

101 Top-cited Dentistry Articles From Turkey: A Bibliometric Analysis

Türkiye'den En Çok Atıf Alan 101 Diş Hekimliği Makalesi: Bibliyometrik Analiz

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Abstract

Objective: This study aimed to evaluate and analyse the 100 top-cited published articles with the first author affiliated in Turkey institutions.

Materials and Methods: Dental articles with authors from Turkey were searched using the "Advanced Search" tool of the Web of Knowledge. The main institution was identified as the address of the first author in Turkey. Descriptive statistics were used to summarise the results.

Results: The 101 top-cited articles were cited 12,577 times and were published between 2016 and 1981. The top-cited article with the highest number of citation was cited 351 times. The Journal of Prosthetic Dentistry published the highest number of top-cited articles, and most of the studies covered by top-cited articles focused on prosthetic dentistry. Twenty-two institutions have made contributions to the top-cited articles. Forty-five articles were produced by individual institutions. The field of basic science had the highest number with 54 articles, followed by the field of clinical research with 40 articles. "Implant" was the main study topic of articles. Randomised controlled trial was the most common study design for articles in the field of clinical research, and the majority of the articles had level II of evidence.

Conclusion: This study provided insights about scientific trends of dentistry in Turkey. If the focus of randomised controlled trials is extended to other clinical topics besides implant and international collaboration is increased, articles may be more recognised and cited.

Keywords

Bibliyometrik citation analysis, ISI web of knowledge, Turkey

Anahtar Kelimeler

Bibliometri, atıf analizi, ISI web of knowledge, Türkiye

Received/Geliş Tarihi : 01.08.2020

Accepted/Kabul Tarihi : 01.10.2020

doi:10.4274/meandros.galenos.2020.59023

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Öz

Amaç: Bu çalışmanın amacı, Türkiye kurumlarına bağlı ilk yazar tarafından yayınlanan ve en çok atıf yapılan 100 makaleyi değerlendirmek ve analiz etmektir.

Gereç ve Yöntemler: "Web of Knowledge" veri tabanının "Advanced Search" aracı kullanılarak Türkiye adresli yazarlara ait dental makaleler hakkında bir araştırma yapıldı. İlk yazarın ana kurumunun Türkiye adresli olduğu yayınlar çalışmaya dahil edildi. Sonuçları özetlemek için tanımlayıcı istatistik kullanıldı.

Bulgular: En çok atıf yapılan 101 makale toplam 12.577 alıntı aldı ve 2016 ile 1981 yılları arasında yayınlandı. En çok alıntı yapılan makalenin atıf sayısı 351 idi. Yayımlanan makaleler önemli ölçüde protetik diş hekimliği ile ilgili olup, yayınların en fazla yayımlandığı dergi "The Journal of Prosthetic Dentistry" oldu. Yirmi iki kurum en çok alıntı yapılan makalelere katkıda bulundu. Kırk beş makale tek merkezli kurumlar tarafından üretildi. Temel bilim alanı 54 makale ile en yüksek

sayıya sahipken, bunu 40 makale ile klinik araştırma alanı takip etti. İmplant makalelerin ana çalışma konusuydu. En yaygın çalışma tasarımı klinik araştırma alanındaki makaleler için randomize kontrollü çalışma ve makalelerin çoğunluğu için kanıt düzeyi II. seviyeydi. **Sonuç:** Bu çalışma Türkiye'deki diş hekimliğinin bilimsel eğilimleri hakkında bir fikir ortaya koymuştur. Randomize kontrollü çalışmaların konusu implantın yanı sıra diğer klinik konulara da genişletilirse ve çalışmalarda uluslararası iş birliği artırılırsa, makaleler daha iyi tanınabilir ve daha fazla atıf alabilir.

Introduction

Bibliometric indicators are useful for assessing research performance; however, this is valid when the indicators are right, sophisticated, current, included expert knowledge, and evaluated and used with care (1). The importance of research which is indicated by the citation count is quantified by using citation data in bibliometric studies (2). The Institute for Scientific Information (ISI) has been compiling the most relevant bibliometric information from published scientific articles since 1945, then the Science Citation index (SCI), a specific tool for measuring citations, was available since 1962 (3). Today, in bibliometric studies, the citation indexes created by Thomson Reuters, particularly the Web of Science (WoS) and its predecessor, the SCI, are commonly used databases (1).

Many bibliometric analysis was published in medicine including the topics of oral and maxillofacial surgery (4,5), psychiatry (6), plastic and reconstructive surgery (7), neurosurgery (8), neurophysiology (9), neurosciences (10,11), orthopedic surgery (12), urology (13), pulmonary diseases (14), public health (15). Bibliometric analysis in dentistry has been performed in such areas endodontics (2,16-20), implant (21-23), paediatric dentistry (24), periodontology (25,26), oral medicine and radiology or radiology (27-29), orthodontics (30) and in such topics dental traumatology (31,32), orofacial pain (33), dental education (34). Some citation studies were based on articles published in several dentistry journals (3,35-37), articles published in a single journal (17,38) or articles published by authors in a single country (39).

Analysis of research results may help get information on the development of policies related to scientific and technological aspects in dentistry, especially in developing countries (e.g. China, Thailand, South Korea, Brazil) and in the EU which is currently undergoing a major reorganization (40). According to ISI database from 1999 to 2003, an

increase in dentistry-related studies was monitored in developing countries, such as Brazil, Turkey, China, Thailand, South Korea, Jordan and Iran. Moreover, the average number of citations for each document was reported as 1.27 and it was reported that Turkey was in the 10 countries with most published articles from 1999 to 2003 (40). The data from SCImago showed that Turkey was the 4th country in Europe and 8th country in the world in terms of the number of dental articles published between 1996 and 2018. Also, a total 550 citable article from Turkey was published in 2018 with 0.36 citation per article (totally 218 citations) (41).

