

Current trends in orthodontic journals listed in Journal Citation Reports. A bibliometric study

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Introduction: The aim of this study is to analyze articles published in orthodontic journals included in Journal Citation Reports (JCR) to determine current trends in orthodontic publishing. **Methods:** Articles included in orthodontic journals in 2016 JCR and published during 2007-2017 were selected. After applying inclusion criteria, author-based parameters (article title, first author's name, institution and sex, number of authors, number of affiliations, first author's origin, and geographic origin), article-based parameters (article type, main topic, and research design), and the number of cites and self-cites were registered for each article. **Results:** A total of 7119 articles were analyzed, and 842 different centers and 4483 different authors were identified. The percentage of female authors showed a tendency to increase over the decade; the most productive country was the United States (17.4%). Bone anchorage was the most recurrent topic (7.2%). More than three-fourths of articles (80.8%) proceeded from orthodontic departments belonging to public institutions, with a decreasing trend in nonacademic or private affiliations. Positive and negative correlations were found to exist between citation counts and other variables. **Conclusions:** *American Journal of Orthodontics and Dentofacial Orthopedics*, *Angle Orthodontist*, and *European Journal of Orthodontics* were the 3 main journals with regard to production volume, with the United States being the most productive country. The most recurrent topic was bone anchorage, and most of the studies were research articles with observational cross-sectional design. Study design, geographic origin of the articles, article type, and the main subject of the article may be predictive of citation numbers. (Am J Orthod Dentofacial Orthop 2019;156:663-74)

Several bibliometric studies have aimed to analyze orthodontic publishing trends in different journals and over different time frames up until 2015.¹⁻¹⁴ However, the results of these studies are not often comparable with one another because the analyzed parameters, journals, and periods vary widely. Most of these bibliometric reviews have only included the leading orthodontic journals^{4-6,15} or specific parameters, such as topic⁴ or type of study design,¹⁰ whereas others analyze the most cited articles in orthodontics.² They have mainly focused either on

article-based parameters and design^{4,10} or on author-based parameters^{3,6,12,15}; it is uncommon to find studies focused on both.⁷ Because of the small number of journals included^{4,6,12,15} and the short periods they cover,^{4,15} they are of limited scope and do not provide an accurate analysis of publishing trends and progression. None of them has conducted a complete and extensive review of the 8 current orthodontic journals included in Journal Citation Reports (JCR).

JCR is a research tool that determines the relative relevance of the journals it lists. However, it does not determine the relevance of particular articles.¹² JCR can be used in orthodontic bibliometric studies to select high-impact journals and investigate their progress over time and to explore the cites, and even self-cites, each journal receives each year.

This study set out to perform a complete and extensive bibliometric analysis of the main orthodontic journals included in JCR, including all issues and all articles published in 2007-2017 to provide information about publication tendencies during the last decade,

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Table I. Journal Citation Reports orthodontic journal ranking 2016 and impact factor

Journal	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
EJO	1.022	1.015	0.975	0.932	0.893	1.078	1.390	1.483	1.440	1.622
AJODO	1.126	1.442	1.327	1.354	1.381	1.458	1.437	1.382	1.690	1.472
AO	0.972	1.166	0.937	1.000	1.207	1.184	1.277	1.225	1.579	1.366
KJO*	–	–	–	0.824	0.662	0.537	0.370	1.173	1.162	1.182
OCR*	–	–	1.607	1.809	1.652	1.186	1.288	1.061	1.640	1.115
JOO*	–	–	0.890	0.500	0.859	0.694	0.819	0.833	0.789	0.753
AOJ*	–	–	–	0.444	0.250	0.281	0.269	0.434	0.434	0.423
SO*	–	–	–	–	–	–	–	–	0.346	0.404

*These journals were not in Journal Citation Reports through the entire period.

topics that can be accessed, and the evolution of recent lines of research, and to help researchers plan new work on the basis of what has already been published.

MATERIAL AND METHODS

Eight orthodontic journals included in the JCR, 2016 Science Edition, in the Dentistry, Oral Surgery & Medicine category, were analyzed: the *European Journal of Orthodontics* (EJO), *American Journal of Orthodontics and Dentofacial Orthopedics* (AJODO), the *Angle Orthodontist* (AO), *Korean Journal of Orthodontics* (KJO), *Orthodontics & Craniofacial Research* (OCR), *Journal of Orofacial Orthopedics* (JOO), *Australasian Orthodontic Journal* (AOJ), and *Seminars in Orthodontics* (SO). The JCR impact factors for each journal from 2007 (or later if the journal was included in the list after 2007) to 2016 are shown in Table I.

All issues published between 2007 and 2017 (both years included) were obtained from each journal's online Web site to avoid any confusion deriving from external databases.

