

A Bibliometric Analysis and Visualisation of Research Trends in of Hip Implant

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Abstract: Innovations and advances in material engineering and surface engineering play a key role in developing modern, safe, durable, and biocompatible implants. The bibliometric analysis had been conducted to understand the active authors, organizations, journals, and countries involved in the research domain of “hip-implants”. All published articles related to “hip-implants” from “Scopus”, were Journal of Bone and Joint Surgery and Journal of Arthroplasty. The leading organization engaged in research regarding hip implants was the University of Leeds. The most active authors who had made valuable contributions related to the surface coating of implants were Jacobs J.J

Keywords: Surface coating, Hip implants, Material engineering, Bibliometric analysis, VOS viewer,

1. Introduction

The medical device to replace a missing or damaged biological structure is known as an implant. Various types of metals are used for hip-implants

Extensive corrosion of steel was observed in femoral hip prostheses with ages ranging from eight to twenty years after implantation (Musolino et al., 1996). The surface coating can be used against corrosion and wear of hip implants. Bone health may be affected by the wear of chromium ions from chromium-based hip implants and may ultimately lead to bone-related complications (Andrews et al., 2011). Increased bone growth and reduced fibrous tissue in the porous coating of Titanium hip implants can be possible by Nanoscale surface coating by anodic oxidation of Titanium hip implants (Hall et al., 2017). Carburized titanium is a solid lubricant on hip implants and can improve corrosion resistance (Cheng et al., 2018). Similarly, the surface properties and biocompatibility of Titanium-based hip implants can be improved by grafting the surface of selective laser melted (SLM) titanium alloy (Ti-6Al-4V) with poly (2-methacryloyloxyethyl phosphorylcholine) (PMPC) (Ghosh et al., 2018).

There can be severe metallosis in case of wear of oxidized Zirconium in hip arthroplasty (Gkouliopoulou et al., 2016), similarly, the wear of Poly Ethylene is a concern in surface oxidized Zirconium hip implants (Jaffe et al., 2009). Similarly, allergic skin disease is another issue associated with patients who underwent hip replacement with metal-on-metal (MOM) bearings. This happens due to corrosion and the release of wear debris and high levels of metal ions in the blood (Bizzotto et al., 2015). Hip implant failure mainly happens due to adverse tissue responses caused by the wear and released ions from the implants. (Posada, Tate and Grant, 2015). Increasing serum Nickel concentration after total hip replacement is another issue to be considered in cases of Nickel-based hip implants (Black et al., 1983)(Dahlstrand et al., 2009)(Hennig et al., 1992). Similarly, Nickel affects the tissues of hip joints (Brodziak-Dopierała et al., 2011). Hypersensitivity to Nickel can be in cases of orthopedic implants or delayed hypersensitivity among patients who underwent a hip replacement. Such patients may with pain, fatigue, and contact allergic dermatitis, and instability (Delimar et al., 2018). Chances for postoperative hypernickemia and nickeluresis should be counted in cases of the nickel-based porous-coated knee or hip prostheses (Sunderman F.W. et al., 1989). The aseptic loosening of a prosthetic-joint component is another issue concerned with steel hip implants. This may be caused by either wear or failure of material or both (Godec et al., 2010)(Godec, 2011).

Increased level of metal content, especially Cobalt-Chromium content in serum and urine, following hip resurfacing arthroplasty (Kim et al., 2011). Similarly enhanced Cobalt-Chromium level was observed in patients following metal on metal hip implants (Ilo et al., 2021)(Hussey et al., 2016). All these points out the need for blood quality tests after hip implants based on Cobalt and Chromium(Harrington and Taylor, 2012)(Finley et al., 2017). However low levels of Cobalt and Chromium level were only observed among males following metal on metal hip implants (Ilo et al., 2021)(Chen et al., 2013). Toxicity of Cobalt due to hip to hip (Dijkman et al., 2012)(Madl, Kovochich, et al., 2015)(Madl, Liong, et al., 2015). A high level of cobalt in blood had been reported among patients who underwent metal to metal hip resurfacing (Kim et al., 2011). Hip implants may lead to symptoms of polycythemia, hypothyroidism, neurological, or cardiac dysfunction (Paustenbach, Galbraith and Finley, 2014). Increasing serum Nickel concentration after total hip replacement is another issue to be considered in cases of Nickel-based hip implants (Black et al., 1983)(Dahlstrand et al., 2009)(Hennig et al., 1992). Similarly, Nickel affects the tissues of hip joints (Brodziak-Dopierała et al., 2011).

