

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

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Abstract: Several metals are used for Knee implants. Toxicity of metals may lead to toxicity of knee implants. This bibliometric analysis had been conducted to understand the active authors, organizations, journals, and countries involved in the research domain of “toxicity of knee implants”. All published articles related to “toxicity of knee 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 knee implants” and also to find out the trends related to the same. The most active journal in this research domain was Biomaterials. The most active country was the United States of America. The leading organization engaged in research regarding the toxicity of knee implants were the Indian Institute of Science, Bengaluru, India, University of Leeds, United Kingdom, and the Beihang University of China. The most active authors were Hallab N.J. and Jacobs J.J.

Keywords: knee-implants, Toxicity, 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. Human knee joints are facing numerous problems including wear, damage, and accidents. Total knee replacement surgery can improve quality of life in cases where repair of the knee is impossible. A knee implant is placed in the knee joint in cases of total knee replacement. Knee implants are often used subjected to wear and corrosion and ultimately lead to poor performance, pain, and wastage of money. Material engineering and surface engineering can play a significant role in the development of new types of knee implants; and in enhancing the performance of knee implants.

Hypersensitivity to Nickel is a serious issue associated with Nickel based knee implants, which can even lead to failure of Nickel knee implants (Apostolopoulos et al., 2018)(Akil et al., 2018)(Beecker, Gordon and Pratt, 2009)(Bergschmidt, Bader and Mittelmeier, 2012)(Bloemke and Clarke, 2015)(Desai et al., 2019)(Dezulovic et al., 2012). Similarly, high metal concentration on the body had also been reported as an adverse effect of Nickel-based knee implants (Cracchiolo III. and Revell, 1982)(Wolff et al., 2017); wear debris from knee replacements may cause chromosomal damages in human cells (Daley et al., 2004). Sensitivity to Chromium and wear may also lead to the loosening of a component of the prosthesis after total joint replacement (Brown et al., 1977). A popular problem raised along with knee implants is the toxicity of Chromium used for the knee implants. Bone health may be affected by the wear of chromium ions from chromium-based implants and may ultimately lead to bone-related complications (Andrews et al., 2011). Monitoring of chromium levels in the blood of patients is necessary (Barry, Lavigne and Vendittoli, 2013)(Back, Young and Shimmin, 2005). In short, the toxicity of knee implants are actually toxicity of metal on which the implant was based.

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 knee 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

- a) To consolidate the literature regarding the toxicity of knee implants
- b) To find out the trends related to research in toxicity of knee implants

1.2 Research Questions

- a) Who are the active researchers working on the toxicity of knee implants?
- b) Which are the main organizations and countries working on the toxicity of knee implants?
- c) Which are the main journals related to the toxicity of knee implants?

2. Research Methodology

Scopus files had been used for this article. For the article selection, the Boolean used was TITLE-ABS-KEY (Toxicity knee implant) on 09/03/2021. 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; Kolkaillah 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 56 documents, in 4 languages, out of which 54 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 37 English articles (both open access and others). This paper had used all English articles to conduct bibliometric analysis and visualization using VOS Viewer. The English research articles in this domain since 1976 had been shown in Figure 2.

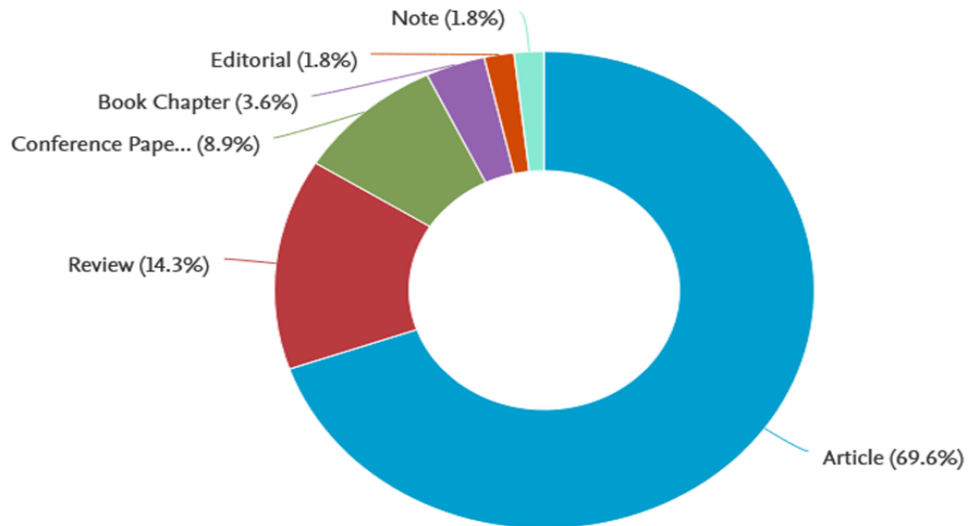


Figure 1: Classification of the documents on “Toxicity of knee implants”, Source: www.scopus.com