Replies, letters to editors, retractions, errata, publications of Congresses and scientific meetings, protocols, reviews of books, summaries of articles, articles of opinion and reflection, news, biographies, and editorials were excluded.

Two sets of parameters (author-based and article-based parameters) were registered independently for each article by 2 researchers (JIA-T and FE):

(1) Author-based parameters

- Title of the article.
- First author's name, institution, and sex.
- Number of authors.
- Number of affiliations; this number could be higher than the sum of authors because many authors have more than 1 affiliation.
- Origin of the first author's affiliation: (1) research in public institutional academic orthodontic departments, (2) research in public institutional

academic nonorthodontic departments, and (3) research in private practices or private research centers.

- Geographic origin of first author's affiliation (countries were classified into geographic areas): (1) North America, (2) European Union (EU) member states (EU membership 2006), (3) European countries nonmember states (EU membership 2006), (4) Asia and Australia, (5) Central and South America, and (6) other countries. Norway and Switzerland were included in EU member states.

(2) Article-based parameters

- Main topic of the article (Table II).
- Article type: (1) research, (2) systematic review and meta-analysis, (3) narrative review, (4) case report, and (5) other articles that did not fit the previous categories.
- Research design (only for research articles) based on the classification proposed by Farjo et al.⁴

In addition, the number of cites per year for the top 10 authors and for the 8 journals were registered to relate these data to some of the other variables. Self-cites and the self-citation rate for the journals and for the main authors were also registered. The Scopus database was used to collect authors' data, whereas the JCR database was used for journals.

Statistical analysis

After conducting the search and entering data into an Microsoft Excel file (version 16.12; Microsoft, Redmond, Wash), descriptive statistics were calculated by VP-G, VG-S, and CB-A. The statistical analysis consisted of calculating absolute and relative frequencies for all variables registered. Mean, standard deviation, minimum, maximum, and median values were calculated for continuous variables.

Cross tables were obtained to assess the associations between different variables across the whole sample and

Table II. Main topics of the articles

Topic	Description
T1	Bone anchorage: implants and screws
T2	Upper airways, sleep apnea, snoring
T3	Biomechanics—bone and periodontal biology during tooth movement
T4	Class II fixed or removable functional appliances
T5	TMJ and craniomandibular dysfunction. Bruxism.
T6	Deminerlization: prevention and materials
T7	Root resorption and secondary defects during orthodontic treatment: dehiscence, recessions
T8	Maxillary expansion: appliances, surgical-assisted expansion
T9	Bonding and bracket removal
T10	Cephalometry, radiology, CBCT, scanners
T11	Facial growth and development, facial biotype, facial morphology, and dental arches
T12	Indexes and measurements/mathematical models, dental cast analysis
T13	Stability and relapse/retention/fixed and removable retainers
T14	Eruption problems: impaction, canine ectopic eruption/number problems (supernumeraries and agenesis)
T15	Vertical alterations: open bite
T16	Lip and cleft palate
T17	Dental transplant
T18	Malocclusion etiology: etiologic factors, habits
T19	Extraction and nonextraction therapy
T20	Social professional aspects, professional opinions, cost-benefit
T21	Soft tissues—profile evaluation, smile evaluation
T22	Mastication and malocclusion—posturology
T23	Archwires, resins, and other materials: biochemistry, biology, toxicity
T24	Deepbite
T25	Injuries and complications during orthodontic treatment: periodontal, mucosal, nervous
T26	Orthopedic-functional appliances in class III: facial mask—chin guard, Frankel III
T27	Psychological and psychosocial aspects in patients: perception of esthetics, pain, comfort, quality of life, need of orthodontic treatment, collaboration
T28	Skeletal asymmetries/orthognathic surgery, corticotomies, bone distraction
T29	Skeletal Class III (surgery not included)
T30	Therapeutics, techniques, and procedures in second phase of treatment
T31	Brackets design, friction, self-ligating
T32	Genetics, hormones, chemical transmitters, medications
T33	Syndromes and systemic diseases, cystic and tumoral pathology
T34	Skeletal Class II: diagnosis, micrognathia
T35	Others
T36	Periodontics: prevention, periodontal microbiology, halitosis
T37	Cariology, traumatology/dental sensitivity/carries prevention: cariogenic microbiology, dental brushing
T38	Extraoral appliances in class II, pendulum

TMJ, Temporomandibular joint.

within strata defined by specific journals. Descriptive statistics were calculated using the custom tables module in SPSS statistical software (version 15.0; IBM, Chicago, Ill).

Spearman coefficient was calculated to determine the correlation between citation counts or impact factor and other variables. Statistical significance was set at $P < 0.01$.

