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Top Cited Scientific Articles Published on Artificial Intelligence in the Field of Dentistry- A Bibliometric Analysis

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ABSTRACT: Generally, the bibliometric analysis of articles provides more useful information and scientific knowledge about the field of research. This also helps to encourage the scientists to keep themselves updated in the field of research. The aim of this study is to evaluate the bibliometric analysis of top cited scientific articles related to artificial intelligence in the field of dentistry. The top 30 cited articles related to Artificial Intelligence (AI) in the field of dentistry were specially selected for bibliometric analysis. The articles were retrieved from the electronic databases such as PubMed, Google Scholar and Scopus using keywords. The parameters such as number of citations, geographical distribution, place and year of publication, type of articles, patterns of authorship, outcome of these articles and area of interest were assessed for articles regarding artificial intelligence. Since this article focused only on articles with top thirty citations many articles were excluded due to lack of citations. The citations of the top 30 cited articles range from 448-11. Most of these articles were review articles and were conducted in the United States of America with maximum number of joint authorship patterns. The bibliometric assessment of the articles on artificial intelligence in the field of dentistry enlightened the knowledge as well as provided additional information to design a proper treatment protocol for the beneficiaries.

Keywords: Article, artificial intelligence, bibliometric analysis, citation, dentistry, research.

Abbreviations: AI, Artificial intelligence.

I. INTRODUCTION

Artificial intelligence is the field of science and engineering concerned with the computational understanding of what is commonly called intelligent behaviour and with the creation of artifacts that exhibit such behaviour. It is a breakthrough in the field of technology which is rapidly progressing and has captivated the minds of behaviour. Artificial intelligence uses tools and insights from many fields which overlaps the tasks such as robotics, data mining, facial recognition [1].

The artificial intelligence had been implemented in the field of dentistry to diagnose the exact problem of a disease. It helps to reduce procedure time, cost, and errors. This technology has great potential to support the dental profession for radiographic interpretations, diagnosis of oro-facial pain, and analysis of facial growth in orthodontia, etc [2]. With the help of applications available in the smart phones the patients will be able to diagnose and prevent the progression of dental problems at an earlier stage by self examination [3].

Bibliometrics deals with the analysis of academic literature quantitatively which includes various parameters such as number of publications, citations, name of the journal, year of publication, geographical distribution and type of articles. The citation is the reference which was used by a researcher during publication of the article. The bibliometric analysis provides most useful information for the population to assess about the articles and journal [4].

The scientific journal plays a major role in providing knowledge about the research. This also provides more interaction and participation of the authors to develop their skills in research especially in developing countries. No previous studies have been conducted based on the bibliometric assessment of artificial intelligence related articles in the dentistry so this study was conducted by using the reference of various studies based on the bibliometric analysis related to dentistry [4, 5, 6]. The bibliometric analysis of artificial intelligence related articles in the field of dentistry will be useful for the dentists in providing appropriate diagnosis and treatment and moreover this also helps them to conduct new researches by using this paper. So this present study aims to evaluate the bibliometric analysis of the top most cited articles related to artificial intelligence in the field of dentistry.

II. MATERIALS AND METHODS

This study was carried out to assess the bibliometric analysis of top 30 cited artificial intelligence articles in the field of dentistry. These articles were searched manually from the Pubmed, Google scholar and Scopus databases by using keywords such as artificial intelligence, dentistry.

The top thirty cited articles were ranked based on the citation number provided in the Google Scholar and assessed for bibliometric analysis which includes the number of citations, journal name, authorship pattern, place, year of publication, geographical distribution, type of articles, area of interest and outcome of the study.

The inclusion criteria are only original and review articles related to artificial intelligence in the field of dentistry were selected and those articles published in English language are included. Only top 30 cited articles with full text are included. The exclusion criteria are those articles with no number of citations, case reports and patency related articles were excluded, those articles with no open assess are excluded from the study. The collected data entered in the Microsoft excel and they were analyzed and tabulated using descriptive statistics.

III. RESULTS AND DISCUSSION

The citations of the top 30 cited artificial intelligence articles in dentistry ranges from 448-11. Most of them are review articles and were published in American continent followed by Asian continent.

The current bibliometric analysis would be very useful to enlighten the knowledge to the researchers as well as to the public pertaining to artificial intelligence. This helps the scientists to be updated in the field of research and also motivates them to actively participate in the research. In this study, the bibliometric analysis was done based on the top thirty cited artificial intelligence articles in the field of dental practice.

Table 1 shows about the ranking of the top 30 cited articles based on the artificial intelligence in dental practice. The citation of these articles ranges from 448-11. The total number of original articles was 9 whereas the review articles were 21. The publication of these top thirty cited articles was between the years 1988-2018. The articles which were published after 2018 had only minimum number of citation so they were excluded since this paper considers only top thirty cited articles. This might lead to lack of updating recent information and technologies.

