Wiley Online Library was responsible for publishing the majority of the articles in the top cited list.

CONCLUSION:

According to our citation analysis, it was revealed that most of the researches in dental traumatology have been based on epidemiology with surveys being the most popular study design. More studies need to direct towards prevention of dental trauma, with experimental study designs. Dental Traumatology may be the best journal to study dental trauma, as this journal has the highest number of top cited articles related to dental traumatology.

KEY TERMS:

Bibliometrics, citation analysis, dental trauma

**Introduction:**

A citation is an abbreviated alphanumeric expression embedded in the body of an intellectual work that denotes an entry in the bibliographic references section of the work for the purpose of acknowledging the relevance of the works of others to the topic of discussion at the spot where the citation appears. [1] This definition from Google Scholar indicates that a citation can be a reference to any item, be it an article, book, dissertation, newspaper editorial or similar material. It not only provides adequate information at the end of the scholarly work, to locate the item from where the information has been borrowed but also helps to acknowledge the author of that information. In fact, plagiarism issues arise when the author uses a specific source in his body of work but fail to indicate what has been borrowed or do not mention the original author of the referenced material. To cite a particular work serves several important purposes including safeguarding intellectual honesty and integrity as well giving credit to the original author for his authentic thinking and idea. [2] It provides the readers certain autonomy because they can decide, after reading through the references, whether the referenced material supports or refutes the author’s argument in the way it has been claimed. The validity and strength of the material that has been included in the reference section can also be gauged by the readers independently. [3]

Citation analysis is the field of biblio-metrics that uses citation data to quantify the impact of research as illustrated by the number of references that an article receives over time.[[4](#_ENREF_1)] It looks at the frequency, patterns and graphs of citations received by different articles and books. [[5](#_ENREF_2)]Citation analysis is one of the most frequently used methods employed in biblio-metrics. It helps to recognize and identify the trends of research and development in a particular field of science and to determine the gradual progression and accumulation of literature in this regard. The results of the analysis of the most frequently cited articles are also the determining aspect of journals’ impact factor, which are figures of merit frequently looked upon by researchers when they are submitting their original research to a particular journal. In fact Journal Citation Report (JCR) ranks journals on citation data. [[6](#_ENREF_3)] Although a high rank according to citations alone cannot be held as the ultimate criteria for the relevance and quality of the article, it does however indicate the impact that article in has in that particular field of science. Never the less, citation analysis of literature and articles in various specialties is a well-accepted means of scientific recognition.[[7](#_ENREF_4)]

Various tools have been devised and suggested as a means of counting citations. Several resources can be utilized in this regard, in order to fully capture an article’s or an author’s impact in terms of the citations received. Each of these resources produces slightly variable results revealing the need for using more than one data base to count citations. Eugene Garfield founded the Institute for Scientific Information (ISI), which since 1945, has been the largest database for bibliographic information of more than 10,000 international journals through the Science Citation Index Expanded (SCI). Started in 1962, this index has been the tool used in different citation analysis studies done in order to capture the impacts of different articles and authors and to compile information regarding contributions of institutions and countries, and to link researchers through their scholarly work.[[8](#_ENREF_5), [9](#_ENREF_6)] Other sources include Scopus and Google Scholar. Google Scholar is a freely accessible web search engine that allows the use of full text articles and scholarly literature, while indicating the number of citations received by them.

To our knowledge, no citation analysis has been done specifically for articles on dental traumatology, which is an important aspect of clinical dentistry. Therefore, the aim of this article was to identify those published articles, both from dental and medical journals, which have exerted the most influence in the field of dental traumatology, as suggested by the number of citations they have received. These top-cited articles were not only analyzed for their citation counts, but various characteristics including, but not limited to, the authors, year of publication and institute at which the research work was conducted.

**Methods:**

We identified the 100 top cited articles published in dental and medical journals, from 1950 till August 2014, by using the Web of Science data base (through the Science Citation Index Expanded) and Google Scholar. The search terms that were used included ‘dental trauma’, ‘trauma to tooth/teeth’, ‘traumatic dental injuries’, ‘dental injuries’ and a combination of these terms. For the Web of Science, the results were sorted by using the ‘Times Cited’ option to get the list of articles in descending order in terms of number of citations they had received. For Google Scholar, a manual search was performed to identify the articles for the highest number of citations.

