

A Bibliometric Analysis and Visualisation of Research Trends in Nickel-Based Orthopaedic Implants

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Abstract: Nickel is one of the widely used metal for orthopaedic implants. The bibliometric analysis had been conducted to understand the active authors, organizations, journals, and countries involved in the research domain of “Nickel-based orthopaedic implants”. All published articles related to “Nickel-based orthopaedic 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 “Nickel-based orthopaedic implants” and also to find out the trends related to the same. The most active journals in this research domain were the Journal of Orthopaedic Research and Biomaterials. The most active country was the United States of America. The leading organization engaged in research regarding knee implants was the City University of Hong Kong. The most active authors who had made valuable contributions related to orthopaedic implants were Chu. P.K.

Keywords: Orthopaedic-implants, Nickel, Material engineering, Bibliometric analysis, VOS viewer,

Chapter 2 1. Introduction

An engineered medical device to replace a missing or damaged joint or bone is known as an orthopaedic implant. Various types of orthopaedic implants and practices are widely used in the medical world. Wear and corrosion of orthopaedic implants ultimately lead to poor performance, pain, and wastage of money. Similarly, various types of surface treatments and surface coatings can be conducted on orthopaedic implants to improve their competency to be used as a material for orthopaedic-implants. Material engineering and surface engineering can play a significant role in the development of new types of orthopaedic implants; and in enhancing the performance of orthopaedic implants. Patient-specific orthopaedic implants are the trends of the day and can improve the performance and reduce the cost of implant (Haglin et al., 2016).

Nickel is one of the widely used metal for orthopaedic implants. However, Nickel-based implants may be highly hypersensitive (Salahinejad et al., 2013)(Jaimes et al., 2010) and highly prone to hand dermatitis (Kanerva and Förström, 2001)(Rostoker et al., 1986). Hypersensitivity of Nickel is one of the important threat to Nickel based orthopaedic implants. The most common form of Nickel allergy caused by Nickel-based orthopaedic implants is Contact Dermatitis. Delayed wound healing and recurring wound-related issues are signs of allergy-related to Nickel based orthopaedic implants. Proper testing and inquiry before surgical procedures are the best possible measures to reduce allergy-related to Nickel based orthopaedic implants (Baumann and Crist, 2020).

This bibliometric analysis will be a useful platform for future researchers by realizing the top researchers, organizations, and countries involved in research regarding Orthopaedic 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 Nickel-based orthopaedic implants
- To find out the trends related to research in Nickel-based orthopaedic implants

1.2 Research Questions

- Who are the active researchers working on Nickel-based orthopaedic implants?
- Which are the main organizations and countries working on Nickel-based orthopaedic implants?
- Which are the main journals related to Nickel based orthopaedic implants?

2. Research Methodology

Scopus files had been used for this article. For the article selection, the Boolean used was TITLE-ABS (Nickel orthopaedic implants) on 11/032021. 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 217 documents, in 10 languages, out of which 195 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 137 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 1973 had been shown in Figure 2.

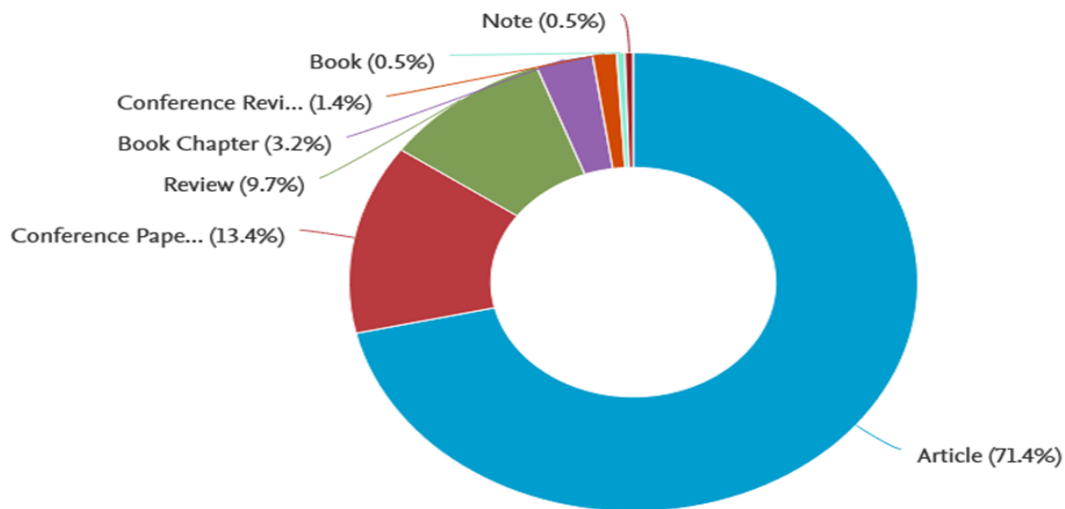


Figure 1: Classification of the documents on “Nickel-based orthopaedic implants”, Source: www.scopus.com

