

## **A BIBLIOMETRIC ANALYSIS ON WHITE SPOT LESIONS (WSLs) IN FIXED ORTHODONTICS**

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### **ABSTRACT**

*An article's potential to influence future research and change therapeutic practices is often indicated by a high number of citations. Researchers can identify influential papers and gain insight into their salient features by analyzing the most often cited papers in a specific field of science. This current study sought to conduct a bibliometric review to analyze the top cited papers related to White spot lesions in orthodontics(1).*

*Enamel decalcification is a consequence of orthodontic treatment (2). The objective of orthodontic treatment is to improve both the aesthetic appearance of the face and the arrangement of the teeth. Teeth that have been banded or bonded exhibit a significantly increased prevalence of WSLs when compared to those without braces, primarily due to the way fixed orthodontic appliances and bonding materials promote the retention of biofilms(3).This bibliometric analysis focuses on original research articles concerning white spot lesions in orthodontics between the years 1976 and 2023, encompassing all such articles extracted systematically from the SCOPUS database. The study encompassed a total of 216 articles, the number of sources being 111, accumulating 23.27average citations per document. Furthermore, 14.8% of these articles were published in the Journal Caries Research, with 841 authors, 8 under authors of single authored documents or co-authored by 4.69 co-authors per document, international co-authorship of 21.76% with an annual growth rate of 6.9% (4). Among the most cited papers on this topic, only a handful of systematic reviews and interventional studies were found.*

**KEYWORDS:** *White Spot Lesions, Orthodontics, Dental Fluorosis, Bibliometric Analysis*

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### **INTRODUCTION**

Several sources indicate, WSLs are subsurface enamel porosity resulting from carious demineralization, and they appear "milky white" when situated on smooth surfaces. It is linked to the use of fixed orthodontic appliances, which are a prevalent undesirable outcome of orthodontic therapy and pose a substantial obstacle in attaining aesthetic perfection. The acidic substances produced by plaque bacteria are accountable for the subsequent demineralization of enamel and the

development of WSLs. Studies have documented that orthodontic patients often have higher concentrations of acid-producing bacteria in their plaque, with a particular emphasis on *Streptococcus mutans* and *Lactobacilli*. These heightened bacterial populations have the capacity to orthodontic patients' plaque pH reduces substantially in patients' who do not have orthodontic appliances. Consequently, the advancement of tooth decay tends to occur more rapidly in individuals wearing full orthodontic appliances (5). The configuration of hydroxyapatite crystals undergoes a natural cycle of alternating between demineralization and remineralization. The outcome of this cycle, whether it leans more towards demineralization or remineralization, is contingent upon environmental factors (6). These lesions can give rise to tooth decay, resulting in diminished esthetic appearance, patient dissatisfaction, and potential legal issues (7). White spots around orthodontic attachments can develop in a clinical setting starting as early as a month into treatment (8). The occurrence of these issues in orthodontic patients varies significantly, with reported rates ranging from as low as 2% to as high as 96% (10). Among WSLs, the maxillary posterior segments are the least frequently affected, whereas the labio-gingival area of the lateral incisors is the most affected location. In addition, WSLs are likely to affect men more than women. The extent of remineralization differs from person to person and can also vary within different areas of the mouth (11). Occasionally, the size of a demineralized area may be so extensive that even the use of an effective remineralization agent cannot bring about improvement. The timely identification and intervention of WSLs during orthodontic treatment is very crucial. It enables clinicians to proactively introduce preventive measures to manage the demineralization process before the lesions advance further (12).

In conclusion, data may help researchers uncover gaps in knowledge and new avenues for investigation, which may help prevent new cases from arising and effectively manage the ones that are already in existence. After examining 100 most-cited papers, the present bibliometric research has the capacity to evaluate the current state of research on white spot lesions as well as provide an overview of the influence of these studies.

## **METHODOLOGY AND RETRIEVAL OF DATA**

In September 2023, the current bibliometric investigation was carried out using the Web of Scopus database. The search strategy employed is as follows- TS = "WSLs" AND "orthodontics" OR "consequences of fixed orthodontic treatment" OR "Enamel Defect".

Additionally, the "Dentistry, Orthodontics and dentofacial orthopedics" category filter was utilized. There were no restrictions imposed regarding language or publication year, and papers that did not pertain to topics related to white spot lesions in orthodontics, conference papers, and editorials were excluded from the study.

