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A Review on Aggravating Circumstances using Cobalt-Based Orthopaedic Implants

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Abstract

Cobalt is one of the widely used metal for orthopaedic implants. The review analysis had been conducted to understand the active authors, organizations, journals, and countries involved in the research domain of "Allergy of Cobalt-based orthopaedic implants". All published articles related to "Allergy of Cobalt-based orthopaedic 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 "Allergy of Cobalt-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 Contact Dermatitis. The most active country was the United States of America. The leading organizations engaged in research regarding "Allergy of Cobalt-based orthopaedic implants" were the University of Rostock, Germany; Gentofte Hospital and Aarhus University Hospital of Denmark. The most active authors were Thyssen J.P. and Jacobs J.J.

Keywords: Orthopaedic-implants, Cobalt, Allergy, Material engineering, Review analysis, Meta Analysis,

1. Introduction

Orthopaedic implants are medical devices to replace a missing or damaged joint or bone. Various types of orthopaedic implants and practices are widely used in the medical world. 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.

Cobalt is one of the widely used metal for orthopaedic implants. Poor performance, pain, and wastage of money due to orthopaedic implants are mainly due to corrosion and wear of implants. Corrosion of Cobalt-based orthopaedic implants leads to the rapid increase of metals in blood, serum and of a variety of tissues and organs (Michel *et al.*, 1987). 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. The carcinogenic potential of metal elements is another threat faced by users of Cobalt-based orthopaedic-implants. In comparison with

IJMTARC – VOLUME – IV – ISSUE - 16 – DEC 2016 ISSN: 2320-1363

other metal implants, Cobalt-based orthopaedic implants are more toxic and produce inflammatory cytokines (Dalal *et al.*, 2012).

Cobalt-based toxicity can also cause hypersensitivity(Basko-Plluska, Thyssen and Schalock, 2011), to human immune system human lymphocytes (Hallab *et al.*, 2001). Dermatitis is another issue associated with Cobalt-based orthopaedic implants (Rostoker *et al.*, 1986)(Dujardin *et al.*, 1995). However, there are contradicting studies on cobalt toxicity, which had not found any pieces of evidence of toxicity among samples on Cobalt-based orthopaedic implants. Compulsory and rigorous background checking and testing for allergies is essential before all types of Cobalt-based Orthopaedic implants.

This review analysis will be a useful platform for future researchers by realizing the top researchers, organizations, and countries involved in research regarding Cobalt-based 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 review analysis systematically.

1.1 Research Objectives

a) To consolidate the literature regarding allergy of Cobalt-based orthopaedic implants
b) To find out the trends related to research in allergy of Cobalt-based orthopaedic implants

1.2 Research Questions

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

2. Research Methodology

Scopus files had been used for this article. For the article selection, the Boolean used was TITLE-ABS (Allergy Cobalt orthopaedic). 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

IJMTARC – VOLUME – IV – ISSUE - 16 – DEC 2016 ISSN: 2320-1363

3.1 Results

This first round of search produced an outcome of 87 documents, in eight languages, out of which 73 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 50 English articles (both open access and others).This paper had used all English articles to conduct review analysis and visualization using Meta Analysis. The English research articles in this domain since 1973 had been shown in Table1.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 two and the minimum number of citations of authors as one. This combination plotted the map of14authors, in 8clusters. The overlay visualization map of co-authorship analysis plotted in Table1, 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	Thyssen J.P.	4	140	35	20
Authors with the highest citations	Jacobs J.J	2	176	44	4

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 30 thresholds, in three clusters. The overlay visualization of co-occurrence analysis of keywords has been shown in Table2.The leading organizations engaged in research on "Allergy of Cobalt-based 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 "Allergy of Cobalt-based orthopaedic implants", with the highest number of publications and citations, was the University of Rostock, Germany; Gentofte Hospital and Aarhus University Hospital of Denmark.

(Refer to table 2).

Table 2: Highlights of the most active organization

ISSN: 2320-1363

Organizations	Country	Documents	Citations	Average Citations per document
University of Rostock	Germany	3	58	19.3
Gentofte Hospital	Denmark	3	125	41.6
Aarhus University Hospital	Denmark	3	123	41

Co-authorship analysis of the countries engaged in the research on "Allergy of Cobalt-based orthopaedic implants" had been shown in Table3. The overlay visualization map of co-authorship analysis plotted in Table3, 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, links, and citations	United States of America	19	453	1

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 "Allergy of Cobalt-based orthopaedic implants" are shown in table 4. Table 4shows 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	4	242	40.5	6
Journal with the highest co-authorship links	Contact Dermatitis	7	149	21.3	8

IJMTARC – VOLUME – IV – ISSUE - 16 – DEC 2016 ISSN: 2320-1363

From the above discussion regarding the review patterns in the research regarding "Allergy of Cobalt-based orthopaedic implants",this research had observed a gradual increase in research interest regarding "Allergy of Cobalt-based 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 Table 2).The most active authors in this research domain were Thyssen J.P. and Jacobs J.J 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 Table 5). The top journals of this research domain were identified as the Journal of Orthopaedic Research and Contact Dermatitis. Researchers can focus on top journals where they can identify the most relevant and highly cited articles regarding an allergy to Cobalt-based orthopaedic implants.

4. Conclusion

The "Allergy of Cobalt-based orthopaedic implants" was an interesting research domain and the most active journals related to this research domain were the Journal of Orthopaedic Research and Contact Dermatitis. The most active country was the United States of America. The leading organizations engaged in research regarding "Allergy of Cobalt-based orthopaedic implants" were the University of Rostock, Germany; Gentofte Hospital and Aarhus University Hospital of Denmark. The most active authors who had made valuable contributions related to orthopaedic implants were Thyssen J.P. and Jacobs J.J. This research domain offers a new avenue for researchers and future research can be on "Allergy of Cobalt-based orthopaedic implants".

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IJMTARC – VOLUME – IV – ISSUE - 16 – DEC 2016 ISSN: 2320-1363

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