In the literature, there is no article specifically on the top-cited papers in dentistry published by authors affiliated to the institutions in Turkey. Another study analyzed the characteristics of the top 100 articles which are the most cited on dentistry which are published in scientific journals with international collaboration whose coauthor(s) affiliated to the institutions in Brazil (39). In this study, it was stated that such analysis could help provide the current status of Brazilian dentistry regarding the most cited dental articles, as well as the areas and topics which attract international attention. So, country-based citation analysis studies will provide a panorama in terms of the scientific studies of that country in that field and will provide scientist with guiding data in terms of future planned studies. Also, this study will provide a wider perspective to evaluate the studies that are in the field of dentistry. Therefore, in the present study, we aimed to evaluate and analysis the 100 top-cited articles published by first author affiliated to Turkey institutions.

Materials and Methods

A search about dental articles with authors from Turkey was performed on 23 March 2020 on the WoS (Clarivate Analytics Co., Philadelphia, PA), which is an online platform (<http://www.webofknowledge.com>) providing bibliographic data on scientific materials.

In order to investigate the publications of the authors addressed in Turkish institutions in both in dental journals and other journals containing articles related to dentistry, as the first step, "All Database" was selected from "Select a Database" option. Following the election of "Advanced Search" option, without any year or language restrictions, the proposed query set [CU =(TURKEY)] was scanned and this search resulted in 658,322 articles (n=658,322). Finally, we used "Dentistry, Oral Surgery & Medicine" as the "Research Area" category filter. With these limitations, 18,243 articles are obtained as a result (n=18,243).

In the present study, the articles without the first authors affiliated to a Turkish institution and publications of the source types such as "books", "book series", "conference proceedings", "trade publications" and "undefined" were excluded. The selection of the articles was performed by two independent researchers (M.D. and F.K.). The articles were listed from the highest to the lowest based on the number of citations received and the 100 most cited articles were identified (Table 1). Accordingly, as for articles which have same number of citations, the more current one was ranked higher.

The 100 articles receiving the most citations were analyzed with regard to citation count, title of the article, the year of publication, the number of authors, journal name, institutions, collaborations type, type of study, distribution of articles to subfield of Dentistry and subfield topic, study design of clinical articles, thematic field and level of evidence of clinical study. Any disagreement between two researchers on article analysis was resolved through discussion and consensus.

The journal names are listed based on the number of the articles which are top-cited, but journals with the same number of articles are ranked based on the Journal Impact Factor (JIF) 2018 which is provided from the Journal of Citation Reports (<https://jcr.clarivate.com>) (Table 2).

The main institution was indicated by the address of the first author in Turkey. The institutions and the addresses of co-authors were also considered to detect the type of institutional collaboration without considering the departments. Thus, institutional collaboration type was considered as individual institution when all contributing

authors were affiliated to the same research institution regardless of the departments. The other institutional collaboration types were classified as "multi-institutional collaboration" if multiple institutions within the Turkey joined the study and as "international collaborations" if there were institutes from different countries (18,20). If the first author is working in multiple institutions addressing Turkey or there is more than one country cooperation in one article, each one of these institutions and countries were counted.

The study types included basic science, clinical research, and review. A study classified as a basic study when it included experiments on extracted human teeth, animal, dental plaque, microorganism, saliva, dental materials or cells (18). While determining the study field, the full text of all the articles in the list was read and discussed until the consensus was achieved by the two researchers to determine the study types. In addition, an abstract of each study in PubMed has been reached and the Medical Subject Headings (Medical Subject Headings terms) given for this study field have been considered. The main subject of the articles was categorized as prosthetic dentistry, endodontics, periodontology, orthodontics, restorative dentistry, oral and maxillofacial surgery, pedodontics, oral and maxillofacial radiology and oral implantology according to the department of which the first author is affiliated. If first author was not affiliated to dentistry, the department of co-author which was affiliated to dentistry was based on. Where no author was affiliated to dentistry, the main subject of the articles was determined according to topic of article. After this, each article for each main subject was classified according to its own subtopics which were investigated in article (Table 3).

The previously described the study design of clinical articles were used as follows: randomized controlled trial (RCT) controlled trial, systematic review of RCT, non-randomized experimental study, systematic review of cross-sectional study among consecutive presenting patients, cross-sectional study among consecutive presenting patients, cross-sectional study among non-consecutive patients, case-control study, case report, and cross sectional study. Afterwards, the level of evidence (level I to V) was defined for the clinical articles according to the type of research question (intervention 1, diagnosis, prognosis and etiology) (Table 4) (42).

Statistical Analysis

Statistical analysis for frequency of descriptive measures was performed using SPSS version 21 (IBMCorp, Armonk, NY).

Results

The 101 top-cited articles are listed according to the citation count in a descending order in Table 1. The last four articles have the same number of citations (91 citations); therefore, 101 articles were listed. The highest top cited article had 351 citations and it is in *in vitro* study on the fracture resistance of endodontically-treated teeth which were restored with

different post systems. This study related to Prosthetic Dentistry field and was published 2002. Least cited four articles had 91 citations and one of them is *in vivo* study which is related to orthognathic surgery, three of them are *in vitro* studies on the cytotoxicity of root canal sealers, the strength of translucent fiber post bond to dentin and the biomechanical effects of rapid maxillary expansion, respectively. These studies related to Prosthetic Dentistry and Orthodontics field and they were published 2006 and 1998, respectively. The 101 most top-cited articles received 12,577 citations in total and the mean citation count for each article was 125 (Table 1).