RESULTS

After reviewing the content of the issues and applying exclusion criteria, 7119 articles were identified in issues of the selected journals published during 2007–2017. The overall distribution was homogeneous within the study period, being 9% per year, with a maximum

production peak in 2011 (10.4%). The AJODO, AO, and EJO published 73.5% of all articles.

Author-based parameters

Regarding the first author’s name, a total of 5481 different authors were identified. Table III lists the top 10 first authors. Registering the first author’s institutional affiliation, 842 different centers were found. Table IV lists the top 10 institutions.

Regarding the sex of the first authors, more than half were males (61%; Table V). SO reported the lowest percentage of women (22%), whereas EJO showed the highest (46%). Analyzing the evolution of sex balance over the period reviewed, 2 different phases could be

Table III. List of top 10 first authors

	<i>First Author</i>	<i>EJO</i>	<i>AJODO</i>	<i>AO</i>	<i>KJO</i>	<i>OCR</i>	<i>JOO</i>	<i>AOJ</i>	<i>SO</i>	<i>Total</i>
1	Uysal, Tancan	11 (0.9)	8 (0.3)	8 (0.5)	3 (0.7)	2 (0.5)	2 (0.4)	2 (0.7)	0 (0)	36 (0.5)
2	Janson, Guilherme	4 (0.4)	22 (0.9)	3 (0.2)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	29 (0.4)
3	Pandis, Nikolaos	8 (0.7)	13 (0.5)	2 (0.1)	0 (0)	1 (0.3)	0 (0)	1 (0.3)	3 (0.9)	28 (0.4)
4	Pithon, Matheus M.	4 (0.3)	8 (0.3)	6 (0.4)	0 (0)	0 (0)	0 (0)	4 (1.4)	0 (0)	22 (0.3)
5	Baccetti, Tiziano	6 (0.5)	10 (0.4)	4 (0.2)	0 (0)	0 (0)	0 (0)	0 (0)	2 (0.6)	22 (0.3)
6	Knösel, Michael	5 (0.4)	3 (0.1)	9 (0.5)	0 (0)	1 (0.3)	2 (0.4)	0 (0)	0 (0)	20 (0.3)
7	Reichert, Christoph	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	18 (3.8)	0 (0)	0 (0)	18 (0.2)
8	Çelikoğlu, Mevlüt	1 (0.1)	5 (0.2)	7 (0.4)	1 (0.2)	1 (0.3)	0 (0)	3 (1.0)	0 (0)	18 (0.2)
9	Fleming, Padhraig S.	2 (0.2)	7 (0.3)	4 (0.2)	0 (0)	1 (0.3)	0 (0)	2 (0.7)	1 (0.3)	17 (0.2)
10	Paschos, Ekaterini	0 (0)	2 (0.1)	2 (0.1)	0 (0)	0 (0)	12 (2.5)	0 (0)	0 (0)	16 (0.2)
	Total*	861 (100)	1835 (100)	1297 (100)	382 (100)	325 (100)	285 (100)	224 (100)	272 (100)	5481 (100)

Note. Values are n (%).

*Total number of different authors, not only the top 10.

Table IV. List of top 10 institutions

	<i>Institution</i>	<i>EJO</i>	<i>AJODO</i>	<i>AO</i>	<i>KJO</i>	<i>OCR</i>	<i>JOO</i>	<i>AOJ</i>	<i>SO</i>	<i>Total</i>
1	Seoul National University	13 (1.2)	47 (1.9)	49 (2.9)	20 (4.6)	3 (0.8)	0 (0)	0 (0)	1 (0.3)	133 (2.1)
2	Yonsei University	3 (0.3)	42 (1.7)	28 (1.7)	49 (11.4)	4 (1.1)	0 (0)	0 (0)	4 (1.2)	130 (2.0)
3	Federal University of Sao Paulo	11 (0.9)	86 (3.5)	27 (1.6)	0 (0)	4 (1.1)	0 (0)	2 (0.7)	0 (0)	130 (2.0)
4	Federal University of Rio de Janeiro	6 (0.5)	44 (1.8)	25 (1.5)	0 (0)	2 (0.5)	0 (0)	5 (1.7)	0 (0)	82 (1.3)
5	University of North Carolina	1 (0.1)	41 (1.7)	12 (0.7)	0 (0)	7 (1.9)	0 (0)	0 (0)	12 (3.6)	73 (1.1)
6	University of Alberta	10 (0.9)	25 (1.0)	27 (1.6)	3 (0.7)	3 (0.8)	0 (0)	1 (0.3)	1 (0.3)	70 (1.1)
7	KyungHee University	0 (0)	21 (0.8)	24 (1.4)	20 (4.6)	0 (0)	0 (0)	0 (0)	1 (0.3)	66 (1.0)
8	Catholic University of Korea	3 (0.3)	17 (0.7)	9 (0.5)	32 (7.4)	0 (0)	0 (0)	2 (0.7)	2 (0.6)	65 (1.0)
9	Sichuan University	5 (0.4)	21 (0.8)	26 (1.6)	0 (0)	4 (1.1)	4 (0.8)	3 (1.0)	0 (0)	63 (0.9)
10	Tokyo Dental College	8 (0.7)	16 (0.6)	28 (1.7)	3 (0.7)	6 (1.6)	0 (0)	0 (0)	0 (0)	61 (0.9)
	Total*	324 (100)	464 (100)	427 (100)	101 (100)	178 (178)	117 (100)	121 (100)	126 (100)	842 (100)