This bibliometric analysis will be a useful platform for future researchers by realizing the top researchers, organizations, and countries involved in research regarding the hip-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 hip implants
- b) To find out the trends related to the research of hip implants

1.2 Research Questions

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

2. Research Methodology

Scopus files had been used for this article. For the article selection, the Boolean used was TITLE-ABS (hip implants) on 27/02/2021. 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 searches produced an outcome of 701 documents, in eight languages, out of which 676 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 464 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 1961 had been shown in Figure 2.

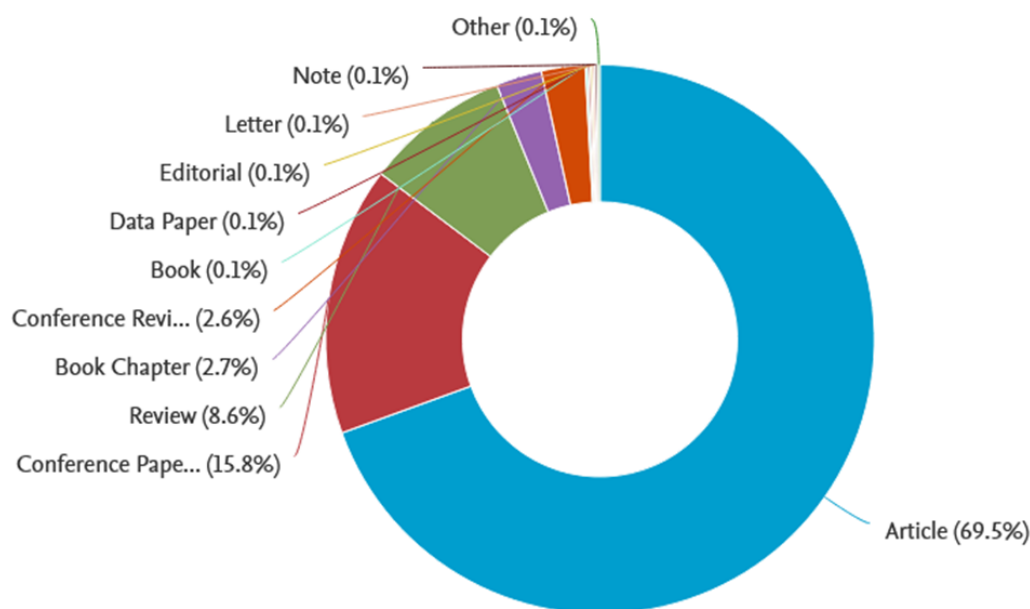


Figure 1: Classification of the documents on “hip-implants”, Source: www.scopus.com



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 26 authors, in 17 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.

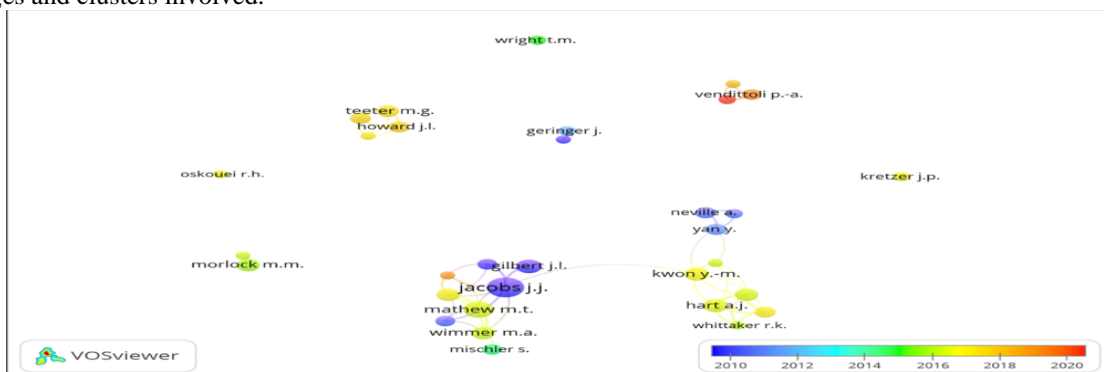


Figure 3: Co-authorship analysis on basis of authors

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, LINKS, and citations	Jacobs J.J	24	3467	144.1	38

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 two clusters. The overlay visualization of co-occurrence analysis of keywords has been shown in Figure 4.