Table 1. Top 100 articles with authors from Turkey

		No. of citations
1	Resistance to fracture of endodontically treated teeth restored with different post systems. J Prosthet Dent 2002; 87: 431-7.	351
2	Effect of zirconium-oxide ceramic surface treatments on the bond strength to adhesive resin. J Prosthet Dent 2006; 95: 430-6.	237
3	Time-dependent effects of EDTA on dentin structures. J Endod 2002; 28: 17-9.	237
4	The effect of improved periodontal health on metabolic control in type 2 diabetes mellitus. J Clin Periodontol 2005; 32: 266-72.	229
5	Evaluation of the root canal configurations of the mandibular and maxillary permanent teeth by gender in the Turkish population. J Endod 2004; 30: 391-8.	229
6	Virulence factors of <i>Enterococcus faecalis</i> : Relationship to endodontic disease. Crit Rev Oral Biol Med 2004; 15: 308-20.	213
7	The influence of functional forces on the biomechanics of implant-supported prostheses - A review. J Dent 2002; 30: 271-82.	189
8	Chemical compositions and antimicrobial activities of four different Anatolian propolis samples. Microbiol Res 2005; 160: 189-95.	182
9	Three-dimensional finite element analysis of the effect of different bone quality on stress distribution in an implant-supported crown. J Prosthet Dent 2005; 93: 227-34.	170
10	Perception of pain during orthodontic treatment with fixed appliances. Eur J Orthod 2004; 26: 79-85.	169
11	Lipid peroxidation levels and total oxidant status in serum, saliva and gingival crevicular fluid in patients with chronic periodontitis. J Clin Periodontol 2007; 34: 558-65.	167
12	Gingival crevicular fluid levels of RANKL and OPG in periodontal diseases: Implications of their relative ratio. J Clin Periodontol 2007; 34: 370-6.	167
13	The smear layer: a phenomenon in root canal therapy. Int Endod J 1995; 28: 141-8.	167
14	Ablation-cooled material removal with ultrafast bursts of pulses. Nature 2016; 537: 84-8.	162
15	Salivary mutans streptococci and lactobacilli levels after ingestion of the probiotic bacterium <i>Lactobacillus reuteri</i> ATCC 55730 by straws or tablets. Acta Odontol Scand 2006; 64: 314-18.	159
16	Color stability of resin composites after immersion in different drinks. Dent Mater J 2006; 25: 371-6.	152
17	Mechanical and physical properties of contemporary dental luting agents. J Prosthet Dent 2003; 89: 127-34.	151
18	Host-derived diagnostic markers related to soft tissue destruction and bone degradation in periodontitis. J Clin Periodontol 2011; 38(Suppl 11): 85-105.	150

Table 1 continued

19	Clinical Accuracy of 3 Different Types of Computed Tomography-Derived Stereolithographic Surgical Guides in Implant Placement. J Oral Maxillofac Surg 2009; 67: 394-401.	149
20	Oral hygiene habits, denture cleanliness, presence of yeasts and stomatitis in elderly people. J Oral Rehabil 2002; 29: 300-4.	149
21	Root canal morphology of human permanent teeth in a Turkish population. J Endod 1995; 21: 200-4.	148
22	Flexural strength and fracture toughness of dental core ceramics. J Prosthet Dent 2007; 98: 120-8.	144
23	MMPs, IL-1, and TNF are regulated by IL-17 in periodontitis. J Dent Res 2007; 86: 347-51.	144
24	Observation of bacteria and fungi in infected root canals and dentinal tubules by SEM. Dent Traumatol 1995; 11: 6-9.	142
25	The Effect of Surface Treatment on the Shear Bond Strength of Luting Cement to a Glass-Infiltrated Alumina Ceramic. Int J Prosthodontics 2001; 14: 335-9.	138
26	Skeletal and dental changes after maxillary expansion in the mixed dentition. Am J Orthod Dentofacial Orthop 1997; 111: 321-7.	137
27	Effects of different drinks on stainability of resin composite provisional restorative materials. J Prosthet Dent 2005; 94: 118-24.	136
28	Comparison of digital and conventional impression techniques: Evaluation of patients' perception, treatment comfort, effectiveness and clinical outcomes. BMC Oral Health 2014; 14: 10.	135
29	Effect of chitosan on a periodontal pathogen Porphyromonas gingivalis. Int J Pharm 2002; 235: 121-7.	128
30	Finite element analysis of the effect of cantilever and implant length on stress distribution in an implant-supported fixed prosthesis. J Prosthet Dent 1996; 76: 165-9.	128
31	Bacteriotherapy and probiotics' role on oral health. Oral Dis 2005; 11: 131-7.	126
32	Zirconia dental implants: A literature review. J Oral Implantol 2011; 37: 367-76.	125
33	Evaluation of two post core systems using two different methods (fracture strength test and a finite elemental stress analysis). J Endod 2002; 28: 629-33.	125
34	Oral lichen planus: A review. Br J Oral Maxillofac Surg 2000; 38: 370-77.	125
35	The influence of occlusal loading location on stresses transferred to implant-supported prostheses and supporting bone: A three-dimensional finite element study. J Prosthet Dent 2004; 91: 144-50.	124
36	Influence of surface treatments on surface roughness, phase transformation, and biaxial flexural strength of Y-TZP ceramics. J Biomed Mater Res B Appl Biomater 2009; 91: 930-7.	123
37	Effect of yogurt with Bifidobacterium DN-173 010 on salivary mutans streptococci and lactobacilli in young adults. Acta Odontol Scand 2005; 63: 317-20.	123
38	Chitosan delivery systems for the treatment of oral mucositis: <i>in vitro</i> and <i>in vivo</i> studies. J Control Release 2004; 98: 269-79.	123
39	An <i>in vitro</i> study evaluating the effect of ferrule length on fracture resistance of endodontically treated teeth restored with fiber-reinforced and zirconia dowel systems. J Prosthet Dent 2004; 92: 155-62.	122
40	Isolation and <i>in vitro</i> characterisation of dental pulp stem cells from natal teeth. Histochem Cell Biol 2010; 133: 95-112.	118
41	Maxillofacial fractures. Analysis of demographic distribution and treatment in 2901 patients (25-year experience). J Cranio-Maxillofac Surg 2004; 32: 308-13.	117
42	Expression of Extracellular Matrix Proteins in Human Periodontal Ligament Cells during Mineralization <i>in vitro</i> . J Periodontol 1997; 68: 320-7.	117
43	Comparison of the bond strength of laser-sintered and cast base metal dental alloys to porcelain. Dent Mater 2008; 24: 1400-04.	116
44	Effects of laser irradiation on the release of basic fibroblast growth factor (bFGF), insulin like growth factor-1 (IGF-1), and receptor of IGF-1 (IGFBP3) from gingival fibroblasts. Lasers Med Sci 2008; 23: 211-5.	116
45	Assessment of correlation between computerized tomography values of the bone, and maximum torque and resonance frequency values at dental implant placement. J Oral Rehabil 2006; 33: 881-8.	115
46	Human dental pulp stem cells demonstrate better neural and epithelial stem cell properties than bone marrow-derived mesenchymal stem cells. Histochem Cell Biol 2011; 136: 455-73.	114