Note. Values are n (%).

*Total number of institutions, not only the top 10.

Table V. Distribution of articles and author-based parameters

Parameter	EJO	AJODO	AO	KJO	OCR*	JOO	AOJ	SO	Total
Sex (first author)	1122 (16.6)	2454 (36.4)	1652 (24.5)	431 (6.4)	–	470 (6.7)	287 (4.3)	333 (4.9)	6749 (100)
Male	606 (54)	1552 (63.2)	972 (58.8)	260 (60.3)	–	278 (59.1)	184 (64.1)	261 (78.4)	4113 (61)
Female	516 (46)	902 (36.8)	680 (41.2)	171 (39.7)	–	192 (40.9)	103 (35.9)	72 (21.6)	2636 (39)
Affiliation origin	1122 (15.8)	2454 (34.5)	1652 (23.2)	431 (6.0)	370 (0.5)	470 (6.6)	287 (4.0)	333 (4.7)	7119 (100)
Orthodontic	892 (79.5)	1879 (76.6)	1412 (85.5)	389 (90.3)	315 (85.1)	401 (85.3)	245 (85.4)	217 (65.2)	5750 (80.8)
Nonorthodontic	150 (13.4)	193 (7.9)	106 (6.4)	14 (3.2)	36 (9.7)	29 (6.2)	25 (8.7)	51 (15.3)	604 (8.5)
Nonacademic	80 (7.1)	382 (15.6)	134 (8.1)	28 (6.5)	19 (5.1)	40 (8.5)	17 (5.9)	65 (19.5)	765 (10.7)
Geographic origin	1122 (15.8)	2454 (34.5)	1652 (23.2)	431 (6.0)	370 (0.5)	470 (6.6)	287 (4.0)	333 (4.7)	7119 (100)
North America	55 (4.9)	674 (27.5)	343 (20.8)	7 (1.6)	112 (30.3)	1 (0.2)	18 (6.3)	190 (57.1)	1400 (19.7)
Europe-EU	648 (57.8)	499 (20.3)	363 (22)	21 (4.9)	129 (34.9)	406 (86.4)	47 (16.4)	72 (21.6)	2185 (30.7)
Europe-nonEU	116 (10.3)	143 (5.8)	203 (12.3)	46 (10.7)	13 (3.5)	28 (6)	31 (10.8)	3 (0.9)	583 (8.2)
Central and South America	67 (6)	349 (14.2)	180 (10.9)	4 (0.9)	21 (5.7)	5 (1.1)	18 (6.3)	6 (1.8)	650 (0.9)
Oceania/Pacific	157 (14)	602 (24.5)	452 (27.4)	347 (80.5)	69 (18.7)	13 (2.8)	113 (39.4)	28 (8.4)	1781 (25)
Other countries	79 (7)	187 (7.6)	111 (6.7)	6 (1.4)	26 (7)	17 (3.6)	60 (20.9)	34 (10.2)	520 (7.3)
Number of authors	1122 (15.8)	2454 (34.5)	1652 (23.2)	431 (6.0)	370 (0.5)	470 (6.6)	287 (4.0)	333 (4.7)	7119 (100)
1	24 (2.1)	91 (3.7)	28 (1.7)	13 (3)	15 (4.1)	50 (10.6)	25 (8.7)	114 (34.2)	360 (5.1)
2	106 (9.4)	223 (9.1)	160 (9.7)	38 (8.8)	38 (10.3)	51 (10.9)	50 (17.4)	98 (29.4)	764 (10.7)
3	242 (21.6)	445 (18.1)	331 (20)	85 (19.7)	50 (13.5)	81 (17.2)	61 (21.3)	53 (15.9)	1348 (18.9)
4	273 (24.3)	554 (22.6)	413 (25)	110 (25.5)	76 (20.5)	107 (22.8)	76 (26.5)	34 (10.2)	1643 (23.1)
5	250 (22.3)	526 (21.4)	568 (34.4)	92 (21.3)	65 (17.6)	158 (33.6)	65 (22.6)	20 (6)	1744 (24.5)
6	129 (4.1)	361 (14.7)	94 (5.7)	56 (13)	51 (13.8)	8 (1.7)	7 (2.4)	5 (1.5)	711 (10)
>6	98 (8.7)	254 (10.3)	58 (3.5)	37 (0.1)	75 (20.3)	15 (3.2)	3 (1.0)	9 (2.7)	549 (7.7)
Number of affiliations	1122 (15.8)	2454 (34.5)	1652 (23.2)	431 (6.0)	370 (0.5)	470 (6.6)	287 (4.0)	333 (4.7)	7119 (100)
1	275 (26.4)	525 (25.3)	520 (34.3)	153 (38)	86 (24.5)	99 (23)	131 (48.5)	132 (49.3)	1921 (30.2)
2	332 (31.9)	784 (37.8)	549 (36.2)	99 (24.6)	91 (25.9)	134 (31.2)	81 (30)	67 (25)	2137 (33.6)
3	256 (24.6)	460 (22.2)	327 (21.5)	70 (17.4)	78 (22.2)	109 (25.3)	41 (15.2)	47 (17.5)	1388 (21.8)
4	107 (10.3)	223 (10.8)	94 (6.2)	44 (10.9)	54 (15.4)	53 (12.3)	14 (5.2)	19 (7.1)	608 (9.6)
5	50 (4.8)	52 (2.5)	17 (1.1)	13 (3.2)	19 (5.4)	27 (6.3)	3 (1.1)	3 (1.1)	184 (2.9)
6	16 (1.5)	20 (1)	8 (0.5)	12 (3)	9 (2.6)	7 (1.6)	0 (0)	0 (0)	72 (1.1)
>6	6 (0.6)	8 (0.4)	3 (0.2)	12 (2.9)	14 (4.0)	1 (0.2)	0 (0)	0 (0)	44 (0.7)

