

A Bibliometric Analysis and Visualisation of Research Trends in Toxicity of Chromium Implants

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Abstract: The toxicity of implants is a vital factor affecting the safety of implants. The bibliometric analysis had been conducted to understand the active authors, organizations, journals, and countries involved in the research domain of “toxicity of Chromium implants”. All published articles related to “toxicity of Chromium implants” from “Scopus”, were analyzed using the VOS viewer to develop analysis tables and visualization maps. This article had set the objective to consolidate the scientific literature regarding “toxicity of Chromium implants” and also to find out the trends related to the same. The most active journals in this research domain were the Journal of Biomedical Materials Research, Journal of Bone and Joint Surgery, and Biomaterials. The most active country was the United States of America. The leading organizations were the University Medical Center and the University of Strathclyde. The most active authors were Grant M.H., Jacobs J.J., and Savarino I.

Keywords: Toxicity of implants, Chromium implant, Material engineering, Bibliometric analysis, VOS viewer,

1. Introduction

An engineered medical device to replace a missing or damaged biological structure is known as an implant. Different types of metals and materials are used to create implants and the most popularly used metals and alloys for bio-implants are stainless steel, cobalt-chromium alloy, and Titanium (Priyanka et al., 2014). Various types of implants had been used in modern medicine and include sensory implants, neurological implants, cardiovascular implants, orthopedic implants, contraceptive implants, and cosmetic implants.

Despite having various advantages associated with implants, the safety of implants is an important parameter associated with acceptance. As various metals and alloys are used as implants, the toxicity of implants and treatments to reduce implants is a serious issue to be addressed. Material engineering and surface engineering play a vital role in the selection and usage of safe metals and alloys as implants. The toxicity of implant can be possible through wear and corrosion of the metal; and through allergy of the metal implant. Serious health issues due to corrosion and wear of metal-metal implants based on Cobalt and Chromium (Campbell and Estey, 2013) (Cobb and Schmalzreid, 2006) Cytotoxic effects of chromium-based dental implants had been identified (Arvidson et al., 1987). Implants derived Cobalt-Chromium and molybdenum (CoCrMo alloy) nanoparticle disrupts DNA replication dynamics in neuronal cells (Bijukumar et al., 2021) Hip-implant based on chromium had been reported the issue of toxicity (Ng, Ebnetter and Gilhotra, 2013); similarly, toxicity due to implants based on cobalt-chromium alloys (Posada et al., 2015); (Posada, Tate, and Grant, 2015). Toxicity and health issues associated with chromium implants may be serious not only to users but the health professionals, regularly handling chromium implants (Armstead et al., 2017).

This bibliometric analysis will be a useful platform for future researchers by realizing the top researchers, organizations, and countries involved in research regarding the toxicity of chromium 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 bibliometric analysis systematically.

1.1 Research Objectives

- To consolidate the literature regarding the toxicity of chromium implants
- To find out the trends related to research in toxicity of chromium implants

1.2 Research Questions

- Who are the active researchers working on the toxicity of chromium implants?
- Which are the main organizations and countries working on the toxicity of chromium implants?
- Which are the main journals related to the toxicity of chromium implants?

2. Research Methodology

Scopus files had been used for this article. For the article selection, the Boolean used was TITLE-ABS-KEY (Toxicity Chromium Implants) on 02/03/2021. All the tables in this paper were created by using Microsoft Excel and VOS Viewer. Grammarly was used for spelling and grammar checks. Mendeley was used for article review and citation. This paper had been inspired by bibliometric analysis in its presentation style, analysis, and methodology from the works (Farhat et al., 2013; Liao et al., 2016; Kolkailah et al., 2019; Rodríguez-Padial et al., 2019; Tran et al., 2019; Ullah et al., 2019; Shahid et al., 2020).

3. Results and discussion

3.1 Results

This first round of search produced an outcome of 206 documents, in five languages, out of which 192 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 139 English articles (both open access and others) and had been used to conduct bibliometric analysis and visualization using VOS Viewer. The English research articles in this domain since 1967 had been shown in Figure 2.