Table 1 continued

47	Internal fit evaluation of crowns prepared using a new dental crown fabrication technique: Laser-sintered Co-Cr crowns. J Prosthet Dent 2009; 102: 253-9.	114
48	The use of skeletal anchorage in open bite treatment: A cephalometric evaluation. Angle Orthod 2004; 74: 381-90.	114
49	Prevalence and distribution of dental anomalies in orthodontic patients. Am J Orthod Dentofacial Orthop 2007; 131: 510-4.	113
50	Effects of irrigation temperature on heat control <i>in vitro</i> at different drilling depths. Clin Oral Implants Res 2009; 20: 294-8.	112
51	Clinical Study on the Reasons for and Location of Failures of Metal-Ceramic Restorations and Survival of Repairs. Int J Prosthodontics 2002; 15: 299-302.	110
52	Photodynamic therapy in dentistry: A literature review. Clin. Oral Invest 2013; 17: 1113-25.	109
53	Reliability of implant placement with stereolithographic surgical guides generated from computed tomography: Clinical data from 94 implants. J Periodontol 2008; 79: 1339-45.	109
54	Gingival crevicular fluid levels of monocyte chemoattractant protein-1 and tumor necrosis factor-alpha in patients with chronic and aggressive periodontitis. J Periodontol 2005; 76: 1849-55.	108
55	The use of chairside silica coating for different dental applications: A clinical report. J Prosthet Dent 2002; 87: 469-72.	108
56	Efficacy of temporomandibular joint arthrocentesis with and without injection of sodium hyaluronate in treatment of internal derangements. J Oral Maxillofac Surg 2001; 59: 613-8.	108
57	An analysis of causes of fracture of acrylic resin dentures. J Prosthet Dent 1981; 46: 238-41.	108
58	Peripheral osteoma of the oral and maxillofacial region: A study of 35 new cases. J Oral Maxillofac Surg 2002; 60: 1299-301.	107
59	Effect of medications for root canal treatment on bonding to root canal dentin. J Endod 2004; 30: 113-6.	106
60	Comparative study of different novel nickel-titanium rotary systems for root canal preparation in severely curved root canals. J Endod 2014; 40: 852-6.	105
61	Regenerative endodontic treatment (revascularization) of immature necrotic molars medicated with calcium hydroxide: A case series. J Endod 2011; 37: 1327-30.	105
62	Effects of NaOCl on bond strengths of resin cements to root canal dentin. J Endod 2003; 29: 248-51.	105
63	Ultrastructural correlates of <i>in vivo/in vitro</i> bond degradation in self-etch adhesives. J Dent Res 2005; 84: 355-9.	104
64	A study of the physical and chemical properties of four resin composite luting cements. Int J Prosthodontics 2004; 17: 357-63.	104
65	Implant design and interface force transfer. A photoelastic and strain-gauge analysis. Clin Oral Implants Res 2004; 15: 249-57.	102
66	Changes in alveolar bone thickness due to retraction of anterior teeth. Am J Orthod Dentofacial Orthop 2002; 122: 15-26.	102
67	Effects of three concentrations of carbamide peroxide on the structure of enamel. J Oral Rehabil 2000; 27: 332-40.	102
68	An analysis of maxillary anterior teeth: Facial and dental proportions. J Prosthet Dent 2005; 94: 530-8.	101
69	Resonance frequency analysis of one-stage dental implant stability during the osseointegration period. J Periodontol 2005; 76: 1066-71.	101
70	Comparison of the effects of 2 doses of methylprednisolone on pain, swelling, and trismus after third molar surgery. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2003; 96: 535-9.	101
71	Effects of chelating agents and sodium hypochlorite on mineral content of root dentin. J Endod 2001; 27: 578-80.	100
72	Immunohistochemical localization of Toll-like receptors 1-10 in periodontitis. Oral Microbiol Immunol 2008; 23: 425-31.	99
73	Dental age assessment using Demirjian's method on northern Turkish children. Forensic Sci Int 2008; 175: 23-6.	99