Note. Values are n (%).

*Sex determination could not be determined in OCR journal.

distinguished: 2007-2015 saw a progressive increase in female authorship (reaching a maximum of 45% in 2015), and during 2015-2017, a clear stabilization of female authorship was established (a minimum of 39% in 2017). Figure 1 shows the evolution of the percentage of female authors in each geographic area.

The average number of authors per article was 4.2 ± 1.8. Half of the articles were signed by 4 authors or less. Journals with the most disparate author numbers were the OCR (average 5 authors) and SO (average 2 authors). A slight tendency for the number of authors to increase could be observed over the decade; the average in 2017 was 4.8 authors per article, whereas 10 years earlier the average was 3.6 (Table V).

The mean number of affiliations was 2.3 ± 1.2, with 63.8% of the articles including at least 2 different affiliations, which shows that the collaboration between departments or institutions was quite frequent. The lowest percentage of affiliations per article was found for the AOJ and SO (maximum of 5 affiliations per article), in

contrast with higher values found in the AJODO (maximum of 12 affiliations per article) and the EJO, KJO, and OCR (10 affiliations per article). A progressive increase in collaborations could be observed over the decade. The EJO was the journal with the highest rise in the mean number of affiliations compared with the AJODO and AO, which showed stability over the period (Table V).

Regarding the origin of the first author's affiliation, 80.8% corresponded to the orthodontic departments belonging to public institutions (universities, medical institutes, and public research centers), 8.5% to nonacademic or private centers, and 10.7% to nonorthodontic departments. A decrease in nonacademic or private affiliations was observed in all journals, with the exception of AO (Table V).

As for the geographic origin of first author's affiliation, the United States produced the most articles (17.4%), followed by South Korea (10%), Brazil (8.4%), Germany (8.2%), and Turkey (7.8%). Three main areas were identified: EU and member states (30.7%), Asia

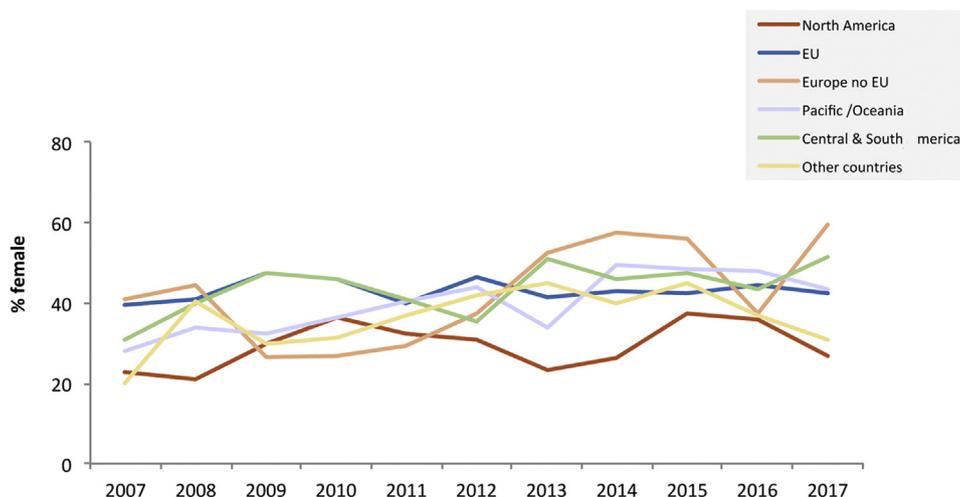


Fig 1. Evolution of the percentage of female authors from 2007 to 2017.