Table 1: Ranking of top 30 cited articles related to artificial intelligence in the field of dentistry.

Rank	Total no. of citations	Year	Place	Type of article	Journal name
1.	448	1988	France	Review	The journal of American Dental Association [7]
2.	101	2004	Columbia	Review	Journal of dental education [8]
3.	69	1998	UK	Review	Journal of dentistry [9]
4.	64	2011	Thailand	Original	Artificial intelligence in medicine [10]
5.	45	2010	China	Original	The Angle orthodontist [11]
6.	38	2011	Romania	Review	Oral health and dental management [12]
7.	35	1992	USA	Review	Journal of Canadian dental association [13]
8.	35	2006	USA	Review	In2006 Canadian Conference on Electrical and Computer Engineering [14]
9.	32	2007	New Zealand	Review	Engineering Applications of Artificial Intelligence [15]
10.	31	2009	India	Review	Journal of evidence based dental practice [16]
11.	30	1993	UK	Review	Artificial intelligence in medicine [17]
12.	29	2001	Greece	Original	International endodontic journal [18]
13.	27	2018	Korea	Original	Journal of periodontal and implant science [19]
14.	26	2014	Japan	Review	Japanese dental science review [20]
15.	25	1989	USA	Review	The journal of prosthetic dentistry [21]
16.	22	1983	USA	Review	The journal of the American Dental Association [22]
17.	21	2008	Brazil	Original	Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology and Endodontology [23]
18.	20	2010	India	Original	International journal of dental clinics [24]
19.	19	2010	India	Review	International dental journal [25]
20.	18	2012	Spain	Original	Distributed computing and artificial intelligence [26]
21.	16	2015	Brazil	Original	Journal of dental education [27]
22.	16	2006	Thailand	Original	International journal of computer assisted radiology and technology [28]
23.	16	1996	Japan	Review	Studies in health technology and informatics [29]
24.	16	2017	India	Review	In2017 5th International Symposium on Computational and Business Intelligence [30]
25.	15	1996	USA	Review	Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology [31]
26.	14	2012	Brazil	Review	In2012 18th International Conference on Virtual Systems and Multimedia [32]
27.	14	2005	USA	Review	The Journal of the Acoustical Society of America [33]
28.	13	2011	Brazil	Review	International Conference on ENTERprise Information Systems [34]
29.	13	1992	Sweden	Review	Dentomaxillofacial Radiology [35]
30.	11	2014	Egypt	Review	Tanta Dental Journal [36]

The Table 1 shows about the number of citations, year, place, type of article and journal name of the scientific articles related to artificial intelligence in dentistry. These articles were ranked based on the number of citations which ranges from 448-11. The publications of these top thirty cited articles were between the years 1988-2018. Among these top cited articles, the highest cited article was conducted in France in the year 1988 and the study published in the Journal of American Dental Association [7] whereas the study was the lowest cited article was conducted at Egypt in the year 2014 which was published in Tanta dental journal [36].

Out of thirty articles, nine were original articles whereas twenty five were review articles. This shows that the clinical applications of artificial intelligence were very less. Further studies should be conducted clinically to ensure the implementation of artificial intelligence as evidence based in the dental practice.

The Fig. 1 shows about the geographical distribution of the artificial intelligence articles in dentistry. Out of thirty articles, ten studies were conducted in Asian continent, one from African continent, seven from European continent, eleven studies were from American continent where as one from Australian continent. Most number of artificial intelligence articles related to dentistry were done in America followed by Asia and Europe. This showed their interest towards the technological advancements in dental practice.

Fig. 2 shows the pattern of authorship of artificial intelligence articles in dentistry. Out of thirty articles, only two articles had single authorship whereas twenty eight of the articles had joint authorship pattern.