Table 1 continued

74	Protein carbonyl levels in serum and gingival crevicular fluid in patients with chronic periodontitis. Arch Oral Biol 2008; 53: 716-22.	98
75	Periodontal infections and pre-term low birth weight: A case-control study. J Clin Periodontol 2005; 32: 174-81.	98
76	Antibacterial activity of 2% chlorhexidine gluconate and 5.25% sodium hypochlorite in infected root canal: <i>In vivo</i> study. J Endod 2004; 30: 84-7.	98
77	The effect of preparation conditions of acrylic denture base materials on the level of residual monomer, mechanical properties and water absorption. J Dent 1995; 23: 313-8.	98
78	Effect of five woven fiber reinforcements on the impact and transverse strength of a denture base resin. J Prosthet Dent 1999; 81: 616-20.	97
79	Effect of different finishing techniques for restorative materials on surface roughness and bacterial adhesion. J Prosthet Dent 2010; 103: 221-7.	96
80	Does the timing and method of rapid maxillary expansion have an effect on the changes in nasal dimensions? Angle Orthod 2002; 72: 118-23.	96
81	Nickel and chromium levels in the saliva and serum of patients with fixed orthodontic appliances. Angle Orthod 2001; 71: 375-9.	96
82	Bone density assessments of oral implant sites using computerized tomography. J Oral Rehabil 2007; 34: 267-72.	95
83	Advances in periodontal disease markers. Clin Chim Acta 2004; 343: 1-16.	95
84	Effect of gallium arsenide diode laser on human periodontal disease: a microbiological and clinical study. Lasers Surg Med 2002; 30: 60-6.	95
85	Reactions of connective tissue to mineral trioxide aggregate and amalgam. J Endod 2004; 30: 95-9.	94
86	Effect of self-etching primers on bond strength-Are they reliable? Angle Orthod 2003; 73: 64-70.	94
87	Dentin moisture conditions affect the adhesion of root canal sealers. J Endod 2012; 38: 240-44.	93
88	The induction of oxidative stress, cytotoxicity, and genotoxicity by dental adhesives. Dent Mater 2008; 24: 362-71.	93
89	The differences in panoramic mandibular indices and fractal dimension between patients with and without spinal osteoporosis. Dentomaxillofac Radiol 2006; 35: 1-9.	93
90	Implant design and intraosseous stability of immediately placed implants: A human cadaver study. Clin Oral Implants Res 2005; 16: 202-9.	93
91	Comparison of antibacterial and toxic effects of various root canal irrigants. Int Endod J 2003; 36: 423-32.	93
92	Comparative evaluation of the effect of diameter, length and number of implants supporting three-unit fixed partial prostheses on stress distribution in the bone. J Dent 2002; 30: 41-6.	93
93	Dentinal tubule penetration of root canal sealers after root canal dressing with calcium hydroxide. J Endod 1999; 25: 431-33.	93
94	Enamel formation genes are associated with high caries experience in Turkish children. Caries Res 2008; 42: 394-400.	92
95	MMP20 active-site mutation in hypomaturation amelogenesis imperfecta. J Dent Res 2005; 84: 1031-5.	92
96	Influence of occlusal forces on stress distribution in preloaded dental implant screws. J Prosthet Dent 2004; 91: 319-25.	92
97	Corrosion behaviour of dental metals and alloys in different media. J Oral Rehabil 1998; 25: 800-8.	92
98	Use of three-dimensional medical modeling methods for precise planning of orthognathic surgery. J Craniofac Surg 2007; 18: 740-7.	91
99	Cytotoxicity of new resin-, calcium hydroxide- and silicone-based root canal sealers on fibroblasts derived from human gingiva and L929 cell lines. Int Endod J 2007; 40: 329-37.	91
100	Influence of dentin bonding agents and polymerization modes on the bond strength between translucent fiber posts and three dentin regions within a post space. J Prosthet Dent 2006; 95: 368-78.	91
101	Biomechanical effects of rapid maxillary expansion on the craniofacial skeleton, studied by the finite element method. Eur J Orthod 1998; 20: 347-56.	91

Journals and The Year of Publication

The top-cited most-cited articles were published in 35 different journals whose publication language is English. 13 journals published three or more top articles. Two of the top-cited articles were published in four journals, and one of them was published in 18 journals. The JIF of 35 journals was between 43.07 and 0.785. Journal of Prosthetic Dentistry published the highest number of top-cited articles (n=17) and "Journal of Endodontics" was the second journal (n=13), followed by "Journal of Clinical Periodontology" (n=5) and "Journal of Oral Rehabilitation" (n=5) (Table 2).

The 101 top-cited articles were published between 2016 and 1981. Fourteen of them was published between 1981 and 2000, 78 between 2001 and 2010 and 9 between 2011 and 2016. In 2004, the highest number of top-cited articles (n=15) was published, which followed by the years of 2002 and 2005 (n=13), and 2007 and 2008 (n=8) (Figure 1). Journal of Prosthetic Dentistry was the first to publish a top-cited article back in 1981. It was related to Prosthetic Dentistry field which was about "causes of fracture of acrylic resin dentures". The newest article was published in Nature in 2016. It was related Restorative Dentistry field which was about "ablation-cooled material removal with ultrafast bursts of pulses" (Table 1).

Authors and Institutions of Origin

A total of 342 unique authors contributed to top 101 most-cited-articles. The number of authors in top-cited articles was between 1 and 12. Four articles had single author. Twenty-two articles were attributed to two authors, 18 articles to 3 authors, 24 articles to 4 authors, and 15 articles to five authors. The number author of 16 articles was between 6 and 9 (Table 5).

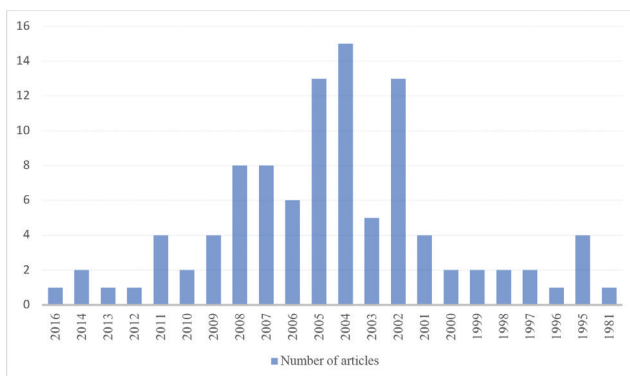


Figure 1. Year of 100 top-cited articles

The number of institutions indicated by the address of the first author in Turkey was 22 (Table 6). 13 of the 22 institutions had two or more top-cited articles which were published. Among the 13 institutions, Hacettepe University had the highest number with 20 top-cited articles (2,393 citations), followed by Ege University with 11 top-cited articles (1,557 citations), Marmara University with 10 articles (1,142 citations) and Selçuk University with 10 articles (1,098 citations). Considering all the authors that contributed to an article, 45 articles were produced by individual institutions, 27 by multi-institutional collaboration within Turkey and 29 by international collaborations. Considering the collaborations made internationally, those with the institutions in the United States had the highest number of published top-cited article (13 articles), followed by those in Finland with three articles, Sweden with three articles and United Kingdom with two articles (Table 7).

Type of Study, Field of Study, and Study Design, Level of Evidence and Type of Research Question of The Clinical Articles

Among 101 top-cited articles, basic science had the highest number of articles with 54 articles. 40 articles focused on clinical research and 8 articles were review. Whenever an article included 2 or 3 topics which were separately defined, it was scored accordingly in 2 or 3 categories (Table 4) (18).