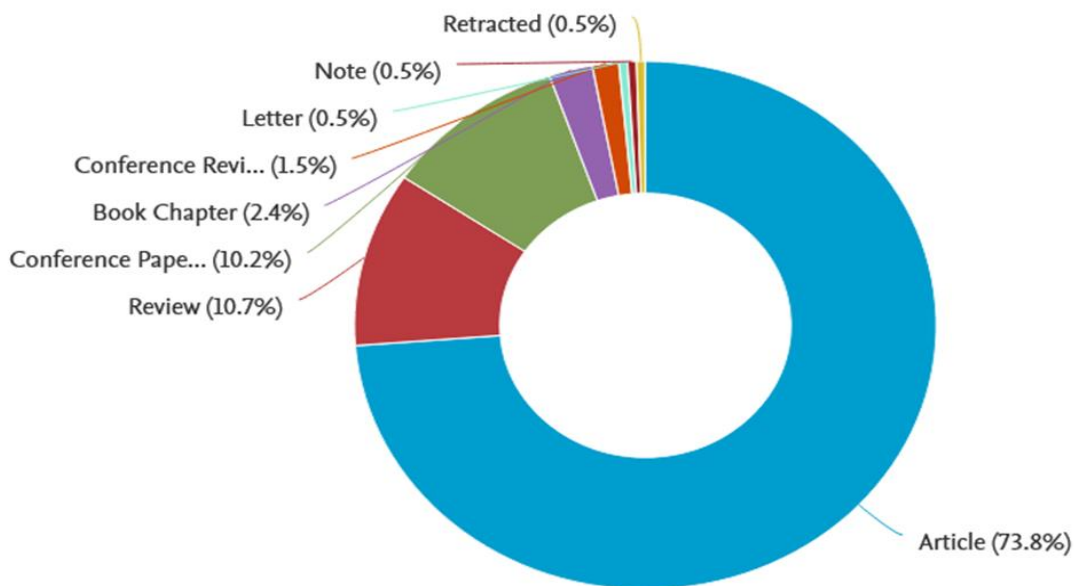


Figure 1: Classification of the documents on “Toxicity of Chromium implants”, Source: www.scopus.com

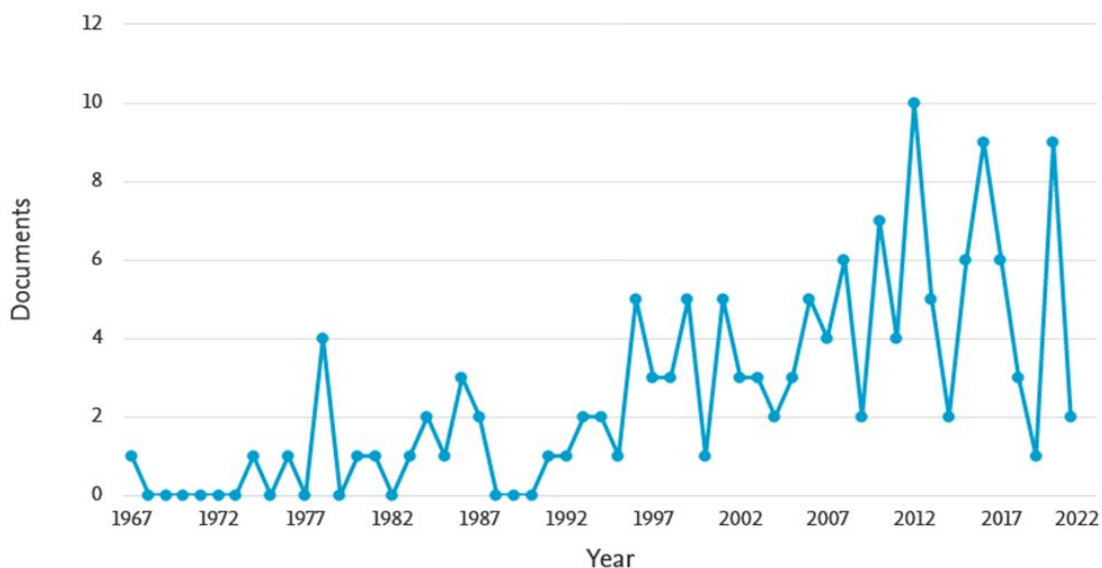


Figure 2: Period wise publication of articles, Source: WWW.scopus.com

Co-authorship analysis of top authors had been shown in figure 3. 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 16 authors, in seven clusters. The overlay visualization map of co-authorship analysis plotted in Figure 3, points out the major researchers with their strong co-authorship linkages and clusters involved.

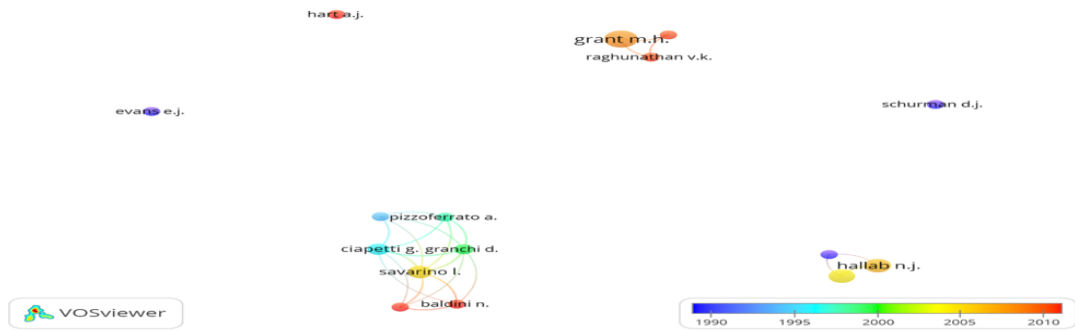


Figure 3: Co-authorship analysis on basis of authors

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	Grant M.H.	11	337	30.6	22
Authors with the highest citations	Jacobs J.J	7	1116	159.4	30
Authors with the highest co-authorship links	Savarino I.	6	237	39.5	41

