

A review on significance and importance of Magnesium-Based Orthopaedic

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Abstract

Magnesium 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 “Magnesium-based orthopaedic-implants”. All published articles related to “Magnesium-based orthopaedic-implants” from “Scopus”, were analyzed using the Meta Analysis to develop analysis tables and visualization maps. article had set the objective to consolidate the scientific literature regarding “Magnesium-based orthopaedic-implants” and also to find out the trends related to the same. The leading Journal was Act a Biomaterialia. The most active country was China. The leading organization engaged in the research regarding Magnesium-based orthopaedic-implants was the Chinese Academy of Sciences, China. The most active author who had made valuable contributions related to Magnesium-implants was Yang K.

Keywords: Magnesium-implants, Orthopaedic 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. The Bio-compatibility of Magnesium and its biodegradability had been helpful for diversified medical applications. The high degradation rate and poor antibacterial properties are the main drawbacks of magnesium implants (Atrens, Liu and Zainal Abidin, 2011) (Bobby Kannan, Moore, and Singh Raman, 2007). There are pieces of evidence that the Cyto-compatible and antibacterial coating layer on magnesium implants can improve the performance of implants; fabrication of the zoledronate-incorporated coating on magnesium alloy for orthopaedic implants; poly(ether imide) coating can be used to improve corrosion resistance and biocompatibility of Magnesium based orthopaedic implants (Kim *et al.*, 2013).

Magnesium had been extensively used for orthopaedic implants (Casanova *et al.*, 2013) (Waizy *et al.*, 2013) (Chen *et al.*, 2011) and calcium addition can reduce corrosion resistance and improve the performance of Magnesium-based orthopaedic-implants (Bobby Kannan, Moore and Singh Raman, 2007) (Brooks and Guo, 2014); magnesium-based composite for the temporary orthopaedic implant with improved corrosion resistance and osteogenic properties.

Material engineering and surface engineering can play a significant role in improving the performance and life of Magnesium based orthopaedic-implants along with measures for reducing toxicity and hypersensitivity of the metal implants. This review analysis will be a useful platform for future researchers by realizing the top researchers, organizations, and countries involved in research regarding Magnesium-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 Magnesium-based orthopaedic-implants
- b) To find out the trends related to research in Magnesium-based orthopaedic-implants

1.2 Research Questions

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

2. Research Methodology

Scopus files had been used for this article. For the article selection, the Boolean used was TITLE-ABS (Magnesium implant 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

3.1 Results

This first round of search produced an outcome of 645 documents, in five languages, out of which 625 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 448 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 1972 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 eight and the minimum number of citations of authors as one. This combination plotted the map of 26 authors, in nine 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, citations, and links	Yang K	22	883	40.13	177

In Co-occurrence analysis, we had used all keyword analyses, by keeping the minimum number of occurrences of a keyword as 65. This combination plotted the map of 31 thresholds, in two clusters. The overlay visualization of co-occurrence analysis of keywords has been shown in Table 2. The leading organizations engaged in research on “Magnesium-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

organizations in the research regarding “Magnesium-based orthopaedic-implants”, with the highest number of publications and citations, were the Chinese Academy of Sciences, China (Refer to table 2).

Table 2: Highlights of the most active organization

Organizations	Country	Documents	Citations	Average Citations per document
Chinese Academy of Sciences	China	40	1549	38.7

Co-authorship analysis of the countries engaged in the research on “Magnesium-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 leading publication, citations, and co-authorship links	China	155	4909	53

The most active country in this research domain was China, with the leading position in 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 “Magnesium-based orthopaedic-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	Links
Journal with the highest publications, citations, and links	Acta Biomaterialia	31	1607	51.8	167

From the above discussion regarding the review patterns in the research regarding Magnesium-based orthopaedic-implants, this research had observed a gradual increase in research interest regarding Magnesium-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 author in this research domain was Yang K. with the highest publication, co-authorship links, and citations (Refer to table 1). The overlay analysis of top countries researching Magnesium-based orthopaedic-implants indicates that China 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 Acta Biomaterialia. From these wide sources of information, researchers can focus on top journals where they can identify the most relevant and highly cited articles regarding Magnesium based orthopaedic–implants.

4. Conclusion

Magnesium-based orthopaedic-implants was an interesting research domain and the most active journals related to this research domain were Acta Biomaterialia. The most active country was China. The leading organization engaged in the research regarding Magnesium-based orthopaedic-implants was the Chinese Academy of Sciences, China. The most active author who had made valuable contributions related to Magnesium-based orthopaedic-implants was Yang K. 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 Magnesium-based orthopaedic-implants.

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