Critical Review on Aluminium Based Dental Implants

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Abstract

The visualisation of research trends in Aluminium dental implants through Review analysis had been conducted in this paper. This research will help to understand the active authors, organizations, journals, and countries involved in the research on "Aluminium dental implants". All published articles related to "Aluminium dental implants" from "Scopus", were analyzed using the Meta Analysis to prepare and present the research trends. This article had set the objective to consolidate the scientific literature regarding "Aluminium dental implants" and also to find out the trends related to the same. The leading Journals were the Dental Materials. The most active country was the United States of America. The leading organization engaged in the research regarding Aluminium-implants was the Sao Paulo State University, Brazil. The most active authors who had made valuable contributions related to Aluminium dental implants were Camilleri J. and Ozcan M.

Keywords: Aluminium, Dental implants, Material engineering, Review analysis, Meta Analysis,

1. Introduction

Aluminium based dental implants are widely used in dentistry. Aluminium dental implants are widely used for treating dental bones and coating (Beldüz *et al.*, 2010).Corrosion is a major threat to Aluminium-based implants.(Bayer, Tiwari and Megaridis, 2008) but can be handled by the advances in material engineering; surface coating; and by using Aluminium free implants (Choudhary *et al.*, 2014). The other challenges faced by Aluminium dental implants are the allergy or hypersensitivity; and toxicity of Aluminium implants. However, the toxicity and allergy of Aluminium implants are comparatively negligible and thus much safer than several counterparts. Another issue associated with Aluminium implants is the high level of serum Aluminium level (Grübl *et al.*, 2006) and lead to various complicated health issues. But contradictory studies are highlighting that there is no evidence for high-level Aluminium content (Adams *et al.*, 2003) Issues of cracks were also associated with Aluminium-based implants.

Aluminium is used to treat dental pulp tissues (Beldüz *et al.*, 2010). Aluminium oxides were also used for various dental ceramic implants (Büsing *et al.*, 1983)(Cook, Anderson and Lavernia, 1983)(Cook, Klawitter and Weinstein, 1981)(Cook, Weinstein and Klawitter, 1982, 1983; Cook *et al.*, 1983); Aluminium usage for dental fillings for biocompatible film coating on dental alloys.

Innovations in material and surface engineering revolutionize the performance and life of Aluminium dental–implants along with measures for reducing toxicity and hypersensitivity of the metal. This Review analysis will be a useful platform for future researchers by realizing the top researchers, organizations, and countries involved in research regarding Aluminium dental implants.

This article is arranged into four sections. The first section is the introduction, followed by the discussion of the methodology by which the research was conducted. The third section deals with results and

discussion. The fourth section deals with the conclusion. The following research objectives and research questions were framed for conducting Review analysis systematically.

1.1 Research Objectives

a) To consolidate the literature regarding Aluminium-based dental implants
b) To find out the trends related to research in Aluminium-based dental implants

1.2 Research Questions

a) Who are the active researchers working on Aluminium-based dental implants?
b) Which are the main organizations and countries working on Aluminium-based dental implants?
c) Which are the main journals onAluminium-based dental implants?

2. Research Methodology

Scopus files had been used for this article. For the article selection, the Boolean used was TITLE-ABS (Aluminium dental)on. All the tables in this paper were created by using Microsoft Excel and Meta Analysis. Grammarly was used for spelling and grammar checks. Mendeley was used for article review and citation.This paper had been inspired by Review analysis in its presentation style, analysis, and methodology from the works.

3. Results and discussion

3.1 Results

This first round of search produced an outcome of 1375 documents, in 20 languages, out of which 1278 documents were in English. The classification of document categories is shown in Table 1. For improving the quality of the analysis, we had selected only the peer-reviewed articles and all other documents had not been considered. Thus after using filters “Article” and “English” the second round search produced an outcome of1067English articles (both open access and others) and had been used to conduct Review analysis and visualization using Meta Analysis. The English research articles in this domain since 1951 had been shown in Figure1.

