SHORT REPORT

Prosthetic complications with dental implants: a bibliometric analysis of 20 top-cited articles

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Abstract

The purpose of this review was to explore the 20 most cited articles on prosthetic complications with dental implants. Identification of such articles could be helpful in prosthodontics residency programmes in devising the curriculum of essential reading material in implantology. The Institute for Scientific Information, Web of Science Database, and Google Scholar were used to identify the 20 top-cited articles published in journals from 1980 till June 2021. These articles were then evaluated according to the number of citations, authors, study design, publication year, and publishing journal. Descriptive statistics were computed for bibliometrics. It was observed that the citation count ranged from 6,391 to 315 (in descending order). The Toronto study is the most cited study on dental implant prosthetic complications. Prospective studies and systematic and narrative reviews were the predominant study designs used in the articles; however, alarmingly no randomised controlled trials were included in the list.

Keywords: Dental Implant failure; Prosthetic complication; Prosthetic failure.

DOI: 10.47391/JPMA.6510

Submission completion date: 03-06-2022
Acceptance date: 17-12-2022

Introduction

Dental implants have gradually evolved into a predictable method of replacement of missing teeth.[1] Though implants have shown high success and survival rate, a small proportion experience failure.[2] Years of research has given insight into the biomechanical properties of implant materials, their mode of failures, and the associated complications. Complications usually arise either at the surgical phase or at the prosthetic level. Understanding of the complications is important as this not only helps in addressing them but ideally prevent them from taking place.

With increasing number of implants done in general dental practice, it is imperative that dentists should be aware of the art and science of the management of complications that are encountered with implant prosthetics.

The rationale of the present paper is to identify the top-cited papers on implant prosthetic complications and to identify the papers which have influenced the knowledge-base and decision making on prosthetic/technical failures and complications with dental implants. Moreover, this report can help the academic faculty, mainly programme directors of the prosthodontics or dental implantology residency programmes, in compiling an essential reading list on implant prosthetic complications for their residents.

Materials and Methods

A bibliometric study was done to explore top 20 articles on the prosthetic complications of the dental implants. Two authors (AA and FRK) searched the pertinent literature on Web of Science, Google Scholar, and other electronic sources. The data search was done on June 30, 2021, by the authors (SMRK and HKA). The literature search was carried out to retrieve and appraise the 20 most-cited articles on prosthetic complications with dental implants, published in English language from 1980 till the search date. The option of "cited reference search" was employed for ascertaining the citations. To review and synthesise the data, multiple parameters were explored. These include authors, journal, citation count, citation density, keywords and study design, and geographic and institutional affiliation of the first or corresponding authors. The country of literature emergence was determined by the address of the corresponding author. Since, it was a bibliometric study so no prior protocol registration was required.

Results

Table-1 lists the 20 most-cited articles. The selected articles were listed in the descending order of the number

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Table 1: List of 20 top cited articles on prosthetic complications in dental implants

Title	Article type	Citation count	Density	Affiliation
Adell R, Lekholm U, Rockler BR, Brånemark PI. A 15-year study of osseo-integrated implants in the treatment of the edentulous jaw. Int J Oral Surg. 1981;10(6):387-416.[1]	Prospective study	6391	158	University of Göteborg, Sweden
Berglundh T, Persson L, Klinge B. A systematic review of the incidence of biological and technical complications in implant dentistry reported in prospective longitudinal studies of at least 5 years. J Clin Periodontol. 2002;29:197-212. [2]	Systematic Review	1357	74	Göteborg University, Sweden
Goodacre CJ, Bernal G, Rungcharassaeng K, Kan JY. Clinical complications with implants and implant prostheses. J Prosthet Dent. 2003;90(2):121-32. [3]	Narrative Review	1341	75	Loma Linda University, USA
Lindquist LW, Carlsson GE, Jemt T. A prospective 15-year follow-up study of mandibular fixed prostheses supported by osseo integrated implants. Clinical results and marginal bone loss. Clin Oral Implants Res. 1996;7(4):329-36. [4]	Prospective cohort	920	38	Göteborg University and The Brånemark Clinic, Public Dental Health, Göteborg, Sweden
Goodacre CJ, Kan JY, Rungcharassaeng K. Clinical complications of osseo integrated implants. J Prosthet Dent. 1999;81(5):537-52. [5]	Narrative Review	900	41	Loma Linda University, USA.
Zarb GA, Schmitt A. The longitudinal clinical effectiveness of osseo integrated dental implants: the Toronto study. Part III: Problems and complications encountered. J Prosthet Dent. 1990;64(2):185-94. [6]	Prospective cohort	889	29	University of Toronto, Faculty of Dentistry, Ontario, Canada.
Pjetursson BE, Brägger U, Lang NP, Zwahlen M. Comparison of survival and complication rates of tooth-supported fixed dental prostheses (FDPs) and implant-supported FDPs and single crowns (SCs).Clin Oral Implants Res. 2007;18 Suppl 3:97-113. [7]	Systematic review	873	63	University of Berne, Switzerland.
Cheng SJ, Tseng IY, Lee JJ, Kok SH. A prospective study of the risk factors associated with failure of mini-implants used for orthodontic anchorage. Int J Oral Maxillofac Implants. 2004;19(1): 100-6. [8]	Prospective cohort	802	46	National Taiwan, University, Taiwan
Jung RE, Zembic A, Pjetursson BE, Zwahlen M, Thoma DS. Systematic review of the survival rate and the incidence of biological, technical, and aesthetic complications of single crowns on implants reported in longitudinal studies with a mean follow-up of 5 years. Clin Oral Implants Res. 2012;23 Suppl 6:2-21. [9]	Systematic review	776	88	University of Zurich, Switzerland.
Moy PK, Medina D, Shetty V, Aghaloo TL. Dental implant failure rates and associated risk factors. Int J Oral Maxillofac Implants. 2005;20(4):569-77.[10]	Retrospective cohort	770	48	University of California, Los Angeles, USA
Albrektsson T. A multicentre report on osseointegrated oral implants. J Prosthet Dent. 1988;60(1):75-84. [11]	Cross sectional study	752	23	University of Göteborg, Göteborg Sweden
Brägger U, Aeschlimann S, Bürgin W, Hämmerle CH, Lang NP. Biological and technical complications and failures with fixed partial dentures (FPD) on implants and teeth after four to five years of function. Clin Oral Implants Res. 2001;12(1):26-34. [12]	Comparative cross-sectional	534	25	University of Berne, Switzerland
Schwarz MS. Mechanical complications of dental implants. Clin Oral Implants Res. 2000;11 Suppl 1:156-8. [13]	Narrative review	505	24	Torrance, CA, USA
Zarb GA, Schmitt A. The longitudinal clinical effectiveness of osseointegrated dental implants: the Toronto study. Part I: Surgical results. J Prosthet Dent. 1990;63(4):451-7. [14]	Prospective cohort	472	46	University of Toronto Faculty of Dentistry, Ontario, Canada

