

An Investigation of Iridium based Implants in Biomedical Engineering

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Abstract

Iridium 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 “Iridium-implants”. All published articles related to “Iridium-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 “Iridium-implants” and also to find out the trends related to the same. The leading Journals were the International Journal of Radiation, Oncology, Biology, Physics. The most active country was the United States of America. The leading organization engaged in the research regarding Iridium-implants was the Memorial Sloan-Kettering Cancer Center, USA. The most active authors who had made valuable contributions related to Iridium-implants were Pierquin B and Harrison L.B.

Keywords: Iridium-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. Iridium had been used for diversified purposes. Similarly, the high concentration of metals in body fluids, toxicity, and allergy of metals should also be considered in the cases of bio-implants.

Iridium had been mainly used for the treatment of various types of implants for cancer including breast cancer, lip cancer, prostate implant, and breast implants. Iridium wire implants can be used for treatment of cancer (McCormick *et al.*, 1988) (Monticciolo *et al.*, 2001) (Lasso *et al.*, 1998) (Mazon *et al.*, 1987) (Irigaray *et al.*, 1989) (Fentiman *et al.*, 1996) (Fentiman *et al.*, 1991) (Baily, 1982) (Brosman, 1991) (Dale, Jones and Price, 1997) (Daly, Douchez and Combes, 1982) (Daly, Lafontan and Combes, 1984) (De La Huerta Sanchez *et al.*, 1988) (De Paula Carranza *et al.*, 1991) (Deore *et al.*, 1993) (González *et al.*, 2002). Iridium-192 wires were used for interstitial implants (Behar *et al.*, 1994) (Bello *et al.*, 1982). Similarly, Iridium has been widely used in the treatment of carcinomas (Puthawala *et al.*, 1981) (Bagshaw *et al.*, 1991) (Behar *et al.*, 1994) (Carstanjen *et al.*, 2007); in the treatment of gynecological malignancies (Clubb, 1985) (Gerard *et al.*, 1987) (Gerard *et al.*, 1985) (Jackson, 1980). Iridium had also been used for breast implants (Hutchings, 1985) (Ibbott *et al.*, 2007); prostate implant (Khan, David Crawford, and Johnson, 1983) (Khan *et al.*, 1992); for application of the gold button technique for intraoral interstitial implants with iridium 192 seeds (Kumar and Henschke, 1977); brain implants (Sewchand *et al.*, 1984).

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

1.2 Research Questions

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

2. Research Methodology

Scopus files had been used for this article. For the article selection, the Boolean used was TITLE-ABS (Iridium-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 537 documents, in 11 languages, out of which 477 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 411 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 five and the minimum number of citations of authors as one. This combination plotted the map of 22 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 and co-authorship links | Pierquin B | 12 | 523 | 43.6 | 89 |
| Authors with the highest citations | Harrison L.B | 6 | 1067 | 178 | 27 |

In Co-occurrence analysis, we had used all keyword analyses, by keeping the minimum number of occurrences of a keyword as 50. This combination plotted the map of 32 thresholds, in threeclusters. The overlay visualization of co-occurrence analysis of keywords has been shown in Table2.The leading organizations engaged in research on “Iridium-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 “iridium-implants”, with the highest number of publications and citations,was the Memorial Sloan-Kettering Cancer Center, USA(Refer to table 2).

Table 2: Highlights of the most active organization

| Organizations | Country | Documents | Citations | Average Citations per document |
|--|--------------------------|-----------|-----------|--------------------------------|
| Memorial Sloan-Kettering Cancer Center | United States of America | 21 | 1497 | 71.3 |

Co-authorship analysis of the countries engaged in the research on “Iridium-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, citations, and co-authorship links | United States of America | 207 | 6903 | 16 |

The most active country in this research domain was the United States of America, 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 “Iridium -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, citations, and co-authorship links | International Journal of Radiation, Oncology, Biology, Physics | 83 | 3442 | 41.4 | 56 |

From the above discussion regarding the review patterns in the research regarding Iridium - implants, this research had observed a gradual increase in research interest regarding Iridium - implants from the starting of the millennium, and the momentum are 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 Pierquin B and Harrison L.B with the highest publication, co-authorship links, and citations respectively (Refer to table 1). The overlay analysis of top countries researching Iridium-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 International Journal of Radiation, Oncology, Biology, Physics. From these wide sources of information, researchers can focus on top journals where they can identify the most relevant and highly cited articles regarding Iridium-implants.

4. Conclusion

Iridium-implants was an interesting research domain and the most active journals related to this research domain was the International Journal of Radiation, Oncology, Biology, Physics. The most active country was the United States of America. The leading organization engaged in the research regarding Iridium-implants was the Memorial Sloan-Kettering Cancer Center, USA. The most active authors who had made valuable contributions related to Iridium-implants were Pierquin B and Harrison L.B. This research domain offers a new avenue for researchers and future research can be on innovations in Iridium-implants.

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