The papers' titles, authorship information, number of authors, citation count and density, affiliations, geographic location (continent and country based on the corresponding author's affiliation), publication year, journal, keywords, study design, and research focus were among the details that were extracted from the document. Systematic reviews, literature reviews, lab experiments, observational studies, and interventional studies were the different categories used to group study designs. The most common topics found in the papers such as fluoride consumption, epidemiology, diagnosis, pathophysiology, and clinical appearance of white spot lesions were then used to categorize them. Themes with one specific presentation have been classified as "others."

A cross-reference was conducted to compare the citation counts of each selected publication in the SCOPUS and Google Scholar databases after the top 216 most-cited papers had been selected.

### DATA ANALYSIS

Bibliometric metrics including the h-index, total citation count, and publication count were employed for data analysis. Additionally, data visualization was performed using VOS viewer and Biblioshiny software within the R-studio environment (Vienna, Austria's R Foundation for excellence for Computing Statistics).

### RESULTS

In context of the data obtained from the Scopus database, 216 articles from SCOPUS and Google Scholar databases were included in the bibliometric study. Between 1976 and 2023, within this selection, the collection consisted of 169 articles, 3 book chapters, 2 conference papers, 2 conference reviews, 3 errata, 1 letter, 1 note, 34 reviews, and 1 short survey relating to white spot lesions in orthodontics that were published and indexed.

### ANNUAL SCIENTIFIC PRODUCTION

Notably, the number of papers on white spot lesions in fixed orthodontics showed a general upward trend during this period. 2021 had the highest number of papers published (21/216) and the lowest number of articles between the years 1977 to 1984 (0/216) as shown in figure 1 A.

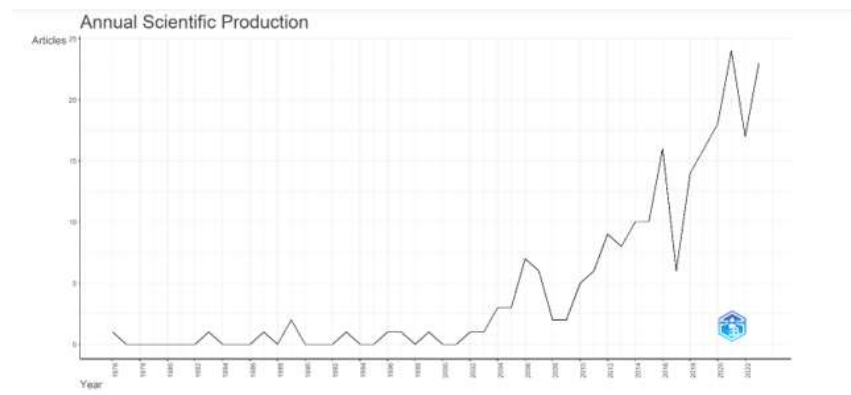


Figure 1A (Annual Scientific Production)

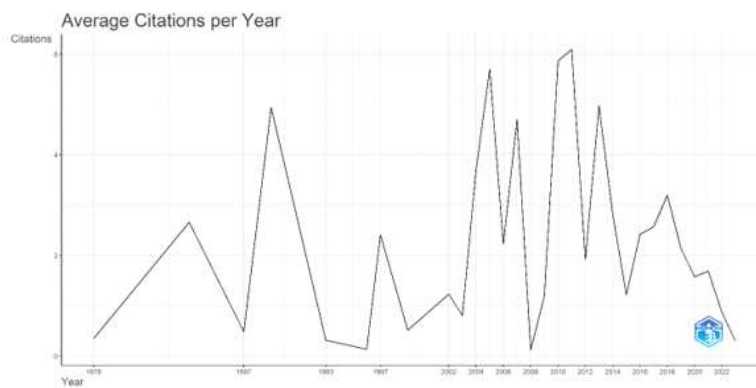


Figure 1B (Average Citations per Year)

FIGURE 1

Figure 1

### AVERAGE CITATIONS PER YEAR

The minimum number of citations recorded was 0.1 in 2008, while the peak number of citations reached 6.1 in 2011 as seen in figure 1B.

### MOST RELEVANT SOURCES

There were 22 documents from various sources, with the highest number being 22 from AJODO and lowest number being 4 from Caries Research, European Journal of Oral Sciences, Indian Journal of Dental Research, and Journal of Clinical and Experimental Dentistry as seen below in figure 2A.

