Review on Magnesium Hip-Implants

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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 hip-implants". All published articles related to "Magnesium hip-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 "Magnesium hip-implants" and also to find out the trends related to the same. The leading journal was Biomaterials. The most active country was China. The leading organization engaged in the research regarding Magnesium hip-implants was The Leibniz University Hannover, Germany. The most active authors who had made valuable contributions related to Magnesium-implants were Huang S., Wang B, Wang W, Zhang X, and Zhao D. F

Keywords: Magnesium, Hip-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). However, to overcome the shortcomings, there are pieces of evidence that the Cyto-compatible and antibacterial coating layer on magnesium implants can improve the performance of implants.

Joint replacement surgery is one of the popular surgeries in medical science, especially hip replacement surgery. Magnesium is used for preparing hip-implants; Magnesium as a bone implant material, such as screws and plates in bones; hip ball and sockets and to make medical equipment (Duygulu, Kaya, *et al.*, 2007) hip joints; Magnesium based cement-less hip implants; magnesium alloys as absorbable porous bone substitute material; Magnesium based surface coatings can enhance bone ingrowth and consequently enhancing the longevity of uncemented orthopedic hip prostheses.

Material engineering and surface engineering can play a significant role in improving the performance and life of Magnesium–implants along with measures for reducing toxicity and hypersensitivity of the metal implants. Future research can also be on surface coatings by using, metal implants using Magnesium, especially for hip 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-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 hip-implants
b) To find out the trends related to research in Magnesium hip-implants

1.2 Research Questions

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

2. Research Methodology

Scopus files had been used for this article. For the article selection, the Boolean used was TITLE-ABS (Magnesium hip implant). 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 of48documents, in three languages, out of which 46 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 18English 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 2007had 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 of16authors, in three 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, citations, and links	Huang S.	2	128	64	23
	Wang B	2	128	64	23
	Wang W	2	128	64	23
	Zhang X	2	128	64	23
	Zhao D	2	128	64	23

In Co-occurrence analysis, we had used all keyword analyses, by keeping the minimum number of occurrences of a keyword as2. This combination plotted the map of 14thresholds, in three clusters. The overlay visualization of co-occurrence analysis of keywords has been shown in Table2.The leading organizations engaged in research on "Magnesium based hip-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 "Magnesium hip-implants", with the highest number of publications and citations, was The Leibniz University Hannover, Germany(Refer to table 2).

Table 2: Highlights of the most active organization

Organizations	Country	Documents	Citations	Average Citations per document
The Leibniz University Hannover	Germany	3	31	10.3

Co-authorship analysis of the countries engaged in the research on "Magnesium hip-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 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 leading publication, citations, and co-authorship links	China	4	134	1

The most active country in this research domain was China, 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 "Magnesium hip-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 leading publications, citations, and links	Biomaterials	1	107	107	0

From the above discussion regarding the review patterns in the research regarding Magnesium hip-implants,this research had observed a gradual increase in research interest regarding Magnesium hip-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 Huang S., Wang B, Wang W, Zhang X, and Zhao D with the highest publication, citations, and co-authorship links(Refer to table 1).The overlay analysis of top countries researching Magnesium hip-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 Biomaterials. 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 hip–implants.

4. Conclusion

Magnesium hip-implants was an interesting research domain and the most active journal related to this research domain was Biomaterials. The most active country was China. The leading organization engaged in the research regarding Magnesium hip-implants was The Leibniz University Hannover, Germany. The most active authors who had made valuable contributions related to Magnesium-implants were Huang S., Wang B, Wang W, Zhang X, and Zhao D.F with the highest publication, co-authorship links, and citations respectively. This research domain offers a new avenue for researchers and future research can be on innovations in Magnesium hip-implants.

References

1. Atrens, A., Liu, M. and Zainal Abidin, N. I. (2011) 'Corrosion mechanism applicable to biodegradable magnesium implants', *Materials Science and Engineering B: Solid-State Materials for Advanced Technology*, 176(20), pp. 1609–1636. doi: 10.1016/j.mseb.2010.12.017.
2. Duygulu, O., Kaya, A. A., *et al.* (2007) 'Diffusion bonding of magnesium, zirconium and titanium as implant material', *Materials Science Forum*, 546–549(PART 1), pp. 417–420. doi: 10.4028/0-87849-432-4.417.
3. Duygulu, O., Alper Kaya, R., *et al.* (2007) 'Investigation on the potential of magnesium alloy AZ31 as a bone implant', *Materials Science Forum*, 546–549(PART 1), pp. 421–424. doi: 10.4028/0-87849-432-4.421.
4. Farhat, T. *et al.* (2013) 'Research in congenital heart disease: A comparative review analysis between developing and developed countries', *Pediatric Cardiology*, 34(2), pp. 375–382. doi: 10.1007/s00246-012-0466-6.
5. Willbold, E. *et al.* (2011) 'Corrosion of magnesium alloy AZ31 screws is dependent on the implantation site', *Materials Science and Engineering B: Solid-State Materials for Advanced Technology*, 176(20), pp. 1835–1840. doi: 10.1016/j.mseb.2011.02.010.