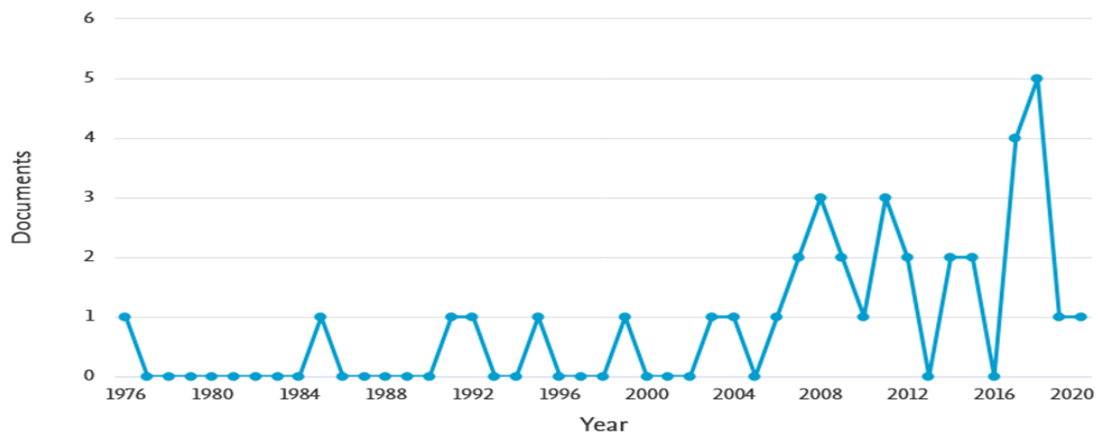


Figure 2: Period wise publication of articles, Source: WWW.scopus.com

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 one and the minimum number of citations of authors as one hundred. This combination plotted the map of 33 authors, in 6 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.

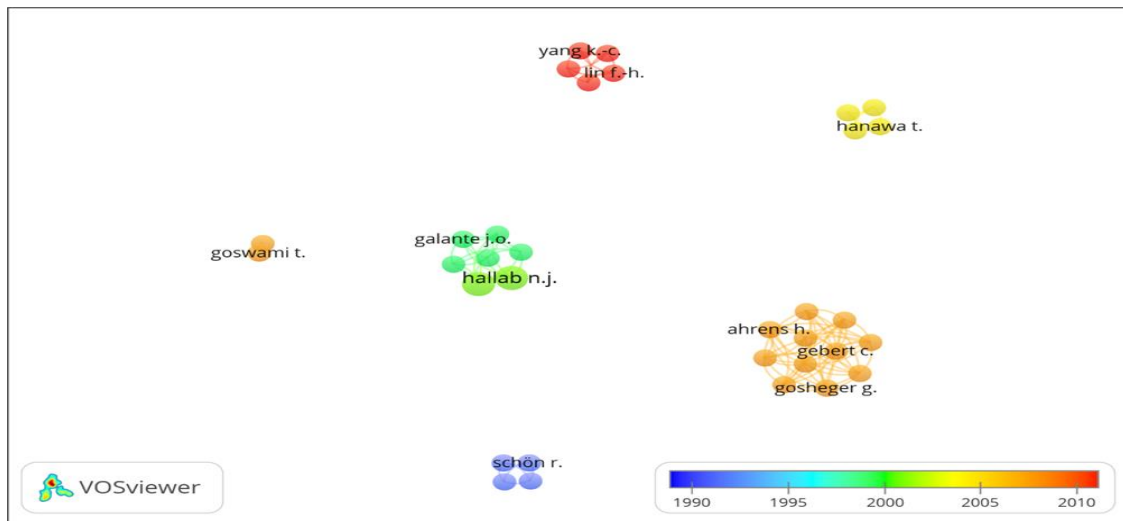


Figure 3: Co-authorship analysis on basis of authors

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
Leading authors on the toxicity of knee implants	Hallab N.J.	2	162	81	7
	Jacobs J.J	2	162	81	7

In Co-occurrence analysis, we had used all keyword analyses, by keeping the minimum number of occurrences of a keyword as six. This combination plotted the map of 29 thresholds, in two clusters. The overlay visualization of co-occurrence analysis of keywords has been shown in Figure 4.

