

A Review on Niobium Dental-Implants

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Abstract

Niobium 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 “Niobium dental-implants”. All published articles related to “Niobium dental 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 “Niobium dental-implants” and also to find out the trends related to the same. The leading journals were Journal of Materials Science: Materials in Medicine and Materials, Science and Engineering. The most active countries were the United States of America and Japan. The leading organization engaged in the research regarding Niobium dental implants was the Sao Paulo State University, Brazil. The most active authors who had made valuable contributions related to Niobium implants were Li Y., Breme J., and Grandini C.R with the highest publication, citations, and co-authorship links respectively.

Keywords: Niobium, Dental-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 (Priyanka *et al.*, 2014). Various types of implants had been used in modern medicine and include dental implants (Bhola *et al.*, 2010) dental crown (Er and Unsaldi, 2013), and cosmetic implants. Niobium-treated titanium implants with improved cellular and molecular activities at the tissue-implant interface.

Niobium is a good alternative to many other metal implants like Titanium, due to reduced cost and high corrosion resistance biological and mechanical characteristics (Plenk Jr. *et al.*, 1983) high strength (Schider, 1986)(Semlitsch, Staub and Weber, 1986)(Slokar, Živko-Babić, and Matković, 2014), bio-inertness with good ductility and workability (Schider *et al.*, 1981). However high serum ion levels in patients using Niobium implants is a concern to be addressed (Cundy *et al.*, 2014).

Niobium is used for dental implants. Niobium is also used for surface coating of bio-implants, especially for endodontic dental implants (Fathi *et al.*, 2006)(Fathi, Zahrani and Zomorodian, 2009) (Ramírez *et al.*, 2011).

Material engineering and surface engineering can play a significant role in improving the performance and life of Niobium –implants along with measures for reducing toxicity and hypersensitivity of the metal. This review analysis will be a useful platform for future researchers by realizing the top researchers, organizations, and countries involved in research regarding Niobium-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

- To consolidate the literature regarding Niobium dental-implants
- To find out the trends related to research in Niobium dental-implants

1.2 Research Questions

- Who are the active researchers working on Niobium dental -implants?
- Which are the main organizations and countries working on Niobium-based dental-implants?
- Which are the main journals Niobium dental-implants?

2. Research Methodology

Scopus files had been used for this article. For the article selection, the Boolean used was TITLE-ABS-KEY(Niobium Dental). 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 418 documents, in ten languages, out of which 388 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 328 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 1974 had 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 five and the minimum number of citations of authors as one. This combination plotted the map of 28 authors, in twelve 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 leading publications and links | Collares F.M | 11 | 143 | 13 | 56 |
| | Leitune V.C.B | 11 | 143 | 13 | 56 |
| Authors with the highest citations | Niinomi M. | 10 | 360 | 36 | 48 |

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 22 thresholds, in two clusters. The overlay visualization of co-occurrence analysis of keywords has been shown in Table2. The leading organizations engaged in research on “Niobium dental 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 “Niobium dental-implants”, with the highest number of publications and citations, was the Sao Paulo State University, Brazil (Refer to table 2).

Table 2: Highlights of the most active organization

| Organizations | Country | Documents | Citations | Average Citations per document |
|----------------------------|---------|-----------|-----------|--------------------------------|
| Sao Paulo State University | Brazil | 26 | 541 | 21 |

Co-authorship analysis of the countries engaged in the research on “Niobium dental 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, and co-authorship links | United States of America | 45 | 862 | 43 |
| The country with the highest citations | Japan | 67 | 1349 | 13 |

The most active countries in this research domain were the United States of America and Japan, with the highest number of publications, and links; and citations respectively.

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 “Niobium dental-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 |
|---|---|-----------|-----------|---------------------------------|
| Journal with the highest publications and citations | Materials, Science and Engineering | 19 | 465 | 31 |
| Journal with highest co-authorship links | Journal of Materials Science: Materials in Medicine | 14 | 457 | 34 |

From the above discussion regarding the review patterns in the research regarding Niobium dental-implants, this research had observed a gradual increase in research interest regarding Niobium dental-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 Collares F.M, Leitune V.C.B, and Ninomi M. with the highest publication, citations, and co-authorship links respectively (Refer to table 1). The overlay analysis of top countries researching Niobium dental implants indicates that the United States of America and Japan were the leading countries relating to the highest number of publications and co-authorship links, and citations respectively (Refer to Table 5). The top journals of this research domain were identified as the Journal of Materials Science: Materials in Medicine and Materials, 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 Niobium dental-implants.

4. Conclusion

Niobium dental implants was an interesting research domain and the most active journals related to this research domain were the Journal of Materials Science: Materials in Medicine and Materials, Science and Engineering. The most active countries were the United States of America and Japan. The leading organization engaged in the research regarding Niobium implants was the Sao Paulo State University, Brazil. The most active authors who had made valuable contributions related to Niobium implants were Li Y., Breme J., and Grandini C.R with the highest publication, citations, and co-authorship links respectively. This research domain offers a new avenue for researchers and future research can be on innovations in Niobium dental implants.

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