

An Investigation on Silver Hip-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 “Silver hip-implants”. All published articles related to “Silver 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 “Silver hip-implants” and also to find out the trends related to the same. The leading Journals were the Biomaterials and Journal of Arthroplasty. The most active country was the United States of America. The leading organization engaged in the research regarding Silver hip-implants was the Central South University, China. The most active authors who had made valuable contributions related to Silver hip-implants were Carvalho S. and Gosheger G.

Keywords: Silver, 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. 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.

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) (Hardes *et al.*, 2007).

Hip replacement surgery is a popular type of orthopedic surgical procedure. The silver coating can be used against corrosion of implants. 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).

Material engineering and surface engineering can play a significant role in improving the performance and life of Silver-based hip-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 Silver-based hip-implants
- b) To find out the trends related to research in Silver-based hip-implants

1.2 Research Questions

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

2. Research Methodology

Scopus files had been used for this article. For the article selection, the Boolean used was TITLE-ABS (Silver 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 of 258 documents, in fourteen languages, out of which 230 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 164 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 1967 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 three and the minimum number of citations of authors as one. This combination plotted the map of 15 authors, in seven 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	Carvalho S.	4	67	16.75	18
Authors with the highest citations and co-authorship links	Gosheger G.	3	266	89	25

In Co-occurrence analysis, we had used all keyword analyses, by keeping the minimum number of occurrences of a keyword as 12. This combination plotted the map of 28 thresholds, in four clusters. The overlay visualization of co-occurrence analysis of keywords has been shown in Table 2. The leading organizations engaged in research on “Silver 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 “Silver hip-implants”, with the highest number of publications and citations, was the Central South University, China, (Refer to table 2).

Table 2: Highlights of the most active organization

Organizations	Country	Documents	Citations	Average Citations per document
Central South University	China	5	12	2.4

Co-authorship analysis of the countries engaged in the research on “Silver 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 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	United States of America	40	692	11

The most active country in this research domain was the United States of America, with the leading 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 “Silver hip-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	Journal of Arthroplasty	5	86	17	3
Journal with highest citations and co-authorship links	Biomaterials	2	372	186	10

From the above discussion regarding the review patterns in the research regarding Silver-hip implants, this research had observed a gradual increase in research interest regarding Silver 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 Carvalho S. and Gosheger G. with the highest publication; and co-authorship links and citations respectively (Refer to table 1). The overlay analysis of top countries researching Silver hip-implants indicates that the United States of America 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 Journal of Arthroplasty. From these wide sources of information, researchers can focus on top journals where they can identify the most relevant and highly cited articles regarding Silver hip-implants.

4. Conclusion

Silver hip-implants was an interesting research domain and the most active journals related to this research domain were the Biomaterials and Journal of Arthroplasty. The most active country was the United States of America. The leading organization engaged in the research regarding Silver hip-implants was the Central South University, China. The most active authors who had made valuable contributions related to Silver hip-implants were Carvalho S. and Gosheger G. This research domain offers a new avenue for researchers and future research can be on innovations in Silver hip-implants.

References

1. Alves, C. F. A. *et al.* (2014) 'Influence of albumin on the tribological behavior of Ag-Ti (C, N) thin films for orthopedic implants', *Materials Science and Engineering C*, 34(1), pp. 22–28. doi: 10.1016/j.msec.2013.09.031.
2. Bitika, O., Uzuna, H. and Keçika, A. (2013) 'In-vivo analysis of antibacterial silver coated titanium implants in a contaminated rabbit knee model [Antibakteriyel gümüş kaplı titanyum İmplantları kontamine tavşan diz modelinde İn-vivo analizi]', *Turkiye Klinikleri Journal of Medical Sciences*, 33(6), pp. 1462–1472. doi: 10.5336/medsci.2013-37380.
3. Colmano, G., Edwards, S. S. and Barranco, S. D. (1980) 'Activation of antibacterial silver coatings on surgical implants by direct current: Preliminary studies in rabbits', *American Journal of Veterinary Research*, 41(6), pp. 964–966.
4. Dearnaley, G. *et al.* (2007) 'The use of thin layer activation to evaluate ion beam surface treatments of orthopaedic implant materials', *Surface and Coatings Technology*, 201(19-20 SPEC. ISS.), pp. 8070–8075. doi: 10.1016/j.surfcoat.2006.01.079.
5. 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.
6. Fordham, W. R. *et al.* (2014) 'Silver as a Bactericidal Coating for Biomedical Implants', *Surface and Coatings Technology*, 253, pp. 52–57. doi: 10.1016/j.surfcoat.2014.05.013.
7. Gordon, O. *et al.* (2010) 'Silver coordination polymers for prevention of implant infection: Thiol interaction, impact on respiratory chain enzymes, and hydroxyl radical induction', *Antimicrobial Agents and Chemotherapy*, 54(10), pp. 4208–4218. doi: 10.1128/AAC.01830-09.
8. Harges, J. *et al.* (2007) 'Lack of toxicological side-effects in silver-coated megaprotheses in humans', *Biomaterials*, 28(18), pp. 2869–2875. doi: 10.1016/j.biomaterials.2007.02.033.