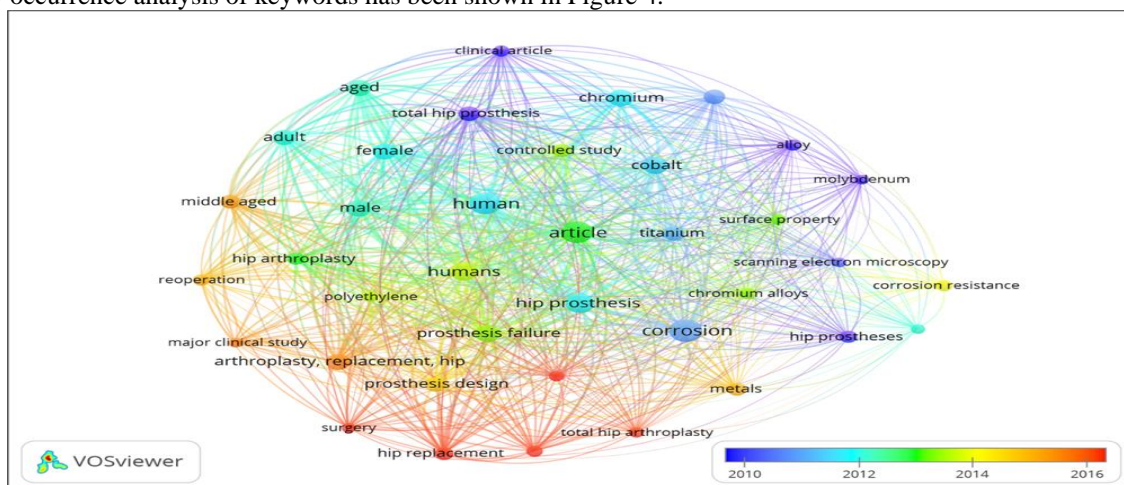


Figure 4: Co-occurrence analysis on basis of all keywords

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

Table 2: Highlights of the most active organization

Organizations	Country	Document s	Citatio ns	Average Citations per document

University of Leeds	United Kingdom	35	605	17
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Co-authorship analysis of the countries engaged in the research on “hip 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.

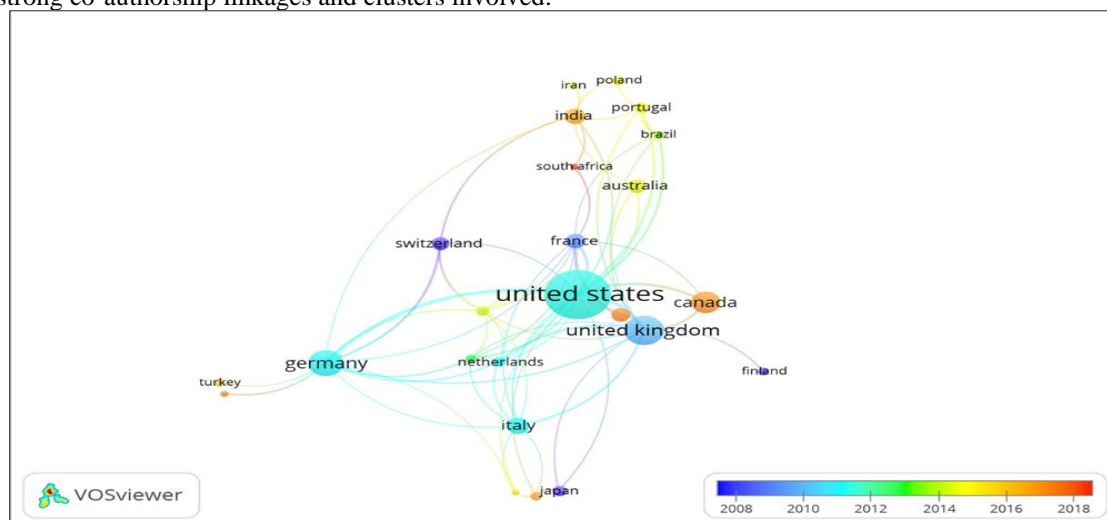


Figure 5: Co-authorship analysis on basis of countries

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, citations, and co-authorship links	United States of America	188	7321	68

The most active country in this research domain was the United States of America, with the highest number of publications, citations, and co-authorship links respectively

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 “hip 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	Co-authorship
Journal with the highest publications and citations	Journal of Arthroplasty	66	1448	293
Journal with the highest co-authorship links	Journal of Bone and Joint Surgery	10	2171	178

From the above discussion regarding the bibliometric patterns in the research regarding hip implants, this research had observed a gradual increase in research interest in hip 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 Jacobs J.J with the highest publication, co-authorship, and citations respectively (Refer to table 1). The overlay analysis of top countries researching hip implants indicates that 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 Arthroplasty and Journal of Bone and Joint Surgery. From these wide sources of information, researchers can focus on top journals where they can identify the most relevant and highly cited articles regarding hip implants.

4. Conclusion

Hip implants was an interesting research domain and the most active journals related to this research domain were the Journal of Bone and Joint Surgery and Journal of Arthroplasty. The leading organization engaged in research regarding hip implants was the University of Leeds. The most active authors who had made valuable contributions related to the surface coating of implants were Jacobs J.J. This research domain offers a new avenue for researchers and future research can be on innovations in hip implants.

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