Most of the topics of the 54 top-cited basic science articles were implant with 6 articles, followed by post and/or core materials with 5 articles and root canal sealer with 5 articles. Major topics of interest of 40 clinical research were implant with 4 articles, followed by gingival crevicular or chronic periodontitis with 4 articles. The majority of the topics of 8 top-cited review articles were implant with two articles (Table 3). Prosthetic Dentistry was the field with the highest number of top-cited articles (n=34) followed by Periodontology with 16 articles and Endodontics with 14 articles. Major topics of articles in different dentistry field were shown Table 3.

RCT was the type of study design with the highest number of articles (21 articles) in clinical experience, followed by cross-sectional study with 10 articles. The most frequent type of research question was classified as intervention with 22 articles, followed by diagnosis with 12 articles. Level of evidence was classified as having level II in 27 articles and level II in 7 articles.

Table 2. Journals containing 100 top-cited articles

Journal List	Abbreviated name	No. of articles	JIF 2018
Journal of Prosthetic Dentistry	J Prosthet Dent	17	2.787
Journal of Endodontics	J Endodont	13	2.833
Journal of Clinical Periodontology	J Clin Periodontol	5	4.164
Journal of Oral Rehabilitation	J Oral Rehabil	5	2.341
Journal of Dental Research (Critical Reviews in Oral Biology Medicine)	J Dent Res (Crit Rev Oral Biol M)	4	5.125
Journal of Periodontology	J Periodontol	4	2.768
Angle Orthodontist	Angle Orthod	4	1.88
Clinical Oral Implants Research	Clin Oral Implan Res	3	3.825
International Endodontic Journal	Int Endod J	3	3.331
Journal of Dentistry	J Dent	3	3.28
American Journal of Orthodontics and Dentofacial Orthopedics	Am J Orthod Dentofac	3	1.911
Journal of Oral and Maxillofacial Surgery	J Oral Maxil Surg	3	1.781
International Journal of Prosthodontics	Int J Prosthodont	3	1.533
Dental Materials	Dent Mater	2	4.44
Histochemistry and Cell Biology	Histochem Cell Biol	2	2.640
European Journal of Orthodontics	Eur J Orthodont	2	1.841
Acta Odontologica Scandinavica	Acta Odontol Scand	2	1.565
Nature	Nature	1	43.070
Journal of Controlled Release	J Control Release	1	7.901
International Journal of Pharmaceutics	Int J Pharmaceut	1	4.213
Oral Microbiology and Immunology	Oral Microbiol Immun	1	3.62
Lasers in Surgery and Medicine	Laser Surg Med	1	3.262
Clinica Chimica Acta	Clin Chim Acta	1	2.735
Journal of Biomedical Materials Research Part B-Applied Biomaterials	J Biomed Mater Res B	1	2.674
Oral Diseases	Oral Dis	1	2.625
Clinical Oral Investigations	Clin Oral Invest	1	2.453
Caries Research	Caries Res	1	2.326
Lasers in Medical Science	Laser Med Sci	1	2.076
Bmc Oral Health	Bmc Oral Health	1	2.048
Forensic Science International	Forensic Sci Int	1	1.990
Journal of Cranio Maxillofacial Surgery	J Cranio Maxill Surg	1	1.942
Oral Surgery Oral Medicine Oral Pathology Oral Radiology and Endodontology	Oral Surg Oral Med O	1	1.69
Archives of Oral Biology	Arch Oral Biol	1	1.663
Dentomaxillofacial Radiology	Dentomaxillofac Rad	1	1.525
Endodontics Dental Traumatology	Endod Dent Traumatol	1	1.494
Dental Materials Journal	Dent Mater J	1	1.424
British Journal of Oral Maxillofacial Surgery	Brit J Oral Max Surg	1	1.164
Journal of Oral Implantology	J Oral Implantol	1	1.062
Journal of Craniofacial Surgery	J Craniofac Surg	1	0.785
JIF: Journal Impact Factor			

Table 3. Numbers of the 100 top-cited articles categorized on basis of type and specific field

Field of study		Type of Study		
		Clinical	Basic	Review
Prosthetic Dentistry	Implant	4	6	2
	Metal-ceramic restorations	1	1	-
	Denture base material	1	2	1
	Luting material	-	3	-
	Post and/or core materials	-	5	-
	Surface roughness	1	3	-
	Provisional restorative materials	-	1	-
	Impression techniques	1	-	-
	Tooth morphology	1	-	-
	Dental metals and alloys	-	1	-
Endodontics	Microbiology	-	1	1
	Canal morphology	-	2	-
	Root canal sealer	-	5	-
	Root canal preparations	-	1	-
	Dentin structure	-	2	-
	Dental pulp stem cells	-	1	-
	Smear layer	-	-	1
Periodontology	Gingival crevicular or chronic periodontitis	4	-	-
	Periodontal disease and systemic health problems	2	-	-
	Periodontal disease and molecular mechanism	2	4	-
	Periodontal diseases and microbiology	1	1	-
	Photodynamic therapy	1	-	1
Orthodontics	Maxillary expansion	2	1	-
	Orthodontic appliances	2	-	-
	Bonding to enamel of bracket	-	1	-
	Dental anomalies	2	-	-
	Open bite treatment	1	-	-
	Serum and saliva	1	-	-
Restorative Dentistry	Dental composite	-	1	-
	Bleaching agents	-	1	-
	Dentin adhesives	-	2	-
	Dentin	-	1	-
	Luting agents	-	1	-
	Microbiology	1	-	-
Oral and Maxillofacial Surgery	Implant placement	-	2	-
	Oral mucositis	-	1	-
	Oral lichen planus	-	-	1
	Methylprednisolone	1	-	-
	Maxillofacial fractures	1	-	-
	Peripheral osteoma	1	-	-
	Root canal sealer	-	1	-
	Temporomandibular joint arthrocentesis	1	-	-
Pedodontics	Dental caries	2	1	1
	Amelogenesis imperfecta	1	-	-
	Root canal irrigants	-	1	-
	Tooth development/or dental pulp stem cells	1	1	-
	Regenerative endodontic	1	-	-
	Saliva	1	-	-
Oral Implantology	Implant surgery	1	-	-
Oral and Maxillofacial Radiology	Osteoporosis	1	-	-

