

A Study on Research Trends in Aluminium Oxide Implants

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Abstract

This research paper is the visualisation of research trends in the usage of Aluminium oxide for medical implants using Review analysis. This research will help to understand the active authors, organizations, journals, and countries involved in the research of “Aluminium oxide-based implants”. All published articles related to “Aluminium oxide-based implants” from “Scopus”, were analyzed using the Meta Analysis to develop analysis tables and visualization maps. This article had set the objective to consolidate the scientific literature regarding “Aluminium oxide-based implants” and also to find out the trends related to the same. The leading Journals were the Journal of Biomedical Materials Research, Biomaterials and International Journal of Oral and Maxillofacial Implants. The most active country was the United States of America. The leading organization engaged in research regarding Aluminium oxide-based implants was the University of Ottawa Eye Institute of Canada. The most active authors who had made valuable contributions related to Aluminium oxide-based implants Jordan D.R and Wennerberg A.

Keywords: Aluminium oxide, Implants, Material engineering, Review analysis, Meta Analysis,

1. Introduction

Aluminium and Aluminium oxides are used for medical implants and for preparing medicines. Moreover, Aluminium oxides are used as a coating for various medical implants. Despite various advantages and diversified application of Aluminium implants like, bone implants, knee, tissue engineering and hip implants; the major challenge associated with Aluminium oxide implants is corrosion of the Aluminium implants. However, the threat of corrosion of Aluminium implants can be handled by the advances in material engineering; surface coating; and by using Aluminium free implants (Choudhary *et al.*, 2014). There are other challenges of the allergy or hypersensitivity; and toxicity; high level of serum Aluminium level (Grübl *et al.*, 2006) and lead to various complicated health issues.

Aluminium oxides are used for the surface coating of orthopaedic implants (Dunn *et al.*, 1976) and also used for preventing corrosion of biomedical implants. Aluminium oxide is also used for improving the tissue compatibility of Titanium implants (Frolov *et al.*, 1995). Aluminium oxide is used for surface coating and encapsulation of bio-implants (Gembaczka *et al.*, 2014)(Walpole *et al.*, 2003; Tercero *et al.*, 2009; Nejatidanesh, Savabi and Jabbari, 2014); improving the efficiency of implants through Nanoporous inorganic membranes or coatings (Gultepe *et al.*, 2010); orbital implants.

Material engineering and surface engineering can play a significant role in improving the performance and life of Aluminium oxide-based-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 oxide-based-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

- To consolidate the literature regarding Aluminium oxide-based implants
- To find out the trends related to research in Aluminium oxide-based implants

1.2 Research Questions

- Who are the active researchers working on Aluminium oxide-based implants?
- Which are the main organizations and countries working on Aluminium oxide-based implants?
- Which are the main journals on Aluminium oxide-based implants?

2. Research Methodology

Scopus files had been used for this article. For the article selection, the Boolean used was TITLE-ABS (Aluminium oxide implant). 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 506 documents, in 18 languages, out of which 433 documents were in English. The classification of document categories is shown in Figure 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 of 335 English 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 1967 had been shown in Figure 1.

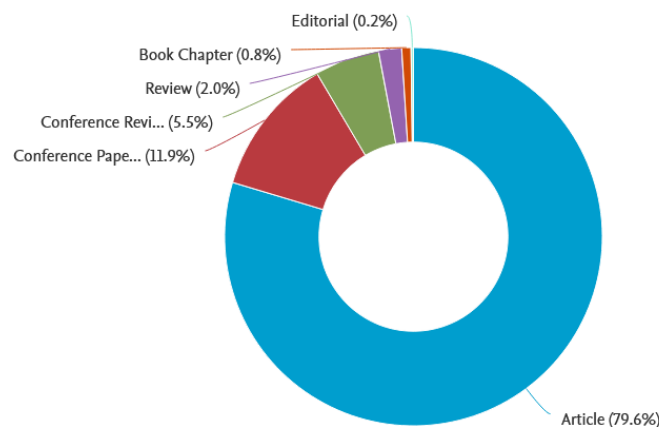


Figure 1: Classification of the documents on “Aluminium oxide-based implants”,

Co-authorship analysis of top authors had been shown in Table 1. For a better presentation of the analysis, the parameters used were the minimum number of documents of an author as three and the minimum number of citations of authors as one. This combination plotted the map of 31 authors, in 14 clusters. The overlay visualization map of co-authorship analysis plotted in Table 1, 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. 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 links	Jordan D.R	14	487	35	37
Authors with the highest citations	Wennerberg A.	4	568	142	14

In Co-occurrence analysis, we had used all keyword analyses, by keeping the minimum number of occurrences of a keyword as 40. This combination plotted the map of 26 thresholds, in three clusters. The overlay visualization of co-occurrence analysis of keywords has been shown in Table 2. The leading organizations engaged in research on “Aluminium oxide-based 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 oxide-based implants”, with the highest number of publications and citations, was the University of Ottawa Eye Institute, Canada (Refer to table 2).

Table 2: Highlights of the most active organization

Organizations	Country	Documents	Citations	Average Citations per document
University of Ottawa Eye Institute	Canada	8	352	44

Co-authorship analysis of the countries engaged in the research on “Aluminium oxide-based implants” had been shown in Table 3. The overlay visualization map of co-authorship analysis plotted in Table 3. 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 a country 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 leading publication, citations, and co-authorship links	United States of America	99	3796	39

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 oxide-based implants” are shown in table 4. Table 4 shows the journal activity of this research domain through parameters of publication volume and citations.

Table 4: Analysis of journal activity

Description	Journal details	Documents	Citations	Average citations per documents
Journal with the highest publications	Journal of Biomedical Materials Research	20	1165	8
Journal with the highest citations	Biomaterials	16	1198	22
Journal with the highest links	International Journal of Oral and Maxillofacial Implants	19	1137	24

From the above discussion regarding the Review patterns in the research regarding Aluminium oxide-based implants, this research had observed a gradual increase in research interest regarding Aluminium oxide-based implants from 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 Jordan D.R and Wennerberg A. with the highest publication and links; and citations respectively (Refer to table 1). The overlay analysis of top countries researching Aluminium oxide-based implants indicates that the United States of America was the leading country relating to the highest number of publications and citations (Refer to Table 5). The top journals of this research domain were identified as the Journal of Biomedical Materials Research, Biomaterials and International Journal of Oral and Maxillofacial Implants. 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 oxide-based implants.

4. Conclusion

Aluminium oxide-based implants was an interesting research domain and the most active journals related to this research domain was the Journal of Biomedical Materials Research, Biomaterials and International Journal of Oral and Maxillofacial Implants. The most active country was the United States of America. The leading organization engaged in research regarding Aluminium oxide-based implants was the University of Ottawa Eye Institute of Canada. The most active authors who had made valuable contributions related to Aluminium oxide-based implants Jordan D.R and Wennerberg A. with the highest publication and links; and citations respectively. This research domain offers a new avenue for researchers and future research can be on innovations in Aluminium oxide-based implants.

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