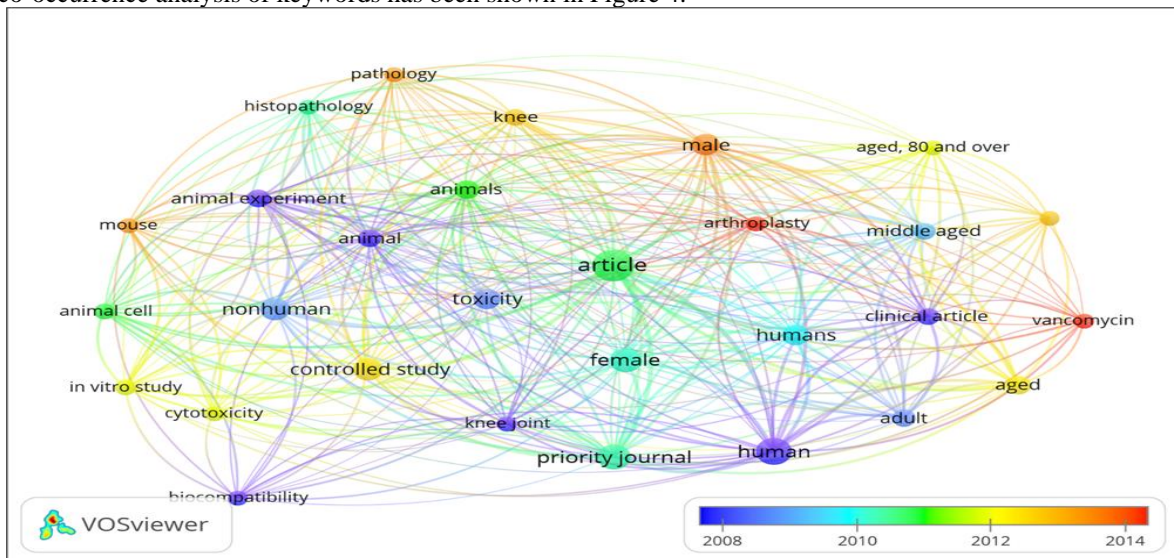


Figure 4: Co-occurrence analysis on basis of all keywords

The leading organizations engaged in research on “toxicity of knee 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 “toxicity of knee implants”, with the highest number of publications and citations, was the Indian Institute of Science, Bengaluru, India, University of Leeds, United Kingdom, and Beihang University (Refer to table 2).

Table 2: Highlights of the most active organization

Organizations	Country	Documents	Citations	Average Citations per document
Beihang University	China	2	103	51.5
Indian Institute of Science	India	2	23	11.5
University of Leeds	United Kingdom	2	14	7

Co-authorship analysis of the countries engaged in the research on “Toxicity of knee 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.

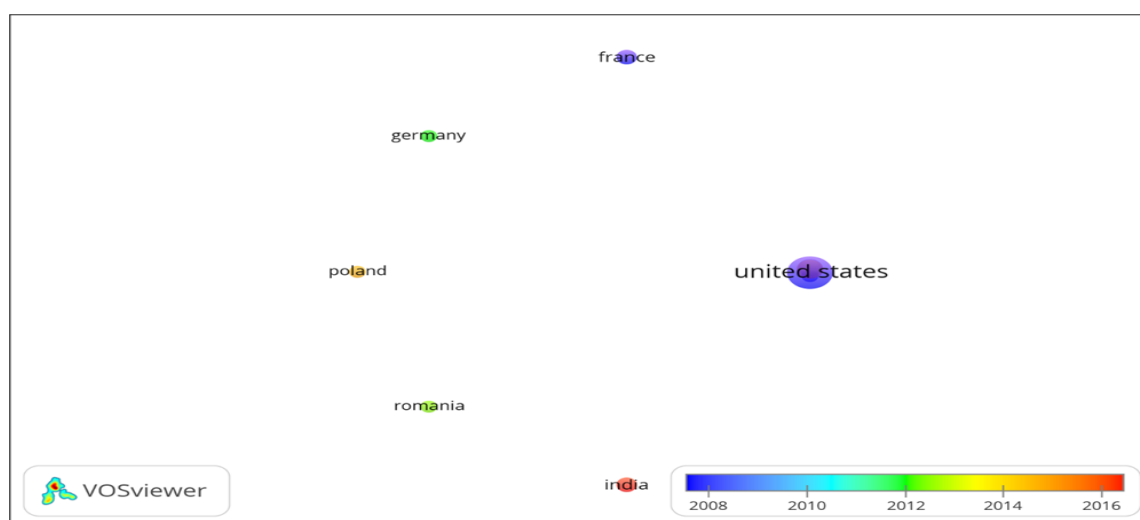


Figure 5: Co-authorship analysis on basis of countries

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	Documents	Citations	Link strength
The country with the highest publication, links, and citations	United States of America	14	409	7

The most active countries in this research domain were the United States of America with the highest number of publications, co-authorship 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 knee 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	Links
Journal with the highest publications,	Biomaterials	5	647	129.4	

co-authorship links, and citations					1
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From the above discussion regarding the bibliometric patterns in the research regarding the toxicity of knee implants, this research had observed a gradual increase in research interest regarding the toxicity of knee 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 Hallab N.J. and Jacobs J.J (Refer to table 1). The overlay analysis of top countries researching dental implantations indicates that the United States of America was the leading country relating to the highest number of publications citations, co-authorship links (Refer to figure 5). The top journals of this research domain were identified as the Biomaterials with the highest number of publications, citations, and links. 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 knee implants.

4. Conclusion

The toxicity of knee implant was an interesting research domain and the most active journal related to this research domain was Biomaterials. The most active country was the United States of America. The leading organization engaged in research regarding the toxicity of knee implants were the Indian Institute of Science, Bengaluru, India, University of Leeds, United Kingdom, and the Beihang University of China. The most active authors who had made valuable contributions related to the toxicity of knee implants were Hallab N.J. and Jacobs J.J. This research domain offers a new avenue for researchers and future research can be on innovations in the toxicity of knee implants.

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