A Bibliometric Analysis and Visualisation of Research Trends in Toxicity of Nickel-implants

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Abstract: Nickel is one of the most used metals for implants. The bibliometric analysis had been conducted to understand the active authors, organizations, journals, and countries involved in the research domain of “Toxicity of Nickel-implants”. All published articles related to “Toxicity of Nickel-implants” from “Scopus”, were analyzed using the VOS viewer to develop analysis tables and visualization maps. This article had set the objective to consolidate the scientific literature regarding “Toxicity of Nickel-implants” and also to find out the trends related to the same. The most active journals in this research domain biomaterial. The most active country was the United States of America and United Kingdom. The leading organization engaged in the research regarding the toxicity of Nickel implants was the Rush University Medical Center, United States of America. The most active author who had made valuable contributions related to the toxicity of Nickel implants was Hallab N.J.

Keywords: Toxicity, Nickel-implants, Material engineering, Bibliometric analysis, VOS viewer,
from the works (Farhat et al., 2013; Liao et al., 2016; Kolkailah et al., 2019; Rodríguez-Padial et al., 2019; Tran et al., 2019; Ullah et al., 2019; Shahid et al., 2020).

3. Results and discussion

3.1 Results

This first round of search produced an outcome of 60 documents, in 3 languages, out of which 58 documents were in English. The classification of document categories is shown in Figure 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 35 English articles (both open access and others) and had been used to conduct bibliometric analysis and visualization using VOS Viewer. The English research articles in this domain since 1981 had been shown in Figure 2.

Figure 1: Classification of the documents on “Toxicity of Nickel implants”, Source: www.scopus.com

![Classification of documents](image1)

Figure 2: Period wise publication of articles, Source: WWW.scopus.com

Co-authorship analysis of top authors had been shown in figure 3. For a better presentation of the analysis, the parameters used were the minimum number of documents of an author as one and the minimum number of citations of authors as seventy-five. This combination plotted the map of 32 authors, in 6 clusters. The overlay visualization map of co-authorship analysis plotted in Figure 3, points out the major researchers with their strong co-authorship linkages and clusters involved.
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Figure 3: Co-authorship analysis on basis of authors

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 two.

Table 1: Highlights of most active authors

<table>
<thead>
<tr>
<th>Description</th>
<th>Authors</th>
<th>Documents</th>
<th>Citations</th>
<th>Average citations per document</th>
<th>Link strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authors with the highest publication, citations, and co-authorship links</td>
<td>Hallab N.J</td>
<td>5</td>
<td>297</td>
<td>59.4</td>
<td>23</td>
</tr>
</tbody>
</table>

In Co-occurrence analysis, we had used all keyword analyses, by keeping the minimum number of occurrences of a keyword as seven. This combination plotted the map of 27 thresholds, in three clusters. The overlay visualization of co-occurrence analysis of keywords has been shown in Figure 4.

Figure 4: Co-occurrence analysis on basis of all keywords

The leading organizations engaged in research on “Toxicity of Nickel-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 “Toxicity of Nickel-implants”, with the highest number of publications and citations, was the Rush University Medical Center, United States of America (Refer to table 2).

Table 2: Highlights of the most active organization

| Organizations | Country | Documents | Citations | Average Citations per document |
|---------------|---------|-----------|-----------|-------------------------------|---------------|

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Co-authorship analysis of the countries engaged in the research on “Toxicity of Nickel-implants” had been shown in Figure 5. The overlay visualization map of co-authorship analysis plotted in Figure 5, points out the main countries with their strong co-authorship linkages and clusters involved.

Figure 5: Co-authorship analysis on basis of countries

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

<table>
<thead>
<tr>
<th>Description</th>
<th>Country</th>
<th>Documents</th>
<th>Citations</th>
<th>Link strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>The country with the highest publication and citations</td>
<td>United States of America</td>
<td>13</td>
<td>439</td>
<td>4</td>
</tr>
<tr>
<td>The country with the highest co-authorship links</td>
<td>United Kingdom</td>
<td>6</td>
<td>224</td>
<td>5</td>
</tr>
</tbody>
</table>

The most active country in this research domain was the United States of America and the United Kingdom, with the highest number of publications, and citations; and co-authorship links 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 “Toxicity of Nickel-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

<table>
<thead>
<tr>
<th>Description</th>
<th>Journal details</th>
<th>Documents</th>
<th>Citations</th>
<th>Average citations per documents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Journal with the highest publications, citations, and links</td>
<td>Biomaterials</td>
<td>4</td>
<td>382</td>
<td>95.5</td>
</tr>
</tbody>
</table>

From the above discussion regarding the bibliometric patterns in the research regarding the toxicity of Nickel-implants, this research had observed a gradual increase in research interest regarding the toxicity of Nickel-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 Figure 2). The most active author in this research domain Hallab N.J with the highest publication, co-authorship links, and citations (Refer to table 1). The overlay analysis of top countries researching the toxicity of Nickel implantations indicates that the United States of America and United Kingdom was the leading country relating to the highest number of publications and citations; and co-authorship links respectively(Refer to figure 5). The top journals of this research domain were identified as the Biomaterials. From these wide sources of information, researchers can focus on top journals where they can identify the most relevant and highly cited articles regarding toxicity Nickel-implants.

4. Conclusion
The toxicity of Nickel-implant was an interesting research domain and the most active journal related to this research domain was the biomaterial. The most active country was the United States of America and United Kingdom. The leading organization engaged in the research regarding the toxicity of Nickel implants was the Rush University Medical Center, United States of America. The most active author who had made valuable contributions related to the toxicity of Nickel implants was Hallab NJ with the highest publication, co-authorship links, and citations respectively. This research domain offers a new avenue for researchers and future research can be on innovations in the toxicity of Nickel-implants.

References