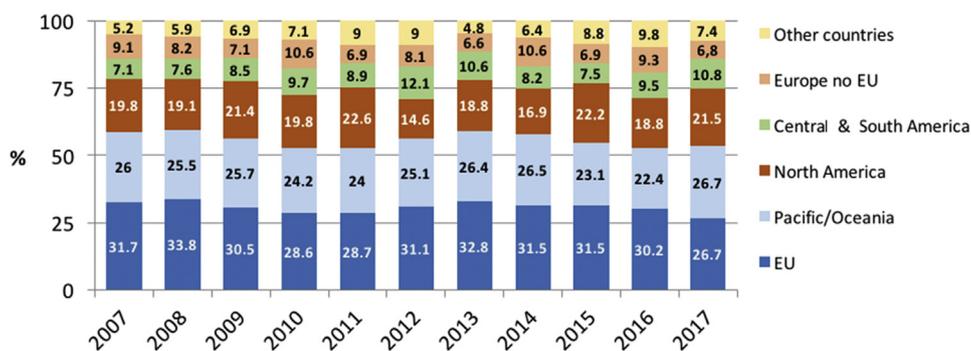


Fig 2. Geographic area evolution from 2007 to 2017.

and Australia (25%), and North America (19.7%) (Table V; Fig 2). EU countries' production decreased progressively during the decade. In 2017, Asia and Australia and the EU were leaders in article production, which was similar to North America. Central and South American countries increased their production over this period. Each geographic area's contribution varied according to the journal. Strong associations were found between the origin of affiliation and the journal's origin for the EJO, KJO, OCR, JOO, AOJ, and SO, unlike the AJODO and AO, where a wider variety of origins was found.

Article-based parameters

Regarding the main topic of the articles, bone anchorage was the most recurrent topic (7.2%), followed by topics related to bonding and bracket removal (5.7%), and topics related to archwires, resins, and dental materials (5%). Rarely published topics included dental

autotransplant (0.6%), injuries and acute complications during orthodontic treatment (0.4%), and topics related to overbite (0.3%) (Fig 3, A). Figure 3, B illustrates trends in topics; the frequency of the topics related to bonding and bracket removal was unstable over time, being the most recurrent in 2010 but the least common in 2017. The topic bone anchorage was also found to vary in frequency, peaking in 2011, but falling to a minimum in 2017. Other topics were more stable during the period analyzed.

As for the types of article, the most published were research articles (81.5%), followed by clinical cases (8.6%) and narrative reviews (5.2%). The highest percentage of research articles was found in the EJO (92.4%), whereas the lowest percentage was found in SO (9%; Table VI). Among research articles, the most common design was observational cross-sectional studies (24.1%), observational cohort studies (13.7%), and randomized controlled trials (13.5%). When study

