

A Review on Implementation of Chromium based implants

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Abstract

Chromium is one of the most used metals for knee implants. The review analysis had been conducted to understand the active authors, organizations, journals, and countries involved in the research domain of “Chromium knee implants”. All published articles related to “Chromium knee 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 “Chromium knee implants” and also to find out the trends related to the same. The most active journals in this research domain were the Journal of Arthroplasty and Journal of Bone and Joint Surgery. The most active country was the United States of America. The leading organization engaged in the research regarding Chromium knee implants was University Medical Center Utrecht of Netherlands. Saris D.B.F and Dwyer K.A. were the authors with the highest publication and co-authorship links and citations in this research domain.

Keywords: Chromium knee implants, Material engineering, Review analysis, Meta Analysis,

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. Similarly, various types of surface treatments and surface coatings can be conducted on chromium knee implants to improve their competency to be used as a material for knee-implants. Hypersensitivity or allergy to Chromium used for knee implants is a serious issue to be considered before the chromium knee implants. Similarly, a popular problem raised along with knee implants is the toxicity of Chromium used for the knee implants. Material engineering and surface engineering can play a significant role in the development of new types of chromium-based knee implants; and for enhancing the performance of knee implants. Rough surfaced implants have better bone anchoring and biomechanical stability (Le Guehenec *et al.*, 2007).

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). Similarly, allergic skin disease is another issue associated with patients who underwent chromium-based implants. This happens due to corrosion and the release of wear debris and high levels of metal ions in the blood. Similarly Dermatitis Associated With Chromium Following Total Knee Arthroplasty(Gao *et al.*, 2011)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) serious adverse health issues had been reported on chromium implants(Campbell and Estey, 2013).

Future research can be on the scope for surface engineering on Chromium-based knee implants, methods for identifying avoiding allergies, and toxicity associated with chromium-based knee implants. Future research can also be on the remedies for the escalated level of chromium level in blood after the knee implants. This review analysis will be a useful platform for future researchers by realizing the top researchers,

organizations, and countries involved in research regarding bio-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

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

1.2 Research Questions

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

2. Research Methodology

Scopus files had been used for this article. For the article selection, the Boolean used was TITLE-ABS (Chromium knee implants). 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 170 documents, in five languages, out of which 161 documents were in English. The classification of document categories is shown in Table 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 132 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 1982 had been shown in Table 1. 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 22 authors, in eight 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, 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 and co-authorship links	Saris D.B.F	5	100	20	28
Authors with the highest citations	Dwyer K.A.	1	275	275	3

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 31 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 “Chromium 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 “Chromium knee implants”, with the highest number of publications and citations, was the University Medical Center Utrecht of Netherlands (Refer to table 2).

Table 2: Highlights of the most active organization

Organizations	Country	Documents	Citations	Average Citations per document
University Medical Center Utrecht	Netherlands	5	100	20

Co-authorship analysis of the countries engaged in the research on “Chromium knee 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 highest publication, citations, and links	United States of America	44	1332	10

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

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 “Chromium 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
Journal with the highest publications and co-authorship links	Journal of Arthroplasty	11	135	7
Journal with the highest citations	Journal of Bone and Joint Surgery	4	376	4

From the above discussion regarding the review patterns in the research regarding Chromium knee implants, this research had observed a gradual increase in research interest regarding Chromium 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 Table 2). The most active authors in this research domain were Saris D.B.F and Dwyer K.A. with the highest publication and co-authorship links, and citations (Refer to table 1). The overlay analysis of top countries researching Chromium knee 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 Table 5). The top journals of this research domain were identified as the Journal of Bone and Joint Surgery and the Journal of Arthroplasty. From these wide sources of information, researchers can focus on top journals where they can identify the most relevant and highly cited articles regarding Chromium knee implants.

4. Conclusion

Chromium knee implant was an interesting research domain and the most active journals related to this research domain were the Journal of Arthroplasty and Journal of Bone and Joint Surgery. The most active country was the United States of America. The leading organization engaged in the research regarding Chromium knee implants was University Medical Center Utrecht of Netherlands. Saris D.B.F and Dwyer K.A. with the highest publication and co-authorship links, and citations. This research domain offers a new avenue for researchers and future research can be on innovations in Chromium knee implant.

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