The selected articles were then grouped by the title of the articles, number of citations they had received, the journal in which they were published, year of publication, the name of first authors and their country of origin, the number of authors that had contributed to each article, the institute were the study had been conducted, the topic of dental trauma that the article covered, the study design followed and the publisher responsible for publishing the journal from which the articles were selected. The topic or field of study related to dental trauma into which the articles were categorized, was classified as etiology, epidemiology, complications and treatment, as well as different forms of dental trauma like avulsions, luxations, fractures or those dealing with non-specific or generalized forms of dental trauma. Sports related trauma and trauma to primary teeth were also included in the classification. With regards to study design, the articles were divided into basic science articles (dealing with histology or basics of dental traumatology), guidelines, reviews, observational studies and surveys, experimental studies and letters to the editor. The first authors of all the selected articles were identified, as well as their country of origin by the address that had been provided by them. The number of the remaining contributing authors for each article was also noted. All the data was analyzed using SPSS version 19.0.

**Results:**

The top 100 articles in dental trauma are listed in descending order according to the number of citations they had received. (Table 1) The article on the top of the list had received 480 citations while the last articles on the list had 67 citations. The mean number of citations that each articles received was 123. There were 53 citation classics identified in our top-cited list, receiving citations in the range of 480 till 100.

**Journals which published the top-cited articles:**

A total of 26 journals were identified from where the top-cited articles had been selected. Out of these, the top ten journals are depicted in Graph 1. Dental Traumatology was at the top of the list, having published 64 articles out of 100.

**Date of Publication:**

In our search from older publications, we found the top-cited having been published in 1970. From 1970 till August 2014, it was found that the highest number of top cited articles were published in 2001 (n=15), followed by 2002 (n=12), 2003 (n=8) and 2007 (n=7). A total of 22 top-cited articles had been published between 1957 and 1990, 28 articles between 1991 and 2000, and 50 articles after year 2000. (Graph. 2)

**Authors:**

A total of 76 first authors were identified, who had contributed to our top-cited list. The top three authors are given in Graph 3. The top three authors in terms of number of publication as first author were Andreasen JO [n=7], Flores MT [n=6] and Marcenes W [n=4]. A closer look at these top three authors revealed that they had also contributed as second, third and fourth authors in other publications, with Andreason JO having four articles as second authors, and two articles each as third and fourth author. Flores contributed to one article as second author while Marcenes had four articles in which he was the second author (Graph. 4).

In terms of the number of authors of each of the top-cited articles, it was found that 18 studies were monographs with only a single author, 30 articles had two researchers contributing to it and 25 publications had three authors (Graph. 5).

**Countries of Origin:**

Twenty five countries were identified in our top-cited article list, with Denmark in the lead with 14 articles, followed by USA (n=14) and Brazil (n=13). The top ten countries are shown in the Table 2.

**Institutions:**

A total of 70 different institutions were recognized to have contributed to the top-cited list with one private practice. The University Hospital (Rigshospitalet) was the determined to be the lead institution with eight articles, followed by the University of Valparaiso (n=5). The top 20 institutions are depicted in the Table. 3. The rest of the institutions had contributed to one paper each.

**Field of Study and Study Designs of the top-cited articles:**

The highest number of the top-cited articles were based on epidemiology (n=40], followed by generalized dental trauma (n=15) and complications (n=12). The rest of the distribution of articles categorized according to the topic of study is depicted in the Graph 6. In terms of study designs, most of studies were observational along with 28 surveys. (Table. 4)

**Publisher:**

The bulk of publishing was identified to be done by the Wiley Online Library, which was responsible for publishing 76 articles out of the top 100 articles, followed by Europepmc.org and Elsevier. (Table. 5)

**Discussion:**

This study was under-taken in order to identify and determine those published articles in both dental and medical journals that have exerted the most influence in the field of dental trauma, as suggested by the number of citations they have received. There have been multiple studies published in literature that have recongnized the most cited articles in various fields of science like ophthalmology, [[10](#_ENREF_7)]general medicine,[11] traumatology,[[12](#_ENREF_9)] gynecology, [13]anesthesiology,[14]urology,[15] surgery,[16] and plastic surgery17] among many others, but very limited studies in different specialties of dentistry are present. A study determining the para-textural variables of citation classics in periodontology has been done by Neiri et al. [18]. One study by Fardi et al. identifies the top cited articles in endodontics[19] and another study looks at the top cited articles in dentistry.[20]

Compared to the top-cited articles in endodontics, where the highest cited articles have been cited 554 times, the citation number for dental traumatology articles is lesser. This can be the result of the fact that the subject of dental trauma is sheltered under various other domains of dentistry like endodontics, oral surgery, periodontology or even orthodontics, instead of being a separate entity. This distribution of literature can result in a lower number of citations received by the literature published exclusively in journals pertaining to dental trauma. The citation analysis of articles in endodontics also had a greater number of citation classics i.e. 63 articles as compared to our results. Another importance difference is the year with the most cited publications, which for endodontics is 1995 and for dental traumatology in 2001. This fact demonstrates that although relevant literature regarding dental trauma had started getting published early on, a greater body of significant research in terms of number of citations these articles received, came much later, perhaps with the recognition from the scientific community regarding the importance and influence of dental trauma, its management and treatment. Most of the top cited literature in dental trauma has been published after 2000, reiterating this fact.

