A Research on use of Computer Technologies in Anti-bacterial properties of Silver coating on-Implants

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Abstract

Silver 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 "Anti-bacterial properties of the Silver coating on implants". All published articles related to "Anti-bacterial properties of the Silver coating on 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 "Anti-bacterial properties of the Silver coating on implants" and also to find out the trends related to the same. The leading Journals were the Biomaterials and Material Science and Engineering. The most active country was China. The leading organizations engaged in the research regarding Silver-implants were the Chinese Academy of Sciences and Ministry of Education, China. The most active authors who had made valuable contributions related to Silver-implants were Liu X, Zhang X., and Chu.P.K.

Keywords: Silver-coating, Silver-implants, Material engineering, Review analysis, Meta Analysis,

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. Silver had been used for diversified purposes. Corrosion and antibacterial infection of implants is a major threat for bio-implants and silver implants/ silver coating can be a good remedy for the issue of anti-bacterial infection of implants. High antibacterial properties and improved performance by silver coating is the reason for the high popularity of silver-based implants. The silver coating can be used against corrosion of implants. Silver can be used for preparing thin film coating over orthopedic implants, especially knee implants (Alves *et al.*, 2014). Limb-saving knee arthrodesis with a silver-coated arthrodesis rod in a patient with aspergillus osteomyelitis of the knee. Doped silver can be effectively used for the preparation of thin-film coating over orthopedic implants, especially hip implants (Alves *et al.*, 2014) (Dearnaley *et al.*, 2007).

The inclusion of silver/silver coating can enhance the anti-bacterial properties of the implants, the zeolite/silver-graphene oxide nanocomposite in bone implants had been used to enhance the anti-bacterial properties of the implants (Gordon *et al.*, 2010)(Fordham *et al.*, 2014) (Bitika, Uzuna and Keçika, 2013) (Colmano, Edwards and Barranco, 1980)(Ascherl, 2010)(Hardes *et al.*, 2007)(Singh and Kumar, 2013).

Material engineering and surface engineering can play a significant role in improving the performance and life of Silver–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 silver. This Review analysis will be a useful platform for future researchers by realizing the top researchers, organizations, and countries involved in research regarding Silver-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 the Anti-bacterial properties of the Silver coating on implants
b) To find out the trends related to research in Anti-bacterial properties of the Silver coating on implants

1.2 Research Questions

a) Who are the active researchers working on the Anti-bacterial properties of the Silver coating on implants?
b) Which are the main organizations and countries working on the Anti-bacterial properties of the Silver coating on implants?
c) Which are the main journals on the Anti-bacterial properties of the Silver coating on implants?

1. Research Methodology

Scopus files had been used for this article. For the article selection, the Boolean used was TITLE-ABS (Silver antibacterial 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 (Farhat *et al.*, 2013).

2. Results and discussion

2.1 Results

This first round of search produced an outcome of 576 documents, in five languages, out of which 563 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 473English 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 1980 had been shown in Table 2.

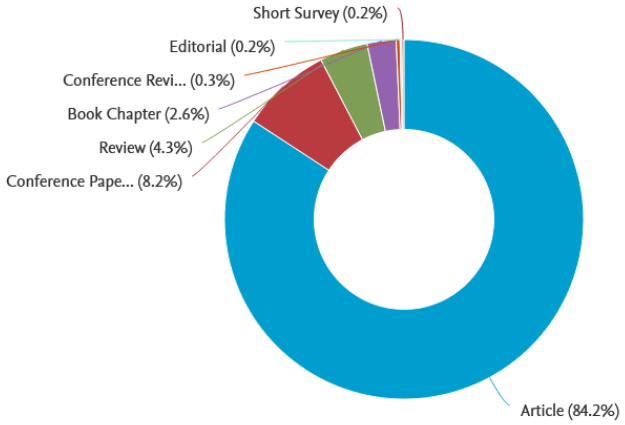

Table 1: Classification of the documents on "Antibacterial properties of Silver implants", Source: www.scopus.com

Co-authorship analysis of top authors had been shown in Table 3. 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 of35authors, in nineclusters. 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	Liu x	26	1229	47.2	174
Authors with the highest citations	Chu.P.K	16	1655	103.4	116
Authors with the highestco-authorship links	Zhang X	24	1107	46.1	182

In Co-occurrence analysis, we had used all keyword analyses, by keeping the minimum number of occurrences of a keyword as 80. This combination plotted the map of 25thresholds, in two clusters. The overlay visualization of co-occurrence analysis of keywords has been shown in Table4.The leading organizations engaged in research on "Anti-bacterial properties of Silver-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 "Anti-bacterial properties of Silver-implants", with the highest number of publications and citations, was the Chinese Academy of Sciences and Ministry of Education, 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	26	1412	54.3
Ministry of Education China	China	26	710	27.3

Co-authorship analysis of the countries engaged in the research on "Anti-bacterial properties of Silver-implants" had been shown in Table 5. The overlay visualization map of co-authorship analysis plotted in Table 5, 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	China	154	5706	52

The most active country in this research domain was China, with the highest number ofpublications, 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 "Antibacterial properties of Silver-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	Material Science and Engineering	35	914	26.1	119
Journal with highest citation and co-authorship links	Biomaterials	10	2435	243.5	234

From the above discussion regarding the Review patterns in the research regarding Antibacterial properties of Silver-implants, this research had observed a gradual increase in research interest regarding Silver-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 Liu X. Zhang X. and Chu.P.K. with the highest publication, co-authorship links, and citations respectively(Refer to table 1).The overlay analysis of top countries researching Antibacterial properties of Silver-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 the Biomaterials and Material Science and Engineering. From these wide sources of information, researchers can focus on top journals where they can identify the most relevant and highly cited articles regarding the Antibacterial properties of Silver-implants.

3. Conclusion

Anti-bacterial properties of Silver implants was an interesting research domain and the most active journals related to this research domain were the Biomaterials and Material Science and Engineering.The most active country was China. The leading organizations engaged in the research regarding Silver-implants were the Chinese Academy of Sciences and Ministry of Education, China. The most active authors who had made valuable contributions related toSilver-implantswere Liu X, Zhang X., and Chu.P.K.This research domain offers a new avenue for researchers and future research can be on innovations in Silver-implants.

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