A Detailed Review in Cobalt prosthesis

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Abstract

Cobalt is one of the most used metals for implants. The review analysis had been conducted to understand the active authors, organizations, journals, and countries involved in the research domain of "Cobalt-implants". All published articles related to "Cobalt-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-implants" and also to find out the trends related to the same. The most active journals in this research domain were the Clinical and Experiential Dental Research and Journal of Biomedical Materials Research. The most active country was the United States of America. The leading organization engaged in the research regarding Cobalt-implants was the Rush University Medical Center, USA. The most active authors who had made valuable contributions related to Cobalt- implants were the Hallab N.J and Jacob J.J.

Keywords: Cobalt-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. Computer-Aided Design and Computer-Aided Manufacturing can be used to develop Cobalt-based dental 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); The cobalt-based implants are stronger and have better mechanical properties. Fabrication techniques can be used for enhancing the applicability of Cobalt-based dental implants by developing dental implants having a porous coating (Klawitter, Weinstein and Peterson, 1977). However, a clinical, radiographic, and histological evaluation of porus rooted, cobalt-based dental implants among dogs had found that the cases of failure in cases were in early (two months) or late stages (after six months).

Titanium is the most popular and widely used metal of implants. The addition of Cobalt in Titanium will result in decreased porosity and reduced corrosion of the implants. 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). Similarly the

Future research can be on research niches of researching on allergic issues due to Cobalt-based implants, measures for reducing the toxicity of Cobalt-based implants. Issues connected with corrosion and failure of Cobalt-based implants are also equally important. 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-implants
b) To find out the trends related to research in Cobalt-implants

1.2 Research Questions

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

2. Research Methodology

Scopus files had been used for this article. For the article selection, the Boolean used was TITLE(Cobalt-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 168 documents, in seven languages, out of which 155 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 120 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 1961 had been shown in Table 2.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 three and the minimum number of citations of authors as one. This combination plotted the map of nine authors, in four 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	Hallab. N.J	7	451	64.4	27
Authors with the highest citations	Jacobs J.J	5	456	91.2	18

In Co-occurrence analysis, we had used all keyword analyses, by keeping the minimum number of occurrences of a keyword as15. This combination plotted the map of 25thresholds, in three clusters. The overlay visualization of co-occurrence analysis of keywords has been shown in Table2.The leading organizations engaged in research on "Cobalt-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-implants", with the highest number of publications and citations, was the Rush University Medical center(Refer to table 2).

Table 2: Highlights of the most active organization

Organizations	Country	Documents	Citations	Average Citations per document
Rush University Medical Center	USA	6	379	63.3

Co-authorship analysis of the countries engaged in the research on "Cobalt-implants" had been shown in Table 5. The overlay visualization map of co-authorship analysis plotted in Table2, 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 acountry 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	33	1110	10

The most active country in this research domain was the United States of America, with the highest number of publications, 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 "Cobalt-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, citations	Journal of Biomedical Materials Research	6	345	4
Journal with highest co-authorship	Clinical and Experiential dental Research	5	252	5012

From the above discussion regarding the review patterns in the research regarding Cobalt-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. This points out the relevance and potential of this research domain (Refer to Table 2).The most active authors in this research domain were the Haalab N.J and Jabob J. J with the highest publication and co-authorship links; and citations respectively(Refer to table 1).The overlay analysis of top countries researching Cobalt implantations 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 Clinical and Experiential Dental Research and Journal of Biomedical Materials Research 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-implants.

4. Conclusion

Cobalt implant was an interesting research domain and the most active journals related to this research domain were the Journal of Biomedical Materials Research and Clinical and Experiential Dental Research. The most active country was the United States of America. The leading organization engaged in the research regarding Cobalt-implants was the Rush University Medical Center, USA. The most active authors who had made valuable contributions related to Cobalt implants were Hallab N.J and Joseph J. J 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-implants.

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