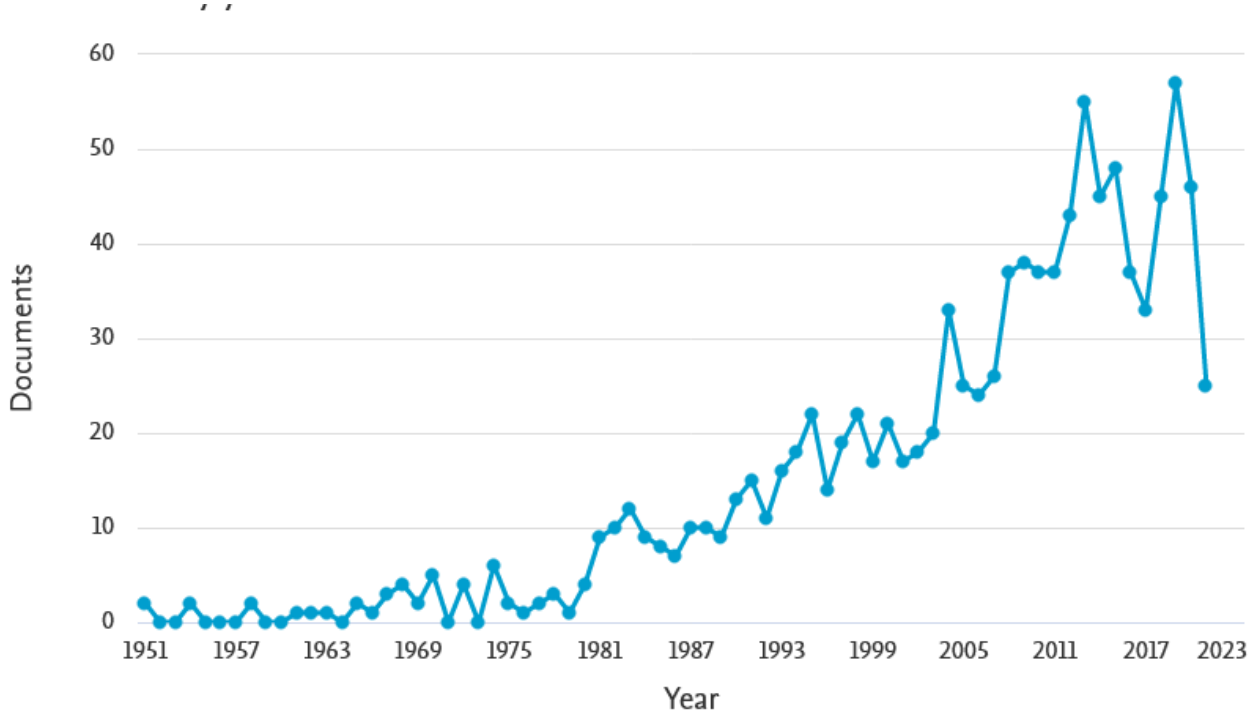

Figure 1: Period wise publication of articles, Source: WWW.scopus.com

Co-authorship analysis of top authors had been shown in Table 3. For a better presentation of the analysis, the parameters used were the minimum number of documents of an author as five and the minimum number of citations of authors as one. This combination plotted the map of19authors, in 11clusters. The overlay visualization map of co-authorship analysis plotted in Table1, points out the major researchers with their strong co-authorship linkages and clusters involved.

The citation analysis of top authors had been shown in table 1, along with co-authorship links. For the citation analysis, the parameters used were the minimum number of documents of an author as one and the minimum citations of an author as one.

Table 1: Highlights of most active authors

Description	Authors	Documents	Citations	Average citations per documents	Link strength
Authors with the highest publication and co-authorship links	Camilleri J.	11	780	71	26
Authors with the highest citations	Ozcan M.	9	276	31	35

In Co-occurrence analysis, we had used all keyword analyses, by keeping the minimum number of occurrences of a keyword as90. This combination plotted the map of 25thresholds, in three clusters. The overlay visualization of co-occurrence analysis of keywords has been shown in Table2.The leading organizations engaged in research on “Aluminium dental implants” had been found out by the volume of publications and citation analysis, the parameters used are the minimum number of documents of an organization as one and the minimum number of citations of organizations as one. The leading organization in the research regarding “Aluminium dental implants”, with the highest number of publications and citations, was the Sao Paulo State University, Brazil(Refer to table 2).

Table 2: Highlights of the most active organization

Organizations	Country	Documents	Citations	Average Citations per document
Sao Paulo State University	Brazil	17	170	10

Co-authorship analysis of the countries engaged in the research on "Aluminium dental implants" had been shown in Table3. The overlay visualization map of co-authorship analysis plotted in Table3, points out the main countries with their strong co-authorship linkages and clusters involved. The citation analysis of top countries had been shown in table 3, along with co-authorship links. For the citation analysis, the parameters used were the minimum number of documents of acountry as one and the minimum citations of the country as one.

Table 3: Highlights of Active Countries

Description	Country	Documents	Citations	Link strength
The country with the highest publication, citations, and co-authorship links	United States of America	224	6136	97

The most active country in this research domain was the United States of America, with the highest number of publications, and citations.

Link analysis and citation analysis were used to identify the most active journal in this research domain. We have taken the parameters of the minimum number of documents of a journal as one and the minimum number of citations of a journal as one for the link analysis and citation analysis. Highlights of the most active and relevant journals related to "Aluminium dental implants" are shown in table 4. Table 4shows the journal activity of this research domain through parameters of publication volume, citations, and co-authorship linkages.