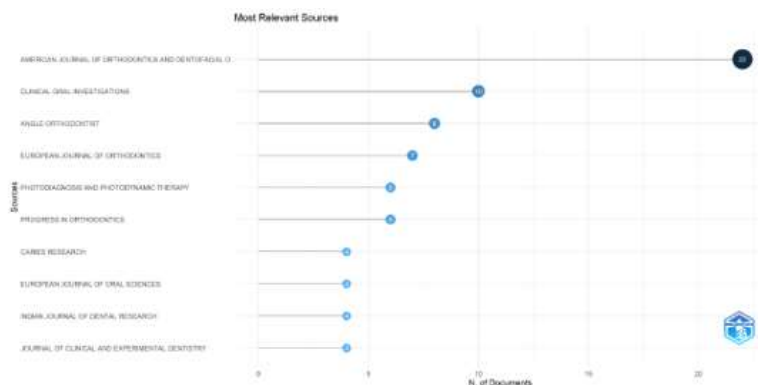


Figure 2A (Most Relevant Sources)

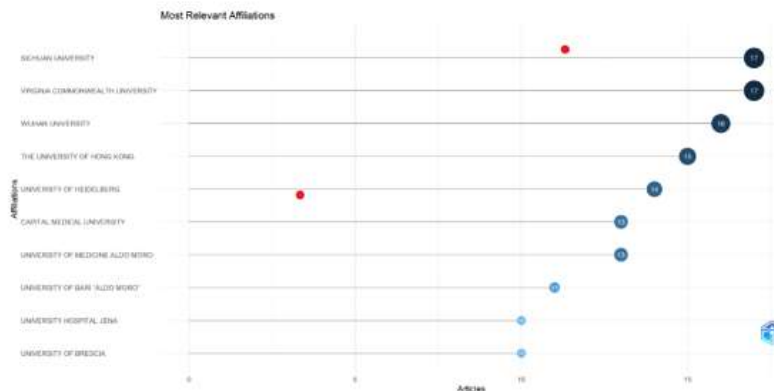


Figure 2B (Most Relevant Affiliations)

Figure 2

Figure 2

### MOST RELEVANT AFFILIATIONS

According to the bibliometric analysis, a ranking of the top 10 universities that have contributed the most pertinent articles on WSLs in Orthodontics has been compiled. Sichuan University and Virginia Commonwealth University stand at the forefront, having published the highest number of articles on WSLs in Orthodontics, totaling 17 articles each. Following closely behind, the Wuhan University secures the second spot with 16 articles, while The University of Hong Kong holds the third position with 15 articles (Figure 2B).

## MOST LOCALLY CITED DOCUMENTS

The identified articles were examined to identify the top ten articles with the highest number of local citations. These ten articles are provided in Table 1. Based on the citation criteria, Ogaard's work stands out with the highest citation count compared to the other articles. Ogaard's research has been cited approximately 204 times (as shown in table 1A).

**Table 1**

Sources	Articles
OGAARD B	204
GORELICK L	86
BENSON P E	56
GEIGER A M	54
TUFEKCI E	45
BISHARA S E	44
ARTUN J	40
BOERSMA J G	38
MIZRAHI E	38
REYNOLDS E C	38

Table 1A (Most Locally cited documents)

Authors	Articles	Articles Fractionalized
VAN DER VEEN MH	7	1.95
HUA F	6	1.13
KNÖSEL M	6	1.73
CAMPBELL PM	5	1.15
TWETMAN S	5	1.21
BUSCHANG PH	4	0.98
EKAMBARAM M	4	0.70
LINDAUER SJ	4	0.73
MEI L	4	0.73
PADMANABHAN S	4	1.42

Table 1B (Top 10 productive authors in the field of WSL in Orthodontics)

**Table 1**

## TOP 10 PRODUCTIVE AUTHORS IN THE FIELD OF WSL IN ORTHODONTICS

A total of 841 authors have been identified across the 216 articles. In Table 1B, you can find the top 10 most prolific authors in the field of WSL in Orthodontics. Leading the list is Van Der Veen MH with an impressive 7 publications on WSL in Orthodontics. Following closely behind are Hua F and Knosel M with 6 articles.