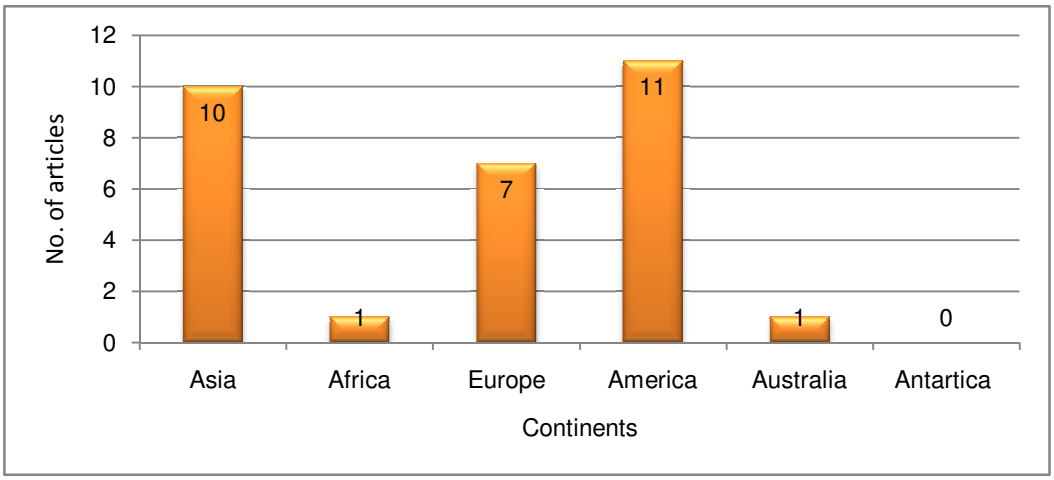

Fig. 1: Geographical distribution of authors

The Fig. 2 shows about the authorship pattern of the artificial intelligence related articles. Out of thirty articles, 2 articles have single authorship pattern whereas 28 articles have joint authorship pattern.

The table 2 discussed about the outcome of artificial intelligence articles in the dental practice. The outcome of these articles showed that artificial intelligence was very effective in making correct clinical decision by diagnosing the exact disease and helps the dental professionals to treat patients in an appropriate manner. This is not only useful for the dental professionals but also to the public by providing the self assessment of their oral health which helps to prevent and reduce the progression of the diseases at an earlier stage.

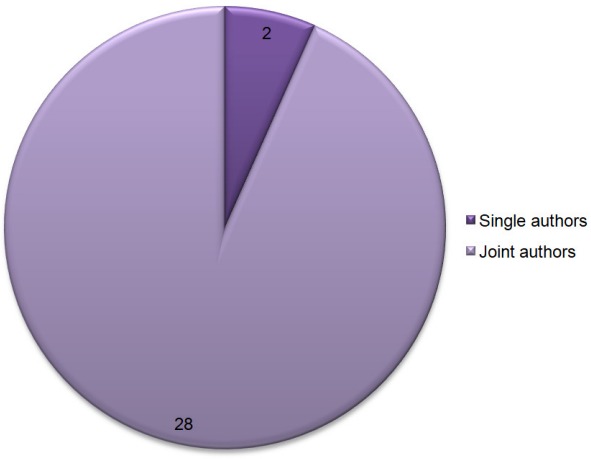

Fig. 2. Patterns of authorship.

Table 2: Outcome of the artificial intelligence articles in the field of dental practice

Rank	Implementation of AL in dentistry	Outcome of the study
1.	CADCAM- for making prosthesis	The use of CAD-CAM in the dentistry helps to improve the design and fabrication of the prosthesis in a better way [7]
2.	Clinical decisions support systems	This helps the dental professionals to make correct diagnosis and treatment [8]
3.	Neural network- decision support system	This helps to improve the clinical care for the patient [9]
4.	Hidden Markov models- a stimulator dental training	This provides a more accurate skill assessment [10]
5.	Artificial intelligence(AI) to make decisions for extractions during orthodontic treatment	AI was very effective in determining whether extraction is required or not for orthodontic treatment [11]
6.	Use of virtual and augmented reality in dental education	This helps to increase the clinical skills and knowledge of the dental students and also enhance their quality of learning [12]
7.	CAD-CAM in dentistry	This enhances the quality, fabrication and aesthetics of the prosthesis [13]
8.	Segmenting of dental radiographs	This enhances the consistency and quality of the radiographs [14]
9.	Object oriented model to estimate chewing behaviour	This helps to evaluate the masticatory forces, jaw movements and muscle activity [15]
10.	Clinical decision support systems(CDSS) in dentistry	CDSS provides more useful information to make correct diagnosis in clinical practice [16]
11.	Computer aided design in dental prosthesis	This provides more efficient retention and fabrication of the prosthesis [17]
12.	Coronal micro leakage	The 3D reconstruction was a very useful tool in detecting coronal micro leakage [18]
13.	Prediction of periodontally affected teeth	The convoluted neural network was very effective in determining the periodontally compromised teeth [19]
14.	Computer- aided diagnosis in dentistry	This provides more efficient and useful knowledge in the clinical diagnosis and to provide an effective treatment [20]
15.	Removable partial denture design by using microcomputer	This tool was very effective to be applied in the clinical practice [21]
16.	Endodontic diagnosis	The computer aided endodontic diagnosis was an effective tool in detecting the pulpally infected teeth [22]
17.	Detection of proximal dental caries	Neural network can be used as tool for detecting proximal caries [23]
18.	Periodontitis risk assessment	Neural network algorithm was effective in predicting the risk assessment of Periodontitis [24]
19.	Clinical decision support system to diagnose dental problems	Clinical decision support system was effective to diagnose the exact diseases and thereby reduces the mortality due to oral and maxillofacial diseases [25]
20.	Genetic evaluation of Class III skeletal malocclusion	AI was an effective tool in analysis the genetics of class III dentofacial deformity [26]
21.	New learning object for operative dentistry	Augmented reality was an effective method in teaching operative dentistry [27]
22.	Detection of stimulated dental caries	Artificial neural network was found to be an effective method in determining the artificial dental caries [28]
23.	Computer aided diagnosis of occlusal disorders	This method rapidly detect the point of contact and irregularities of occlusion between restoration and teeth [29]
24.	Classification of dental diseases	Convolution neural network was an effective tool for the detection and classification of dental diseases [30]
25.	Histopathological diagnosis of salivary gland neoplasm	No significant difference was found in the diagnosis of salivary gland neoplasm by using computer expert system and the human experts [31]
26.	Visualization of dental structures	Mini cave is a virtual reality system effectively used to visualize the dental structures [32]
27.	Anthropomorphic robotic jaw	This jaw allows for linear control, zero-backlash, and up to three times exaggerated mobility ranges making it also suitable for speech research, facial gesture affect research and dentistry applications [33]
28.	Dental education	3D semantic model is an effective tool which enhances the quality of dental education [34]
29.	Oral health care	The computer aided systems improves the quality of radiographic images which enhances the self assessment of the patient to maintain their oral health [35]
30.	Diagnosis of oral ulcer	The visual basic expert system helps effectively in the diagnosis of oral ulcer [36]