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Şahin S, Cehreli MC, Yalçın E. The influence of functional forces on the biomechanics of implant-supported prostheses—a review. J Dent. 2002;30(7-8):271-82. [15]	Narrative review	453	49	Faculty of Dentistry, Hacettepe University, Ankara, Turkey.
Haack JE, Sakaguchi RL, Sun T, Coffey JP. Elongation and preload stress in dental implant abutment screws. Int J Oral Maxillofac Implants. 1995;10(5):529-36. [16]	Basic science research	450	23	School of Dentistry, Minneapolis, USA.
Zarb GA, Schmitt A. The longitudinal clinical effectiveness of osseointegrated dental implants: the Toronto Study. Part II: The prosthetic results. J Prosthet Dent. 1990;64(1):53-61. [17]	Prospective cohort	405	90	University of Toronto, Faculty of Dentistry, Ontario, Canada.
Jemt T, Lindén B, Lekholm U. Failures and complications in 127 consecutively placed fixed partial prostheses supported by Brånemark implants: from prosthetic treatment to first annual checkup. Int J Oral Maxillofac Implants. 1992;7(1):40-4. [18]	Prospective cohort	369	26	Faculty of Odontology, Göteborg, Sweden.
Sailer I, Mühlemann S, Zwahlen M, Hämmerle CH, Schneider D. Cemented and screw-retained implant reconstructions: a systematic review of the survival and complication rates. Clin Oral Implants Res. 2012;23 Suppl 6:163-201. [19]	Systematic review	363	24	University of Zurich, Switzerland.
Gratton DG, Aquilino SA, Stanford CM. Micromotion and dynamic fatigue properties of the dental implant–abutment interface. J Prosthet Dent. 2001;85(1):47-52. [20]	Basic sciences research	315	15	University of Western Ontario, London, Ontario, Canada.

n= citations count as on 30th June 2021.
Density refers to citation density.

of citations.[1-20] The highest citation count observed for the top- most article 1 was 6,391 (Google Scholar) whereas the article number 20 on the list has thus far received only 315 citations.[20]

Table 2 shows that there were six articles each from the Clinical Oral Implant Research and the Journal of Prosthetic Dentistry, followed by five from International Journal of Oral & Maxillofacial Implants. One each from Journal of Dentistry, Journal of Clinical Periodontology and International Journal of Oral Surgery were included.

Table-2: List of journals, institutions and authors contributing top-cited papers on prosthetic complications in dental implants.

Name of Journal	*Article Count
Clinical Oral Implant Research	6
Journal of Prosthetic Dentistry	6
International Journal of Oral & Maxillofacial Implant	5
Name of the institution	
University of Goteborg, Sweden	5
University of Toronto, Canada	3
University of Berne, Switzerland	2
University of Zurich, Switzerland	2
Loma Linda University, USA	2
Top cited authors	
Zarb GA	3
Schmitt A	3
Zwahlen M	3

*Only top three or five articles are reported therefore the numbers don't necessarily sum up to 20.

