



# A Meta Analysis on Teaching methods of Vanadium based Orthopedic-Implants

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## Abstract

Vanadium is one of the widely used metals for ortho-implants. The review analysis had been conducted to understand the active authors, organizations, journals, and countries involved in the research domain of “Vanadium orthopedic-implants”. All published articles related to “Vanadium orthopedic-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 “Vanadium orthopedic-implants” and also to find out the trends related to the same. The leading Journals were Analytical and Bioanalytical Chemistry, Journal of the American Chemical Society, and Journal of Inorganic Biochemistry. The most active country was the United States of America. The leading organization engaged in the research regarding Vanadium-implants was the Russian Academy of Sciences, Russia. The most active authors who had made valuable contributions related to Vanadium-implants were Aureliano M.

**Keywords:** Vanadium, Orthopedic-implants, Material engineering, Review analysis, Meta Analysis.

## 1. Introduction

An artificial 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), including Vanadium. Vanadium implants range from orthopedic implants, knee implants, dental implants (Zagury *et al.*, 2007). The major issues associated with implants of Vanadium are the hypersensitivity and toxicity of the metal; development of systematic dermatitis and implant failure; Similarly poor functioning of implant and issues of cytotoxicity are also associated with Vanadium implants.

Corrosion of Vanadium–implants is also an issue to be addressed. Various types of surface engineering and surface coating can be conducted in Vanadium–implants to improve their performance and longevity. Thermal and chemical modifications in Vanadium implants can improve the performance of the implant. (MacDonald *et al.*, 2004). Various methods are available for the tracing of Vanadium from orthopedic implants and spectrophotometric determination is widely used for tracing Vanadium with ortho-dianisidine (Ariel and Manka, 1961). vanadium



pentoxide is also used for various medical purposes (Wain Wright and Hoffman, 1977; Wainwright and Hoffman, 1977).

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

### 1.2 Research Questions

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

## 2. Research Methodology

Scopus files had been used for this article. For the article selection, the Boolean used was TITLE-ABS (Vanadium ortho). 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 120 documents, in six languages, out of which 113 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 106 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 1937 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 two and the minimum number of citations of authors as one. This combination plotted the map of 19 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	Aureliano M.	3	115	38	15
Authors with the highest citations	Conan F	1	188	188	4
	Gambarotta S.	1	188	188	4
	Reardon D.	1	188	188	4
	Wang Q	1	188	188	4

In Co-occurrence analysis, we had used all keyword analyses, by keeping the minimum number of occurrences of a keyword as 6. This combination plotted the map of 27 thresholds, in three clusters. The overlay visualization of co-occurrence analysis of keywords has been shown in Table 2. The leading organizations engaged in research on “Vanadium ortho-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 “Vanadium ortho-implants”, with the highest number of publications and citations, was the Russian Academy of Sciences, Russia (Refer to table 2).

Table 2: Highlights of the most active organization

Organizations	Country	Documents	Citations	Average Citations per document



Russian Academy of Sciences	Russia	4	11	3
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Co-authorship analysis of the countries engaged in the research on “Vanadium ortho-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	21	619	7

The most active country in this research domain was the United States of America, with the highest number of publications, 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 “Vanadium orthopedic-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	Analytical and Bioanalytical Chemistry	6	58	9.6	0
Journal with highest citations	Journal of the American Chemical Society	3	303	101	1
Journal with highest co-authorship	Journal of Inorganic Biochemistry	3	110	37	3



From the above discussion regarding the review patterns in the research regarding Vanadium orthopaedic implants, this research had observed a gradual increase in research interest regarding Vanadium orthopedic -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 author in this research domain was Aureliano M. with the highest publication and co-authorship links (Refer to table 1). The overlay analysis of top countries researching Vanadium orthopedic-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 Analytical and Bioanalytical Chemistry, Journal of the American Chemical Society, and Journal of Inorganic Biochemistry. From these wide sources of information, researchers can focus on top journals where they can identify the most relevant and highly cited articles regarding Vanadium orthopedic-implants.

#### 4. Conclusion

Vanadium orthopedic -implants was an interesting research domain and the most active journals related to this research domain was Analytical and Bioanalytical Chemistry, Journal of the American Chemical Society, and Journal of Inorganic Biochemistry. The most active country was the United States of America. The leading organization engaged in the research regarding Vanadium-implants was the Russian Academy of Sciences, Russia. The most active authors who had made valuable contributions related to Vanadium-implants were Aureliano M. This research domain offers a new avenue for researchers and future research can be on innovations in Vanadium orthopedic-implants.

#### References

1. Ariel, M. and Manka, J. (1961) 'The spectrophotometric determination of chromium and vanadium with ortho-dianisidine', *Analytica Chimica Acta*, 25(3), pp. 248–256. doi: 10.1016/0003-2670(61)80154-2.
2. 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.
3. MacDonald, D. E. *et al.* (2004) 'Thermal and chemical modification of titanium-aluminum-vanadium implant materials: Effects on surface properties, glycoprotein adsorption, and MG63 cell attachment', *Biomaterials*, 25(16), pp. 3135–3146. doi: 10.1016/j.biomaterials.2003.10.029.
4. Priyanka, P. *et al.* (2014) *Role of nanogrooves on the performance of ultra-fine grained titanium as a bio-implant*, *Advanced Nanomaterials: Synthesis, Properties, and Applications*. Apple Academic Press. doi: 10.1201/b16966.
5. Wain Wright, M. S. and Hoffman, T. W. (1977) 'The oxidation of ortho-xylene on vanadium pentoxide catalysts. I. Transient kinetic measurements', *The Canadian*



- Journal of Chemical Engineering*, 55(5), pp. 552–556. doi: 10.1002/cjce.5450550512.
6. Wainwright, M. S. and Hoffman, T. W. (1977) 'The oxidation of ortho-xylene on vanadium pentoxide catalysts II. The influence of catalyst support material on product distribution', *The Canadian Journal of Chemical Engineering*, 55(5), pp. 557–564. doi: 10.1002/cjce.5450550513.
  7. Zagury, R. *et al.* (2007) 'Histomorphometric analyses of bone interface with titanium-aluminum- vanadium and hydroxyapatite-coated implants by biomimetic process', *Implant Dentistry*, 16(3), pp. 290–296. doi: 10.1097/ID.0b013e3180e9d9ed.