Table 4. Study design, level of evidence and type of research question of the clinical articles in top 100

	Level of evidence	Type of research question	No. of articles	Total no. of citations
Randomized controlled trial	II	Intervention	21	2,532
Cross-sectional study among consecutive presenting patients	II	Diagnosis	6	805
Cross-sectional study among non-consecutive patients	III	Diagnosis	4	406
Case control study	III	Aetiology	3	298
Systematic review of cross-sectional study among consecutive presenting patients	I	Diagnosis	2	245
Systematic review of randomized controlled trial studies	I	Intervention	1	109
Clinical/case report	-	Not applicable	1	108
Case series	IV	Prognosis	1	105
A cross sectional study	IV	Aetiology	1	92

Table 5. The number of authors of 100 top cited articles

The number of authors	No. of articles
1	4
2	22
3	18
4	24
5	15
6	10
7	4
8	1
9	1
11	1
12	1

Discussion

The number of citations to an article is not necessary for the quality of that article. However, citation analysis studies that include all disciplines of dentistry can provide clues for author and topics contributing to major development in dentistry (3). Citation analysis studies on different topics such as country-based are used as a tool to evaluate research performance from both institutional and individual point of the process, including funding and hiring decisions, determination of research needs for resource allocation, and investment in research facilities of field or specialty (34). Citation analyses indices showed an increasing trend. Moreover, findings of citation analyses studies would be beneficial for the editors and publishers of dental journals as a comparative criterion for

Table 6. Institutions of origin of 100 top-cited articles

	No. of articles	Total no. of citations
Hacettepe University	20	2,393
Ege University	11	1,557
Marmara University	10	1,142
Selcuk University	10	1,098
İstanbul University	9	1,144
Gazi University	9	1,121
Yeditepe University	6	737
Ankara University	6	611
Ondokuz Mayıs University	3	387
Çukurova University	3	331
Bogaziçi University	2	243
Kocaeli University	2	232
Dicle University	2	215
Kırıkkale University	1	237
GATA Haydarpaşa Education and Research Hospital	1	229
Süleyman Demirel University	1	229
Bilkent University	1	162
Yakın Doğu University	1	149
İstanbul Medipol University	1	135
Gülhane Military Medical Academy	1	116
İzmir Katip Çelebi University	1	106
Karadeniz Teknik University	1	98

Table 7. Type of collaboration of 100 top-cited articles		
Type of collaboration	No. of articles	
Individual institutions	45	
Multi-institutional collaboration	27	
International collaborations	29	
	United States	13
	Finland	3
	Sweden	3
	United Kingdom	2
	Norway	2
	Germany	2
	Netherlands	1
	Canada	1
	Hong Kong	1
	Denmark	1
	Belgium	1

measuring success and trend of their respective journals as well as providing a self-evaluation for the dental community (37). Therefore, this study evaluated and analyzed the 101 articles which are top-cited and were published by the authors affiliated to the institutions in Turkey.

In the present study, the numbers of citations were between 351 and 91, and the mean citation count for each article was 125. In contrast to our results, Feijoo et al. (3) reported the citation numbers were between 2050 and 326 for the top 100 most-cited articles which were published in dental journals. In another study, it was reported that the citation received by dental journals was 97,081 in 2003 and 233,232 in 2012. Also, the total number of dental journals which made citations of the articles significantly increased from 46 in 2003 to 83 in 2012 (37). On the other hand, 101 top-cited articles received a total 12,577 in our study. This difference may be due to our study being country-based and involving a single country. Studies involving different countries can enable more topics to be studied and collaborate and can provide a wider perspective on study topics. Another study country-based citation analysis which included the top 100 articles which were the most-cited articles and were published in international dental journals with at least one coauthor affiliated to an institutions in Brazil showed citation numbers between 124 and 657 (39).

The difference between this and our study may be due to difference in study design. In our study, the main institution was indicated by the address of the first author in Turkey. However, in this study, it based on at least one coauthor affiliated to Brazil. Therefore, this may have led to greater collaboration opportunities in top cited studies. As a result, it may increase the citation number of top-cited articles compared to our results.

In our study, the majority of the top 101 most-cited articles (71 articles) were published in the journals with a JIF of >2, which included ≥ 2 top-cited articles. Besides, 20 of the 71 articles were published in the journals with a JIF of ≥ 3 , which is relatively high, and included ≥ 2 top-cited articles in the field of dentistry. In contrast to our results, it was found that 59 of the top 100 most-cited articles were published in the journals with a JIF of >2, and 2 or more top-cited articles were published in 58 of the 59 journals published (3). This difference may be due to date of publication of this study which published in 2014. Because the JIF of journals may change depending on time. Difference may also be due to the difference between the journals where top 101 cited articles are published. In accordance with this assumption, it was found that the JIF of 10 dental journals significantly increased from 2003 to 2012, but a wide variation in the magnitude of this rise was observed (37). In accordance with our finding, in a study among the top 100 most-cited articles by the authors from Brazil, it was revealed that 65 of the 100 articles which are the most-cited were published in the journals with a JIF of >2, which included ≥ 2 top-cited articles (39). It was reported that it is known fact that authors consider a JIF as the most important determinant while selecting a journal for publishing their research, on the other hand, high JIF journals draw attention of high quality articles, thereby attracting high quality papers (27). However, in the present study, 20% of the most-cited articles were published in those journals with relatively higher JIFs (3 or more). In agreement with our findings, no significant association has been found between the JIF of a journal and the number of top-cited articles (20,27).

In our study, 92 of the 101 (~92%) top-cited articles were published before the year of 2010. In accordance with our findings, in other studies, the majority of the articles belonged to a decade or more before the

publication of the studies (3,18,20,22,27,30,32,39). In contrast to our results, some studies have reported that those articles which are the most-cited have been published in the last 10 years (2,16,24). It was stated that the oldest articles usually had much more time ahead to be cited than those which have been recently published, without taking their scientific impact account, thereby carrying the risk of excluding the most recent influential articles (27). The total number of citations to an article can only increase over time (39). It was demonstrated that an article requires a minimum of six to 15 years to receive a sufficient number of citations following its publication and become a citations classic (22). In the present study, only 9 top-cited articles were published after the year of 2010 which means those articles have had the last 10 years to be cited. Similarly to our finding, it was reported that the possible reason is the limited amount of time for important studies to receive higher number of citations, or that there is now a higher tendency to submit qualified articles to journals which have the highest JIFs and that those journals are included in other categories of the Journal Citation Report (3,43).