Table 4: Analysis of journal activity

Description	Journal details	Documents	Citations	Average citations per documents	Links
Journal with the highest publications, citations and links	Dental Materials	63	3419	54.2	90

From the above discussion regarding the Review patterns in the research regarding Aluminium dental implants,this research had observed a gradual increase in research interest regarding Aluminium dental implantsfrom the starting of the millennium, and the momentum is going on positively. This points out the relevance and potential of this research domain (Refer to Table 2).The most active authors in this research domain were Camilleri J. and Ozcan M with the highest publication and co-authorship links; and citations respectively(Refer to table 1).The overlay analysis of top countries researching Aluminium dental implants indicates that the United States of America was the leading country relating to the highest number of publications, citations, and co-authorship links(Refer to Table 5). The top journals of this research domain were identified as the Dental Materials. From these wide sources of information, researchers can focus on top journals where they can identify the most relevant and highly cited articles regarding Aluminium dental–implants.

4. Conclusion

Aluminium dental implants was an interesting research domain and the most active journals related to this research domain was the Dental Materials. The most active country was the United States of America. The leading organization engaged in the research regarding Aluminium-implants was the Sao Paulo State University, Brazil. The most active authors who had made valuable contributions related to Aluminium dental implants were Camilleri J. and Ozcan M. This research domain offers a new avenue for researchers and future research can be on innovations in Aluminium dental implants.

References

1. Adams, J. E. *et al.* (2003) 'Prosthetic implant associated sarcomas: A case report emphasizing surface evaluation and spectroscopic trace metal analysis', *Annals of Diagnostic Pathology*, 7(1), pp. 35–46. doi: 10.1053/adpa.2003.50006.
2. Beldüz, N. *et al.* (2010) 'The effect of neodymium-doped yttrium aluminum garnet laser irradiation on rabbit dental pulp tissue', *Photomedicine and Laser Surgery*, 28(6), pp. 747–750. doi: 10.1089/pho.2009.2702.
3. Büsing, C. M. *et al.* (1983) 'Morphological demonstration of direct deposition of bone on human aluminium oxide ceramic dental implants', *Biomaterials*, 4(2), pp. 125–127. doi: 10.1016/0142-9612(83)90052-2.
4. Choudhary, L. *et al.* (2014) 'In-vitro characterization of stress corrosion cracking of aluminium-free magnesium alloys for temporary bio-implant applications', *Materials Science and Engineering C*, 42, pp. 629–636. doi: 10.1016/j.msec.2014.06.018.
5. Cook, S. D. *et al.* (1983) 'Quantitative histologic evaluation of LTI carbon, carbon-coated aluminum oxide and uncoated aluminum oxide dental implants', *Journal of Biomedical Materials Research*, 17(3), pp. 519–538. doi: 10.1002/jbm.820170311.
6. Cook, S. D., Anderson, R. C. and Lavernia, C. J. (1983) 'Histologic and microradiographic evaluation of textured and nontextured aluminum oxide dental implants', *Biomaterials, Medical Devices, and Artificial Organs*, 11(4), pp. 259–269. doi: 10.3109/10731198309118812.
7. Cook, S. D., Klawitter, J. J. and Weinstein, A. M. (1981) 'The influence of implant elastic modulus on the stress distribution around LTI carbon and aluminum oxide dental implants', *Journal of Biomedical Materials Research*, 15(6), pp. 879–887. doi: 10.1002/jbm.820150612.
8. Cook, S. D., Weinstein, A. M. and Klawitter, J. J. (1982) 'Parameters affecting the stress distribution around LTI carbon and aluminum oxide dental implants', *Journal of Biomedical Materials Research*, 16(6), pp. 875–885. doi: 10.1002/jbm.820160612.
9. Cook, S. D., Weinstein, A. M. and Klawitter, J. J. (1983) 'The retention mechanics of LTI carbon, carbon-coated aluminum oxide, and uncoated aluminum oxide dental implants', *Journal of Biomedical Materials Research*, 17(5), pp. 873–883. doi: 10.1002/jbm.820170514.
10. Grübl, A. *et al.* (2006) 'Serum aluminium and cobalt levels after ceramic-on-ceramic and metal-on-metal total hip replacement', *Journal of Bone and Joint Surgery - Series B*, 88(8), pp. 1003–1005. doi: 10.1302/0301-620X.88B8.17870.
11. Subramanian, B., Ananthakumar, R. and Jayachandran, M. (2010) 'Microstructural, mechanical and electrochemical corrosion properties of sputtered titanium-aluminum-nitride films for bio-implants', *Vacuum*, 85(5), pp. 601–609. doi: 10.1016/j.vacuum.2010.08.019.