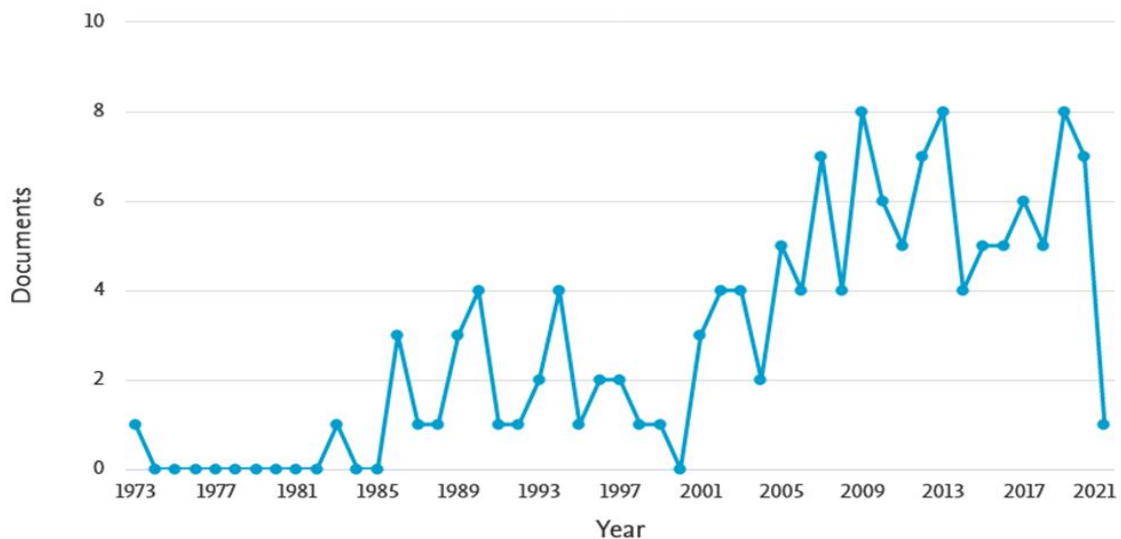


Figure 2: Period wise publication of articles, Source: WWW.scopus.com

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 18 authors, in 8 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.

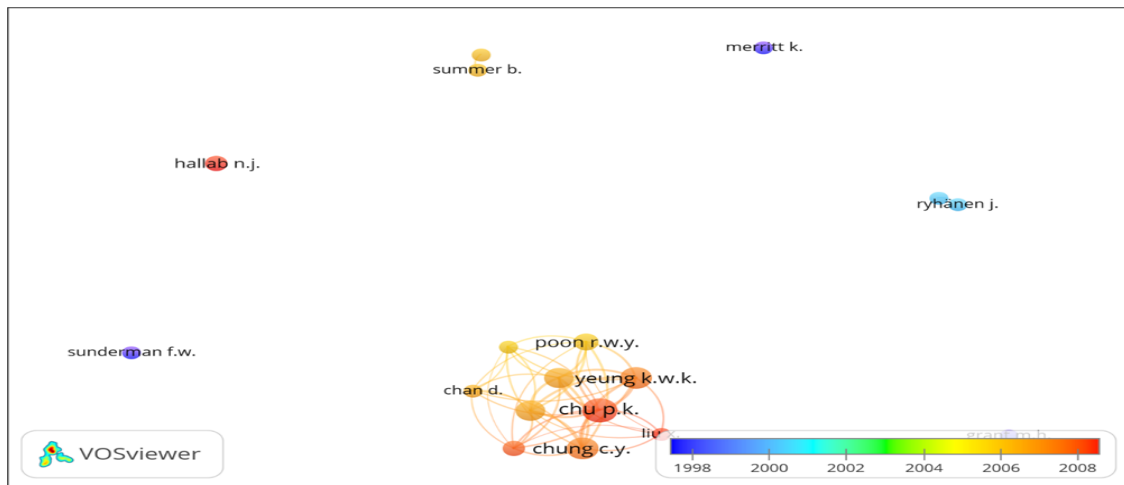


Figure 3: Co-authorship analysis on basis of authors

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, co-authorship links and citations	Chu P.K	10	415	41.5	68

In Co-occurrence analysis, we had used all keyword analyses, by keeping the minimum number of occurrences of a keyword as 15. 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.