Co-authorship is the resulting close collaboration between or among authors who intensively cooperate during the improving of research and take responsibility for the study content through joint signature, so that, in any situation, they can present and defend the original idea of the research (44). In our study, 24 articles had 4 authors. The number of top-articles with 2-6 authors is 89. Similar with our results, another study which is based on at least one co-author affiliated to an institution in Brazil found 79 top-cited articles had 2-6 authors (39). A study on scientific collaboration in research in Brazil revealed that the most recurrent number of is the 6-author authorship, which accounts for about 76% of its scientific production when added to 5 and 7 or more authors (44). In our study, approximately half of top-cited articles (45 articles) showed a single-center collaboration in the form of individual institutions. Also, international collaboration (29 articles) has secondly the highest citation. The most collaborated country was United States followed by Finland and Sweden. In accordance with our findings, it was found that the country with the most international collaboration was the United States, followed by

Finland (39). The explanation for the situation might be the fact that the better the economy a country ranks enables it to produce the higher quantity and quality of biomedical publications (28,45). However, in our studies, the number of a single-center collaboration among top-cited articles was found higher than multi-institutional and international collaboration. It was suggested that young researchers may focus on broad range collaboration of relevant researchers from different disciplines to create a study with high impact/quality (28). Also, a study showed that international collaboration increased the rates of citation which an article received (46). However, in our study, international collaboration with 3600 citations (29% of total citation) did not effect on citation rates. Besides, 18 of 22 (81.8%) institutions with 91 articles are public and 4 of 22 articles (18.2%) are private institutions with 9 articles. This finding agreement with another study in which one co-author affiliated to an institution in Brazil found that of the 138 institutions coauthoring the articles, 73.9% were public and 26.1% were private institutions (39).

In our study, more than half of the top-cited articles (54 articles) were in basic science, followed by clinical research (40 articles) and review (8 articles). In contrast to our study, Feijoo et al. (3) found plurality of clinical research (66%) over basic research (34%). Another study, which is based on minimum one co-author affiliated to an institution in Brazil, found that 75 top-cited articles included epidemiological, clinical, and basic research, and 25 top-cited articles were reviews including those both narrative and systematic (39). In the present study, most of the top-cited articles were on the field of Prosthetic Dentistry with 34 articles and it was followed by the fields of Periodontology and Endodontics with 16 articles and 14 articles, respectively. Partially agreement our results, a study with co-authors from Brazil revealed that the most frequent subjects addressed in 100 top-cited articles were Endodontics, Periodontology, and Dental Materials (61% of the sample). A study including the top 100 most-cited articles in the field of dentistry found that the majority of research was on the field of Periodontology (43 articles), and it was followed by the fields of Implantology and Adhesive Restorations with significantly less number of material (11 articles and 8 articles, respectively) (3). In another study related to the citation rates on the articles in

Scopus which were co-authored by the institutions in Brazil, it was showed that Endodontics had the highest total citations followed by Multidisciplinary and Dental Materials (46). In our study, implant for Prosthetic Dentistry, root canal sealer for Endodontics and, periodontal disease and molecular mechanism for Periodontology were main topic of top-cited articles. On the other hand, for Orthodontics, Restorative Dentistry, Oral and Maxillofacial Surgery, and Pedodontics, there was not predominant topic. In another other 100 top-cited articles studies on one specific area, microbial etiology of periodontal diseases for Periodontology (25), endodontic microbiology for Endodontics (18,20) and implants for Orthodontics (30) were major topics.

In our study, the most common study design of the articles in clinical research were RCTs (21 articles) followed by cross-sectional studies (10 articles). Level of evidence was II at most (27 articles), followed by III (7 articles). In contrast to our findings, the cross-sectional study (24), case series (3,18,21,22,30) or case reports (16) was reported as the most common clinical study design. This difference may be due to difference in study design as most of these studies performed on one area of Dentistry different from our study. Also, it was reported that majority of top-cited clinical experience articles had low level evidence such as level III evidence (20) and IV or V (18,22,27,30) than our study. It was stated that this might indicate relatively easier method of conducting simpler studies (30). In accordance with level of evidence, most of clinical researches were RCTs in our study. It was explained that studies place into a so-called hierarchy of evidence, with systematic reviews and meta-analyses of RCTs at the top contributing to the highest level of evidence, followed by RCTs, non-RCTs, cohort studies, case-control studies, crossover studies, cross-sectional studies, case studies, and expert opinions and uncontrolled studies or opinion at the bottom (36,42,47).

Conclusion

In our study, the top 101 most-cited articles had lower citation when compared to other 100 top-cited articles due to the first author affiliated to Turkey institutions. Journal of Prosthetic Dentistry published the highest number of top-cited articles and Prosthetic Dentistry was the field on which the highest number

of articles conducted. A total of 92% of the top-cited articles were published before 2010. The number of top articles with 2-6 authors is 89. More than half of the top-cited articles were in the field of basic science. Most of the topics of the 101 top-cited articles were implant. The most frequently used study design was RCT for the articles in clinical experience. Level of evidence most of clinical researches were level II. Compared to the literature, it is promising that the number of clinical trials and level evidence is high. However, it is necessary to increase the number of international collaborations to boost the citation count of article.

Ethics

Ethics Committee Approval: This article does not contain any studies with human participants or animals performed by any of the authors.

Informed Consent: For this type of study, formal consent is not required.

Peer-review:Externally and internally peer-reviewed.

Authorship Contributions

Concept: M.D., S.T., Design: M.D., F.K., Data Collection or Processing: F.K, M.B., Writing: M.D., F.K. Critical review: S.T., N.T., Supervision: M.D.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

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