Denmark was identified as the country where most of the top-cited research in dental trauma originated, with the University Hospital (Rigshospitalet) as the institute which primarily acted as the research center. This was seconded by the USA, where the credit for the top-cited literature was divided among 12 different institutions.

We found that Andreason JO with the highest number of publications as the first author. Also, for four out of five articles in which Flores MT was the first author, Andreason has contributed as second, third or fourth author. So our citation analysis revealed an interesting fact regarding these top two authors collaborating closely in terms of contributing to scientific literature in dental trauma.

Citation classics are those articles that have been cited more than 100 times[21] and are said to have a strong impact in research in that particular field. These articles are important because such a high number of citations imply the significant bearing on the progress, research and debate in that particular field of science. [22]

Articles on epidemiology seem to be the main stay in scientific literature on dental trauma, with observational studies making the bulk of the top-cited research. It was noted that researchers seemed particularly interested in identifying the incidence and prevalence of dental trauma in various parts of the world, as well as conducting cross-sectional surveys, both to assess the knowledge of lay people, medical and dental professionals regarding dental trauma, and to identify the different types of dental trauma cases coming to hospital settings and determining related variables. The total number of experimental studies done in dental traumatology was very few, which is in contrast to other fields in medicine. There were no clinical trials identified, which gives an indication of the dearth in research in this particular scope in dental trauma. Also, we recognized only three articles which dealt with prevention, which is a major aspect in terms of traumatic injuries to teeth.[23, 24] Hence, this citation analysis also revealed and highlighted those areas in the field of dental traumatology, where research and exploration can be made in the future.

Some limitations in performing citation analysis for a subject like dental traumatology are the paucity of journals that are dedicated to this particular field of dentistry. Dental Traumatology has the highest collection of top-cited articles, but a lot of significant literature having impact in the field of dental trauma may be scattered in various dental journals that cover other specialties like endodontic, periodontology and restorative dentistry. Therefore, it was decided to conduct the search using key terms instead of exploring specific dental journals.

The limitations of citations analysis in general are that the number of citations that articles receive is not an exact measure of the quality of the study or their level of evidence. Just looking at the number of citations that an article has received will not identify the sound methodology of the study described. There are various reasons that the number of citations for particular articles may be inflated and certain biases may be at play. Classic articles, having been published early on, may automatically receive a greater number of citations instead of articles published later. The longer the article has been published, the greater the chance that it will be cited again and again. There could also be a spontaneous impulse by authors to cite articles that have been cited many times before, in order to lend weight to their argument. This leads to new research findings being ignored for a longer time, and their impact in terms of citations received can only be seen much later. In fact, the actual impact of an article may take greater than two decades to become evident. [14] Perhaps a detailed scrutiny for each of the top cited articles in terms of quality of evidence may make the results of citation analysis more meaningful.

Some other biases that may affect the results of citation analysis can include self-citations [25, 26] as well as editorial policies of some journals which demand the submitting authors to cite articles published in their journals, to inflate their impact factors. Authors may also intentionally cite articles from journals they want to publish, in hope that it would increase the likelihood of their work being published.[27] Authors collaborating in similar areas of research may similarly preferentially cite each other’s work. Also, if only the citation counts for articles are analyzed, then high impact research from book chapters and other types of publication as well as articles in languages other than English may be missing.[27] Articles published in journals that already have a high impact factor may also receive higher number of citations over time as compared to articles published in lower impact factor journals, which helps develop a ‘snow-ball’ effect of the number of citations received by such articles. [28] Some articles may simply be excluded because they were published too far back and hence have no electronic record. [29] Another important issue may be the availability of the articles on-line. Limited access articles that could be included in the study may be excluded and the citation results could become distorted. This is particularly the case when one uses only the ISI Web of Science to determine the number of citations. The ISI Web of Science is also not easily accessible and has a high subscription fee. In contrast, Google Scholar is freely available, and allows access to even those articles that have been published in journals not covered by the ISI Web of Science. The drawbacks of using Google Scholar is that it does not perform well for older publications and can also include some non-scholarly articles. It also is not updated as often as the ISI Web of Science. This comparison helps to highlight the importance of using two or more data bases while performing citation analysis. This methodology would ensure that all relevant articles are included for citation analysis and no literature is inadvertently excluded. These types of studies need to revised, perhaps on a yearly or five yearly basis, in order to keep track of the top-cited articles, and to identify the change in research trends in different fields of science. Citation analysis also aid in developing a data-base of relevant articles that any person interested in a particular topic or subject can access in order to be remain abreast with the top-cited literature.