## COUNTRIES' CONTRIBUTION

Publications regarding WSL in Orthodontics saw contributions from 38 different nations or regions. Among these, two countries surpassed the threshold of 15 publications, four exceeded 8 publications, and one exceeded 5 publications. Leading the pack in productivity was the United States, followed by India, China, Germany, Netherlands, Iran, Brazil, Italy, Romania, and Sweden.

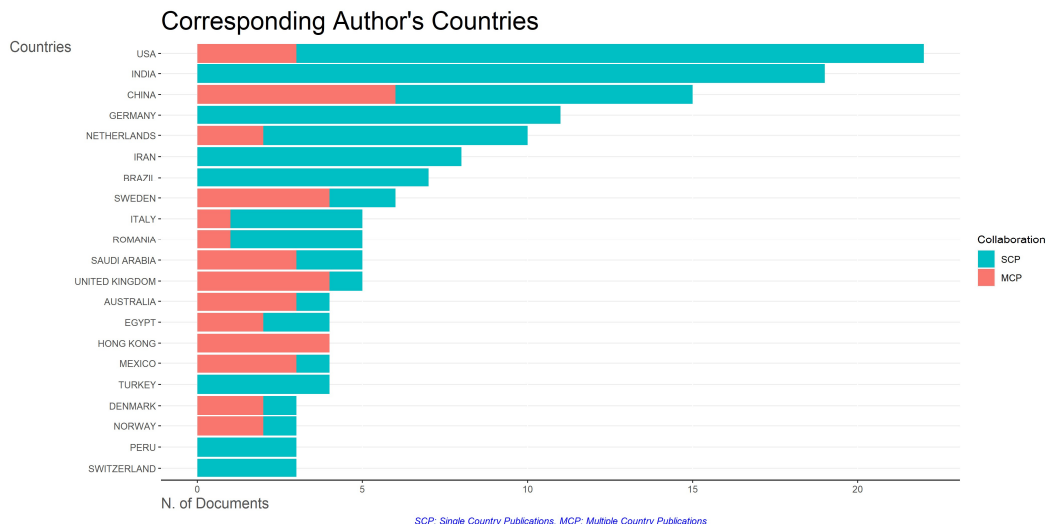


Figure 3 (Corresponding Author's Countries)

**KEYWORD ANALYSIS**

An assessment was conducted on the top 10 keywords of utmost relevance. The keyword that emerged as the most utilized was "dental caries," which appeared a total of 213 times. Additionally, the term "human" featured prominently with 173 occurrences. The remaining highly pertinent keywords can be found in (Figure 3).

Table 2

Words	Occurrences
dental caries	213
human	173
humans	137
orthodontics	131
adolescent	123
male	110
female	106
article	91
child	80
controlled study	71

**DISCUSSION**

This bibliometric analysis is pioneering in its nature, with the primary objective of pinpointing and conducting a quantitative assessment of scientific research articles pertaining to methods for detecting WSLs in Orthodontics. (12) Enamel decalcifications are observed in patients at rates ranging from 15.5% to 40% before commencing orthodontic treatment, and their occurrence increases to 30% to 70% during the treatment phase (14). The management of WSLs should involve a comprehensive approach that addresses multiple factors. The primary strategy focuses on preventing demineralization and the formation of biofilm. Furthermore, methods such as remineralization of lesions, thinning, micro-abrasion, erosion-infiltration, adhesive composite resin restorations, and the use of bonded facets are important components of the approach (16).

The preventive methods include oral hygiene management, fluoride-based products like fluoridated toothpaste, mouthwash, and fluoride varnishes. Additionally, there are strategies to augment the anti-cavity effects of fluoride, such as utilizing casein phosphopeptides amorphous calcium phosphate, probiotics, polyols, and antiseptics like Listerine and chlorhexidine, along with the application of lasers. However, in fixed orthodontic patients, maintaining excellent oral hygiene stands as the foremost preventive measure against WSLs.

## CONCLUSION

This bibliometric analysis offers a comprehensive overview of orthodontic publications on WSLs in fixed orthodontics, presenting insights into the most productive and impactful journals, countries, institutions, authors, and keywords within orthodontic journals.

The findings lead to the conclusion that the rates of WSLs incidence and prevalence are notably elevated in orthodontic patients, underlining the need for both patients and caregivers to focus on implementing effective strategies for preventing the same. (16)

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