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A Review Study on Trace Evidence Analysis in Molybdenum Based Orthopaedic Implants

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Abstract

Molybdenum is one of the most used metals for orthopaedic implants. There view analysis had been conducted to understand the active authors, organizations, journals, and countries involved in the research domain of "Allergy of Molybdenum based orthopaedic implants". All published articles related to "Allergy of Molybdenum 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 Molybdenum based orthopaedic implants" and also to find out the trends related to the same. Contact Dermatitis and Lancet were the leading journals. The most active country was the United States of America and Germany. The leading organization engaged in the research regarding allergy of Molybdenum orthopaedic implants was the Ludwig-Maximilians University, Germany. The most active authors who had made valuable contributions related to the allergy of Molybdenum orthopaedic implants were Thomas P. and Baldus S.

Keywords: Molybdenum-implants, Orthopaedic, Allergy, 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 (Priyanka *et al.*, 2014). Various types of implants had been used in modern medicine and include dental implants (Bhola *et al.*, 2010) dental crown (Er and Unsaldi, 2013)sensory implants, neurological implants, cardiovascular implants, orthopaedic implants(Er and Unsaldi, 2013), contraceptive implants, and cosmetic implants. Molybdenum alloys-based implant materials are having high corrosion resistance to body fluids, excellent mechanical properties, and biocompatibility (Kumar *et al.*, 1985).

Orthopaedic implants are often used subjected to wear and corrosion (Weightman, Zarek and Bingold, 1969)(Gregory and Ozcan, 1980) and ultimately lead to poor performance, pain, and wastage of money. The other major issues associated with orthopaedic implants based on

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Molybdenum are the hypersensitivity (allergy) and toxicity of the metal(Kręcisz, Kieć-Świerczyńska and Chomiczewska-Skóra, 2012)(Kręcisz, Kieć-Świerczyńska and Bąkowicz-Mitura, 2006)(Symeonides, Paschaloglou and Papageorgiou, 1973).Material engineering and surface engineering can play a significant role in improving the performance and life of Molybdenum orthopaedic implants, along with measures for reducing toxicity and hypersensitivity of the metal(Torok *et al.*, 1995). Patient-specific orthopaedic implants are the trends of the day and can improve the performance and reduce the cost of the implant.

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

1.2 Research Questions

a) Who are the active researchers working on the allergy of Molybdenum based orthopaedic implants?
b) Which are the main organizations and countries working on the allergy of Molybdenum based orthopaedic implants?
c) Which are the main journals for allergy of Molybdenum based orthopaedic implants?

2. Research Methodology

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

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3.1 Results

This first round of search produced an outcome of 144 documents, in11 languages, out of which 119 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 88English 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 1965 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 three and the minimum number of citations of authors as one. This combination plotted the map of 24 authors, in 10 clusters. 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 links	Thomas P	5	245	49	33
Authors with the highest citations	Baldus S	1	411	411	7

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 32thresholds, in four clusters. The overlay visualization of co-occurrence analysis of keywords has been shown in Table2.The leading organizations engaged in research on "Allergy of Molybdenum 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 Molybdenum orthopaedic implants", with the highest number of publications and citations, was the Ludwig-Maximilians University, Germany(Refer to table 2).

Table 2: Highlights of the most active organization

Organizations	Country	Documents	Citations	Average Citations per

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				document
Ludwig-Maximilians University	Germany	5	234	47

Co-authorship analysis of the countries engaged in the research on "Allergy of Molybdenum 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	United States of America	24	521	8
The country with the highest citations, and co-authorship links	Germany	15	945	8

The leading countries in this research domain were the United States of America and Germany, with the highest number of publications, 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 Molybdenum 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
Journal with the highest publications and links	Contact Dermatitis	11	282	25.6
Journal with highest citations	Lancet	1	411	0

From the above discussion regarding the review patterns in the research regarding allergy of Molybdenum orthopaedic implants,this research had observed a gradual increase in research interest regarding allergy Molybdenum orthopaedic implantsfrom 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 Thomas P. and Baldus S with the highest publication, citations and co-authorship links(Refer to table 1).The overlay analysis of top countries researching allergy of Molybdenum orthopaedic implants indicates that the United States of America and Germany were 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 Contact Dermatitis and Lancet. From these wide sources of information, researchers can focus on top journals where they can identify the most relevant and highly cited articles regarding allergy of Molybdenum orthopaedic implants.

4. Conclusion

Allergy of Molybdenum orthopaedic implants was an interesting research domain and the most active journals related to this research domain were Contact Dermatitis and Lancet. The most active country was the United States of America and Germany. The leading organization engaged in the research regarding allergy of Molybdenum orthopaedic implants was the Ludwig-Maximilians University, Germany. The most active authors who had made valuable contributions related to the allergy of Molybdenum orthopaedic implants were Thomas P. and Baldus S with the highest publication, citations and co-authorship links. This research domain offers a new avenue for researchers and future research can be on innovations in allergy of Molybdenum orthopaedic implants.

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