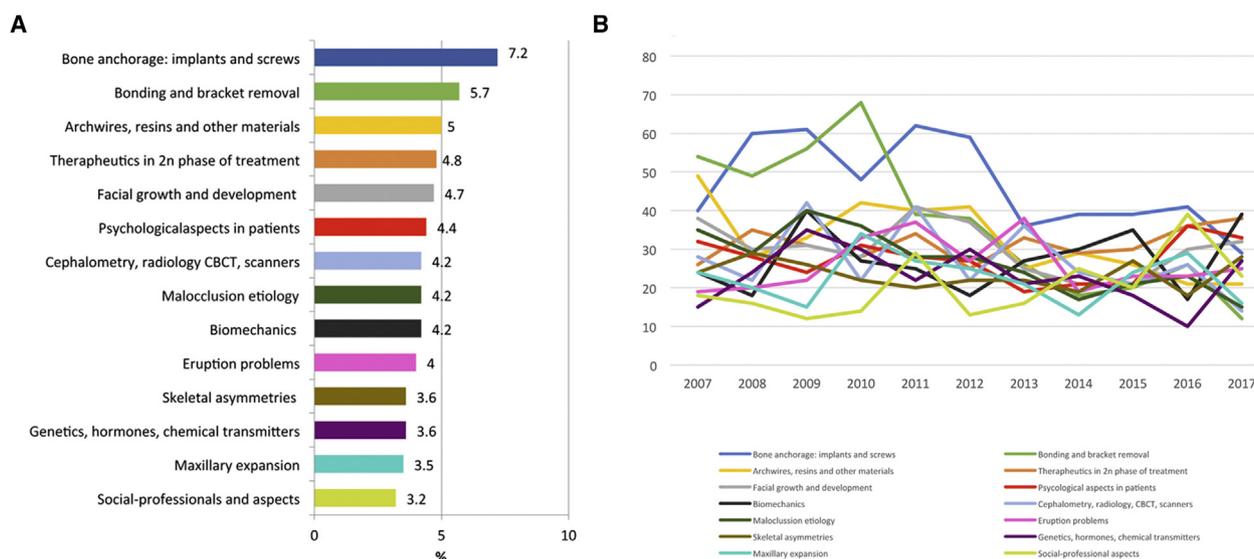


Fig 3. A, Main topic ranking (%). B, Evolution of the topics from 2007 to 2017 (n).

Table VI. Distribution of articles and article-based parameters

Parameter	EJO	AJODO	AO	KJO	OCR	JOO	AOJ	SO	Total
Article type	1122 (15.8)	2454 (34.5)	1652 (23.2)	431 (6.0)	370 (0.5)	470 (6.6)	287 (4.0)	333 (4.7)	7119 (100)
Research	1037 (92.4)	1905 (77.7)	1496 (90.6)	375 (87.4)	310 (83.8)	432 (91.9)	215 (74.9)	30 (9)	5800 (81.5)
Systematic review and meta-analysis	71 (6.3)	65 (2.7)	64 (3.9)	6 (1.4)	60 (16.2)	17 (3.6)	2 (0.7)	4 (1.2)	300 (4.2)
Narrative review	0 (0)	74 (3)	0 (0)	1 (0.2)	0 (0)	1 (0.2)	2 (0.7)	293 (88)	371 (5.2)
Case report	1 (0.1)	405 (16.5)	90 (5.5)	47 (11)	0 (0)	12 (2.6)	51 (17.8)	6 (1.8)	612 (8.6)
Others	13 (1.2)	2 (0.1)	1 (0.1)	0 (0)	0 (0)	8 (1.7)	6 (2.1)	0 (0)	30 (0.4)
Research design	1037 (17.9)	1905 (32.8)	1496 (25.8)	375 (6.5)	310 (5.3)	432 (7.5)	215 (3.7)	30 (0.5)	5800 (100)
Basic-materials	70 (6.8)	97 (5.1)	131 (8.8)	28 (7.5)	4 (1.3)	45 (10.4)	19 (8.9)	1 (3.3)	395 (6.8)
Basic-cells	18 (1.7)	33 (1.7)	29 (1.9)	4 (1.1)	18 (5.8)	8 (1.8)	1 (0.5)	0 (0)	111 (1.9)
Translational-human	73 (7)	148 (7.8)	99 (6.6)	34 (9.1)	19 (6.1)	40 (9.2)	24 (11.3)	3 (10)	440 (7.6)
Translational-animals	107 (10.3)	148 (7.8)	150 (10)	34 (9.1)	68 (21.9)	21 (4.8)	18 (8.5)	0 (0)	541 (9.3)
Translational-theoretical/models	117 (11.3)	205 (10.8)	156 (10.4)	29 (7.7)	21 (6.8)	36 (8.3)	19 (8.9)	3 (10)	629 (10.6)
Clinical randomized controlled trial	153 (14.8)	128 (6.7)	273 (18.2)	72 (19.2)	20 (6.5)	95 (21.9)	53 (24.9)	4 (13.3)	780 (13.5)
Clinical nonrandomized controlled trial	21 (2)	88 (4.6)	87 (5.8)	0 (0)	0 (0)	1 (0.2)	5 (2.3)	1 (3.3)	203 (3.5)
Clinical observational cohort	112 (10.8)	393 (20.6)	131 (8.8)	41 (10.9)	39 (12.6)	61 (14.1)	10 (4.7)	7 (23.3)	794 (13.7)
Clinical observational case-controls	76 (7.3)	200 (10.5)	79 (5.3)	22 (5.9)	32 (10.3)	14 (3.2)	17 (8)	6 (20)	446 (7.7)
Clinical observational case series	11 (1.1)	16 (0.8)	14 (0.9)	4 (1.1)	5 (1.6)	6 (1.4)	6 (2.8)	0 (0)	62 (1.1)
Clinical observational cross-sectional	279 (26.9)	448 (23.5)	347 (23.2)	87 (23.2)	84 (27.1)	106 (24.5)	41 (19.2)	5 (16.7)	1397 (24.1)

Note. Values are n (%).

design subgroups were detailed, observational cohort studies were found to have undergone a notable increase (22.4%) in 2017. An overall decrease in randomized controlled studies was observed during the decade (Table VI).