The authors who contributed the most (or rather were cited the most in the literature) on the topic of implant prosthetic complications are Zarb GA,[6,14,17] Schmitt A[6,14,17] and Zwahlen M,[7,9,19] (three papers each) followed by Bragger U,[7,12] Lang NP,[7,12] Jem T,[4,18] and Pjetursson BE[7,9] (two papers each). The single most study that attracted maximum citations on implant prosthetic complication was the Toronto study, this study was published in three parts as three separate papers, with cumulative citations count exceeding 1763. [6,14,17]

Among the institutions, the University of Goteborg, Sweden (n=5) and the University of Toronto, Canada (n=3) were the leading institutions. According to the country of origin, the highest number of publications in the list were from Sweden and USA (five each) followed by Switzerland and Canada (four each).

Table 3 suggests that prospective cohort was the most

Table-3: Study designs of the 20 top-cited papers on prosthetic complications in dental implants

Article Type	Count
Prospective studies	7
Systematic reviews	4
Narrative reviews	4
Cross sectional studies	2
Basic sciences research	2
Retrospective studies	1

common study design in the top 20 papers list (n=7) followed by systematic reviews and narrative reviews (four each). No randomised controlled trial or quasi-experimental paper made it to the top 20 list on the topic.

Discussion

A scientific article is labelled as a 'classic paper' when its tally of citations goes beyond 100 (or 400 in some fields). In this context, all these top 20-cited articles can be considered as classic papers. Similar to medicine, the count of article references in dental publications are extensive. The citation count of an article reveals its acknowledgement by the scientific fraternity and the influence it has on the knowledgebase of the practitioners and the norms of clinical practice.

Regarding the science of implant prosthetic failures, Wang et al.[21] studied over 4,760 single implant crowns and recorded an annual complication rate of 2.56 per 100 prostheses. Screw loosening in the screw-retained while de-cementation in the cement-retained implant crowns were the most common complications. Inadequate aesthetics, ceramic chipping or fracture, and food packing around the inter-proximal contact areas were the other notable complications.

Jung et al.[9] carried out a systematic review on 46 studies. They documented survival rate of implants supported single crowns at five and 10 years, as 96.3% (95% CI: 94.2-97.6%) and 89.4% (95% CI: 82.8-93.6%), respectively. The technical complications had a cumulative prevalence of 8.8% (95% CI: 5.1-15.0%) for screw-loosening, 4.1% (95% CI: 2.2-7.5%) for de-cementation, and 3.5% (95% CI: 2.4-5.2%) for fracture of the veneer ceramic at five-year follow-up.

Regarding full arch prostheses, the most common complication reported was the fracture of the prosthetic tooth. With overdentures, need for adjustments was the most frequent problem.[22] The location of the dental implant (maxilla versus mandible) had no significant impact on the occurrence of prosthetic complications as no statistically significant difference was observed in the overall prosthetic failures between the maxillary and mandibular implants.[23] However, there are a few pre-requisites that should be followed to avoid implant failures. These include an insertion torque of over 35 Ncm for immediate loading, rigid (non-flexible) provisional prosthesis, and balanced occlusion without interferences. Lastly, a hygienically cleanable prosthesis that is biomechanically adjusted to the implant positions and customised to satisfy the needs of individual patient.[24]

The most reported outcome in implantology is the marginal bone loss. Most papers on prosthetic failures have reported the marginal bone loss as it depicts an early warning or essential sign of a failing implant. Our research group has recently published a bibliometric analysis on the surgical failures of the dental implants[25] whereas the present report is focussed on the prosthetic failures of implants.

The limitations of the present report are common to all bibliometric studies. Our study focussed on the published literature searched according to the key term of prosthetic complications with dental implant. There could be other terms that would imply prosthetic failures in other languages; those were certainly left out. The actual content, techniques, and procedures employed clinically regarding prosthetic complications is beyond the scope of the paper; being a bibliometric report only the number of citations were focussed on. Moreover, the quality of the papers was also not considered. Another bias that is inherent in the bibliometrics is the citation count as a function of time. An old article with a longer time on internet has a higher chance of being cited than a recent publication. Therefore, it has been generally accepted that the true significance and impact of an article cannot be truly estimated with bibliometrics alone. Other limitations include excluding non-English language papers and confining the research question to prosthetic complications only. Similarly, technical reasons for prosthetic failure were not explored.

Implications of the present report is that it identifies classical papers (most cited papers) on prosthetic failures so that clinicians, researchers, and residents can shortlist the papers and update themselves on how to avoid prosthetic failure in their implants.

Conclusion

The Toronto study is the most cited study on dental implant prosthetic complications. Investigators from Sweden, Switzerland, Canada, and USA were the most cited authors. Prospective studies, systematic and narrative reviews were the predominant study designs in the top 20 papers. It's alarming to note that no randomised controlled trial is included in the most cited papers on this subject.

Disclaimer: None.

Conflict of Interest: The authors confirm that they have no conflict of interests regarding publication of this study.

Source of Funding: None.

Ethical Considerations: Since this manuscript is a bibliometric study based on already published literature

and there is no involvement of human or animal subjects, no ethical approval was needed.

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