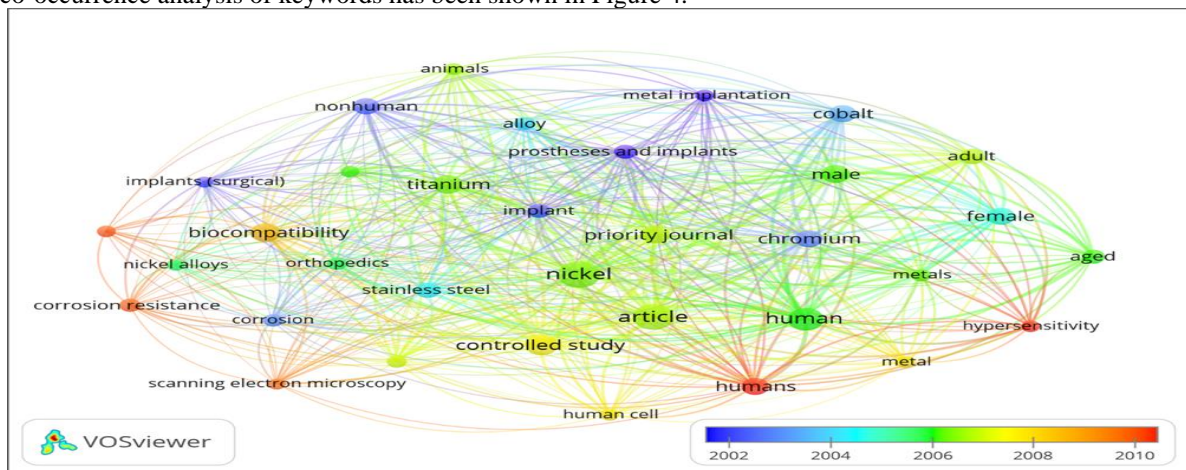


Figure 4: Co-occurrence analysis on basis of all keywords

The leading organizations engaged in research on “Nickel orthopaedic 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 “Nickel orthopaedic implants”, with the highest number of publications and citations, was the City University of Hong Kong (Refer to table 2).

Table 2: Highlights of the most active organization

Organizations	Country	Documents	Citations	Average Citations per document
City University of Hong Kong,	Hongkong	10	405	40.5

Co-authorship analysis of the countries engaged in the research on “Nickel orthopaedic 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.

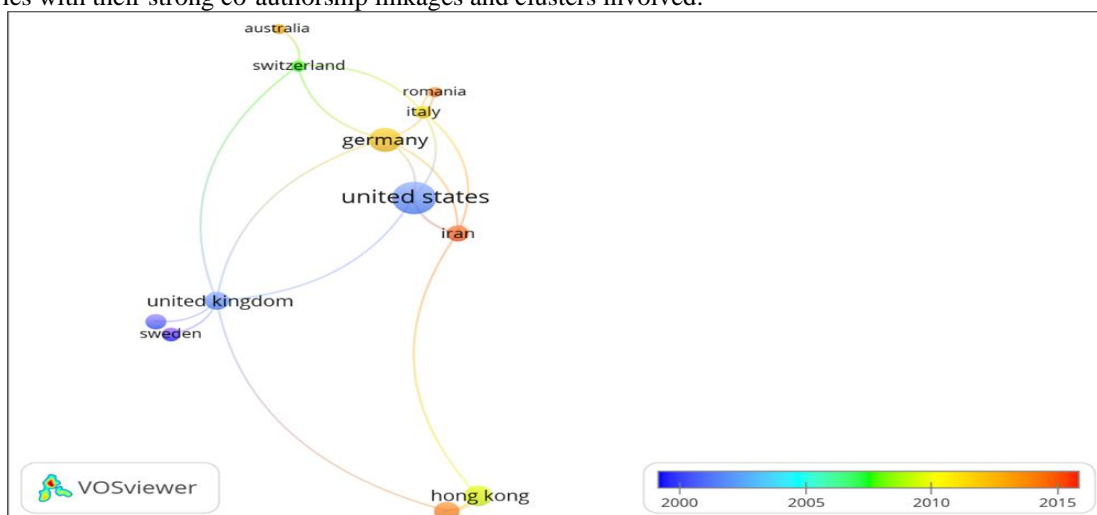


Figure 5: Co-authorship analysis on basis of countries

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, links, and citations	United States of America	31	1265	8

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 “Nickel orthopaedic 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, and citations	Journal of Orthopaedic Research	11	817	74.27	9
Journal with the highest co-authorship links	Biomaterials	8	665	83.1	20

From the above discussion regarding the bibliometric patterns in the research regarding Nickel orthopaedic implants, this research had observed a gradual increase in research interest regarding Nickel orthopaedic 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 author in this research domain was Chu, P.K with the highest publication, co-authorship links, and citations respectively (Refer to table 1). The overlay analysis of top countries researching orthopaedic 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 Journal of Orthopaedic Research and Biomaterials sources of information, researchers can focus on top journals where they can identify the most relevant and highly cited articles regarding implants Nickel orthopaedic implants.

4. Conclusion

The Nickel orthopaedic implants was an interesting research domain and the most active journals related to this research domain were the Journal of Orthopaedic Research and Biomaterials. The most active country was the

United States of America. The leading organization engaged in research regarding knee implants was the City University of Hong Kong. The most active authors who had made valuable contributions related to orthopaedic implants were Chu. P.K. This research domain offers a new avenue for researchers and future research can be on Nickel orthopaedic implants.

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