In Co-occurrence analysis, we had used all keyword analyses, by keeping the minimum number of occurrences of a keyword as 20. This combination plotted the map of 34 thresholds, in three clusters. The overlay visualization of co-occurrence analysis of keywords has been shown in Figure 4.

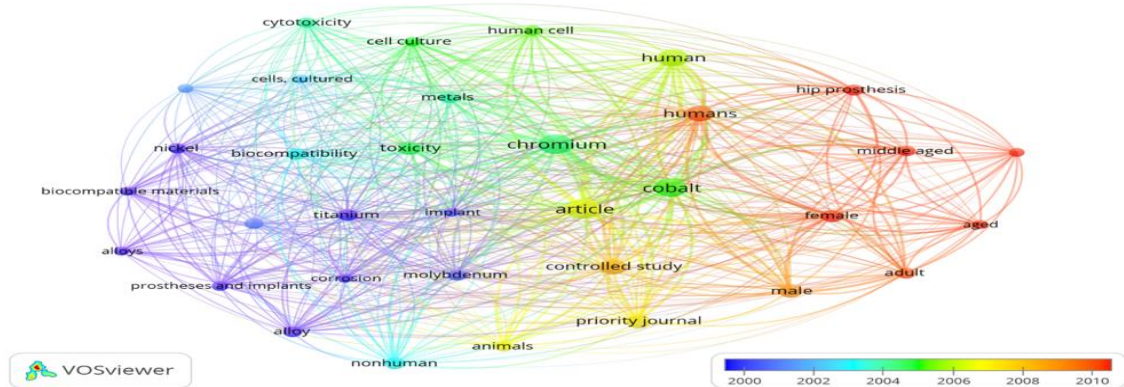


Figure 4: Co-occurrence analysis on basis of all keywords

The leading organizations engaged in research on the “toxicity of chromium 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 organizations in the research regarding “toxicity of implants”, with the highest number of publications and citations, were the Rush University Medical Center, the United States of America, and University of Strathclyde, Scotland. (Refer to table 2).

Table 2: Highlights of the most active organization

Organizations	Country	Document s	Citatio ns	Average Citations per document
Rush University Medical Center	United States of America	11	1222	111.1
University of Strathclyde	Scotland	11	337	30.16

Co-authorship analysis of the countries engaged in the research on “toxicity of chromium implants” had been shown in Figure 5. The overlay visualization map of co-authorship analysis plotted in Figure 5, points out the main countries with their strong co-authorship linkages and clusters involved.



Figure 5: Co-authorship analysis on basis of countries

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	Document s	Citation s	Link strength
The country with the highest publication, citations, and links	United States of America	63	3363	18

The most active country in this research domain was the United States of America, with the highest number of publications, links, 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 “toxicity of chromium implants” are shown in table 4. Table 4 shows 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
Journal with the highest publications	Journal of Biomedical Materials Research	16	957	15
Journal with the highest citations	Journal of Bone and Joint Surgery	4	1254	17
Journal with the highest co-authorship links	Biomaterials	14	1017	32

From the above discussion regarding the bibliometric patterns in the research regarding “toxicity of Chromium implants”, this research had observed a gradual increase in research interest regarding “toxicity of Chromium 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 Figure 2). The most active authors in this research domain were Grant M.H., Jacobs J.J, and Savarino I. with the highest publication, citations, and co-authorship links respectively (Refer to table 1). The overlay analysis of top countries researching “toxicity of Chromium 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 figure 5). The top journals of this research domain were identified as the Journal of Biomedical Materials Research, Journal of Bone and Joint Surgery, and Biomaterials with the highest publication, citations, and co-authorship links respectively. From these wide sources of information, researchers can focus on top journals where they can identify the most relevant and highly cited articles regarding the toxicity of implants.

4. Conclusion

Toxicity of implants was an interesting research domain and the most active journals related to this research domain was the Journal of Biomedical Materials Research, Journal of Bone and Joint Surgery, and Biomaterials. The most active country was the United States of America. The leading organizations were University Medical Center, United States of America, and University of Strathclyde, Scotland. The most active authors who had made valuable contributions related to the toxicity of implants were Grant M.H., Jacobs J.J, and Savarino I. with the highest publication, citations, and co-authorship links respectively. This research domain offers a new avenue for researchers and future research can be on innovations in the toxicity of Chromium implants.

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