



A Review on Cobalt for Production Machine Language

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Abstract

Cobalt-based knee implants are one of the most used implants. The Review analysis had been conducted to understand the active authors, organizations, journals, and countries involved in the research domain of “Cobalt-based knee implants”. All published articles related to “Cobalt-based 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 “Cobalt-based knee implants” and also to find out the trends related to the same. Cobalt knee implants were an interesting research domain and the most active journals related to this research domain were and Journal of Arthroplasty and Knee. The leading authors were Fisher J and Freeman M.A. R.

Keywords: Cobalt, 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. 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 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. Cobalt is widely used for diversified dental implants (Peterson, McKinney and Pennel, 1978)(Harris and Lossin, 1971); Cobalt and Cobalt alloys are one of the widely used biomaterials, especially for hip implants; hip and knee replacements (Aminatun *et al.*, 2014)(Balagna, Faga and Spriano, 2012); The cobalt-based implants are stronger and have better mechanical properties.

The major issues related to Cobalt implants are the toxicity of the metal, failure of cobalt implants, allergy or hypersensitivity, and corrosion of the Cobalt implants. The carcinogenic potential of Cobalt-based implants is an important issue to be addressed and this problem can be handled by sol-gel hybrid coatings in cobalt-based implants (Amato *et al.*, 2005). There are cases of Cutaneous metallosis in patients with knee prostheses composed of cobalt-chromium molybdenum alloy. There is evidence for intolerance reactions due to knee implantations based on Cobalt, like



dermatitis, impaired wound healing, effusions, pain, or loosening. Proper study regarding the history of patients, especially regarding allergy and hypersensitivity towards cobalt is essential before knee implants based on Cobalt (Dietrich *et al.*, 2009). Cobalt Zirconium knee implants can be a good alternative for Cobalt Knee implants as a comparatively lower level of polyethylene volume loss (Brandt *et al.*, 2013). However, there is a wide disparity in results as it was found that there is no significant rise in serum metal level following Cobalt-based knee implants (Garrett *et al.*, 2010) and not demonstrating any inferior quality in short term period (Hui *et al.*, 2011).

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 Cobalt Knee-implants
- b) To find out the trends related to research in Cobalt knee-implants

1.2 Research Questions

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

2. Research Methodology

Scopus files had been used for this article. For the article selection, the Boolean used was TITLE-ABS (Cobalt Knee). 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 466 documents, in 10 languages, out of which 432 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 343 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 1971 had been shown in Figure 1.

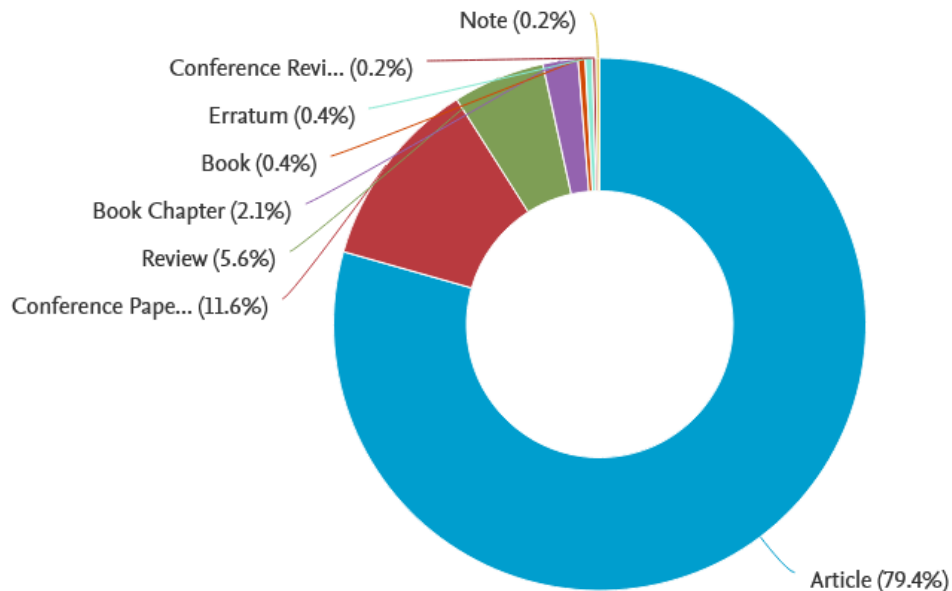


Figure 1: Classification of the documents on “Cobalt knee implants

Co-authorship analysis of top authors had been shown in Table1. For a better presentation of the analysis, the parameters used were the minimum number of documents of an author as four and the minimum number of citations of authors as one. This combination plotted the map of 25 authors, in eight clusters. The overlay visualization map of co-authorship analysis plotted in Table3, 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	Fisher J	9	273	30.3	37
Authors with the highest citations	Freeman M . A. R	5	423	84.6	12



In Co-occurrence analysis, we had used all keyword analyses, by keeping the minimum number of occurrences of a keyword as 50. This combination plotted the map of 28 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 “Cobalt 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 “Cobalt knee 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	Documents	Citations	Average Citations per document
University of Leeds	United Kingdom	13	274	21

Co-authorship analysis of the countries engaged in the research on “Cobalt knee implants” had been shown in Table 5. 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 and citations	United States of America	129	3273	23

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.

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 “Cobalt 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	32	423	61
Journal with the highest citations	Knee	12	165	44

From the above discussion regarding the Review patterns in the research regarding Cobalt knee implants, this research had observed a gradual increase in research interest regarding cobalt implants from the starting of the millennium and the momentum is going on positively. The most active authors in this research domain were Fisher J and Freeman M.A. R with the highest publication, citation, and links (Refer to table 1). The overlay analysis of top countries researching cobalt 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 Arthroplasty and Knee. From these wide sources of information, researchers can focus on top journals where they can identify the most relevant and highly cited articles regarding Cobalt knee implants.

4. Conclusion

Cobalt knee implants were an interesting research domain and Journal of Arthroplasty and Knee. The most active countries were the United States of America and Germany the leading organization engaged in the research regarding Cobalt-knee implants was the University of Leeds. The most active authors who had made valuable contributions related to Cobalt knee implants were Fisher J and Freeman M.A. R with the highest publication and co-authorship links; and citations respectively. This research domain offers a new avenue for researchers and future research can be on innovations in Cobalt based implants.

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