**Conclusion:**

This article provides top-cited articles in dental traumatology and identifies the different characteristics of these articles. Epidemiology remains the primary cited topic of literature on dental traumatology, suggesting that research interests emphasize the incidence and prevalence of dental trauma with observational studies being the mainstay of these publications. ‘Dental Traumatology’ may be the best journal to study dental trauma.

**Tables:**

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| Rank | Article | No. of Citation |
| 1 | Andreasen JO. Etiology and pathogenesis of traumatic dental injuries A clinical study of 1,298 cases. European Journal of Oral Sciences. 1970;78(1-4):329-42. | 480 |
| 2 | Andreasen JQ, Ravn JJ. Epidemiology of traumatic dental injuries to primary and permanent teeth in a Danish population sample. International journal of Oral surgery. 1972;1(5):235-9 | 426 |
| 3 | Trabert KC, Caputo AA, Abou-Rass M. Tooth fracture-A comparison of endodontic and restorative treatments. Journal of endodontics. 1978;4(11):341-5 | 301 |
| 4 | Flores MT, Andersson L, Andreasen JO, Bakland LK, Malmgren B, Barnett F, et al. Guidelines for the management of traumatic dental injuries. II. Avulsion of permanent teeth. Dental Traumatology. 2007;23(3):130-6. | 284 |
| 5 | Bastone EB, Freer TJ, McNamara JR. Epidemiology of dental trauma: a review of the literature. Australian dental journal. 2000;45(1):2-9 | 242 |
| 6 | Andreasen JO. Luxation of permanent teeth due to trauma A clinical and radiographic followup study of 189 injured teeth. European Journal of Oral Sciences. 1970;78(1-4):273-86. | 213 |
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| 16 | Andreasen JO, Andreasen FM, Skeie A, HjortingHansen E, Schwartz O. Effect of treatment delay upon pulp and periodontal healing of traumatic dental injuries-a review article. Dental Traumatology. 2002;18(3):116-28. | 162 |
| 17 | Ravn JJ. Dental injuries in Copenhagen schoolchildren, school years 1967 to1972. Community dentistry and oral epidemiology. 1974;2(5):231-45. | 162 |
| 18 | Flores MT, Andreasen JO, Bakland LK, Feiglin B, Gutmann JL, Oikarinen K, et al. International Association of Dental Traumatology. Guidelines for the evaluation and management of traumatic dental injuries. Dent Traumatol. 2001;17(5):193-8. | 160 |
| 19 | Olsburgh S, Jacoby T, Krejci I. Crown fractures in the permanent dentition: pulpal and restorative considerations. Dental Traumatology. 2002;18(3):103-15. | 160 |
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| 22 | Glendor U. Epidemiology of traumatic dental injuries-a 12 year review of the literature. Dental Traumatology. 2008;24(6):603-11 | 152 |
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Table 1. Top-cited articles in dental traumatology with number of citations

|  |  |
| --- | --- |
| Country | Number of citation |
| Denmark 15  USA 14  Brazil 13  UK 11  Sweden 6  Chile 5  Turkey 5  Italy 4  Switzerland 4  Canada 3 | |

Table 2. Top ten countries of the first authors of the top-cited articles

|  |  |
| --- | --- |
| Name of Institution | Number of Citations |
| University Hospital (Rigshospitalet)  University of Valparaiso  Federal University of Santa Catarina  IADT  University of Oslo  University of São Paulo  Baylor College of Dentistry  Göteborg University  Jordan University of Science and Technology  Karolinska Institute  The University of Hong Kong  University of Alberta  University of Geneva  University of Kuopio  University of North Carolina  University of Pernambuco  University of Verona  University of Washington | 8  5  3  3  3  3  2  2  2  2  2  2  2  2  2  2  2  2 |

Table 3. Top institutions contributing to the top cited list

|  |  |
| --- | --- |
| Study Design | Number of Articles |
| Observational  CS survey  Review  Basic science  Experimental  Guidelines  Letter to the editor | 42  28  13  7  5  4  1 |

Table 4. Study designs of the top-cited articles

Table 5. Publishers of the top-cited articles

|  |  |
| --- | --- |
| Publishing groups | Number of articles |
| Wiley Online Library  Elsevier  europepmc.org  Eur Orthodontic Soc  informahealthcare.com  search.ebscohost.com  Wiley  aapd.org  collegeofdiplomates.org  jada.info  journals.lww.com  nature.com | 77  8  8  2  2  2  2  1  1  1  1  1 |

**Figure Legands:**

Graph 1. Top ten journals according to the number of published top-cited articles

Graph 2. Top-cited articles according to date of publication

Graph 3. First authors having most articles in the top-cited list

Graph 4. Collaboration of the authors of the top-cited article

Graph 5. Number of authors contributing to the top-cited list

Graph 6. Categorization of articles on the basis of field of study

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