Table 2 shows about the outcome of the artificial intelligence articles in the field of dentistry. Most of these articles were focused on the diagnosis of the dental diseases and the outcome of these articles shows that the clinical decision and diagnosis are very efficient and effective by using artificial intelligence in dental practice.

Fig. 3 shows about the area of interest in which the artificial intelligence were implemented in dentistry. Out of thirty articles, five articles were based on the clinical diagnosis, four articles were related to prosthesis such as crowns, inlays and bridges, two articles were related to orthodontic treatment, three articles based on dental education, two articles based on periodontal problems, three studies related to endodontics, two articles

focused on dental caries, one articles was related to the diagnosis of oral ulcer, other one was related to the diagnosis of occlusal disorders, one articles related to the dental radiographs, one article focused on the diagnosis of salivary gland neoplasm where as five articles were related to others subjects which includes jaw movements, chewing efficiency, dental structures, classifying dental diseases and oral health.
The limitations of this study were that only articles with full text were selected. Most of the articles which outfit the inclusion criteria were excluded. Only limited numbers of articles were selected. Other databases should also be considered to get more relevant outcome.

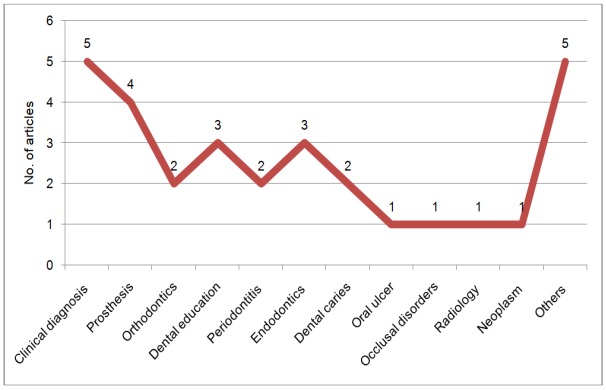

Fig. 3. Area of interest in which artificial intelligence articles were published.

The Fig. 3 shows about the area of the interest in which the artificial intelligence was published in dentistry. Most of these articles were focused on clinical diagnosis followed by prosthesis, dental education, endodontics, periodontitis and dental caries. The dental problems are the most prevalent and major problem that exists throughout the world. The behaviour of dental health plays a major role in maintaining the oral hygiene [37]. The artificial intelligence articles also helps the people to modifying and maintaining the good oral health.
The limitations of this study were that only articles with full text were selected. Most of the articles which outfit the inclusion criteria were excluded. Only limited numbers of articles were selected. Other databases should also be considered to get more relevant outcome.

IV. CONCLUSION

This study concludes that the bibliometric analysis of highly cited articles provides most interesting and useful information about the scientific articles based on the artificial intelligence in the dental practice. The citation of the articles ranged from 448-11. Most of these articles were review articles and these researches were conducted in the American continent followed by Asian and European continent. The implementation of artificial intelligence in dentistry was useful to dental professionals as well as to the public by providing the self assessment of their oral health which prevents and reduce further progression of the diseases at an earlier stage.

V. FUTURE SCOPE

This article will be more useful to the dental professionals and also to the public regarding the recent advancements and treatment modalities of dental health.

Conflict of Interest. No.

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