Tables VII and VIII show the total numbers of cites, self-cites, and self-citation rates for the top 10 first authors and for the journals in each year of the study period. Among the authors, Mevlüt Çelikoğlu showed the highest self-citation rate for the whole period

Table VII. Number of cites, number of self-cites, and self-citation rate for the top 10 authors during the period 2007-2017

Author	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2007-2017
Uysal, Tancan												
Cites	24	49	75	129	122	130	164	212	261	236	255	1657
SC	2	3	15	22	24	4	7	3	5	6	0	91
SCR (%)	8.33	6.12	20	17.05	19.67	3.07	4.27	1.41	1.91	2.54	0	5.49
Janson, Guilherme												
Cites	75	86	97	116	115	156	223	226	210	229	307	1840
SC	32	18	39	33	10	20	35	34	12	40	76	349
SCR (%)	42.67	20.93	40.20	28.45	8.69	12.82	15.69	15.04	5.71	17.46	24.75	18.96
Pandis, Nikolaos												
Cites	10	19	35	51	70	80	146	252	296	353	415	1727
SC	2	3	3	9	4	12	36	46	65	47	42	269
SCR (%)	20	15.78	9.57	17.64	5.71	15	24.66	18.25	21.96	13.31	10.12	15.58
Pithon, Matheus M.												
Cites	1	1	13	18	22	60	66	76	107	135	135	634
SC	0	1	4	10	7	35	32	28	32	22	10	181
SCR (%)	0	100	30.76	55.55	31.82	58.33	48.48	36.84	29.90	16.29	7.4	28.55
Baccetti, Tiziano												
Cites	182	241	273	395	444	573	742	701	662	633	628	5474
SC	54	55	66	93	93	23	24	6	0	0	1	415
SCR (%)	29.67	22.82	24.18	23.54	20.95	4.01	3.23	0.86	0	0	0.16	7.58
Knösel, Michael												
Cites	0	1	6	5	10	22	43	37	55	53	55	287
SC	0	1	3	1	6	10	5	0	10	9	0	45
SCR (%)	–	100	50	20	60	45.45	11.63	0	18.18	16.98	0	15.685
Reichert, Christoph												
Cites	0	1	6	19	25	26	31	46	44	42	59	299
SC	0	0	3	0	0	4	0	12	0	0	6	25
SCR (%)	–	0	50	0	0	15.38	0	26.08	0	0	10.17	8.36
Çelikoğlu, Mevlüt												
Cites	0	0	0	1	20	53	66	90	133	173	139	549
SC	0	0	0	0	6	18	1	35	59	33	23	175
SCR (%)	–	–	–	0	30	33.96	1.52	38.89	44.36	19.07	16.55	31.88
Fleming, Padhraig S.												
Cites	4	3	13	31	22	44	103	146	167	242	275	1050
SC	0	0	1	8	0	1	13	22	38	38	25	146
SCR (%)	0	0	7.69	2.58	0	2.27	12.62	15.07	22.75	15.7	9.09	13.90
Paschos, Ekaterini												
Cites	24	48	54	53	75	103	104	94	88	82	68	793
SC	1	0	2	1	3	4	0	8	1	6	0	26
SCR (%)	4.16	0	3.7	1.88	4	3.88	0	8.51	1.14	7.32	0	3.28

SC, Self-cite; SCR, self-citation rate.

(31.88%), and Ekaterini Paschos showed the lowest (3.28%). Data were unavailable for some years in KJO, OCR, JOO, AOJ, and SO. Citation rates showed heterogeneity across journals and from year to year for the individual journal. KJO showed a self-citation rate of 52.28% in 2010; it also presented the highest rate among the journals across the entire study period (27.33%).

Associations between the numbers of cites or impact factor and some of the other variables registered are available in the [Supplementary Table](#). The journal SO was not included in the analysis because data for only

3 of the years were available. For some variables, no significant correlations were found, whereas others presented positive and negative correlations with cites or impact factor. In the EJO, the percentage of articles from North America showed a positive significant correlation with the number of cites and impact factor, but only with the overall citation count. The AJODO showed negative correlations between both impact factor and the citation count and articles originating in North America and Europe. Regarding article type, in the EJO, systematic reviews showed a positive correlation with cites and impact factor, whereas a negative

Table VIII. Number of cites, number of self-cites, and self-citation rate for the studied journals for the period 2007-2017

Journal	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2007-2017
EJO												
Cites	1793	2234	2340	2427	2462	2739	3000	3080	3315	3580	4365	31,335
SC	349	268	289	329	235	351	384	338	337	321	302	3503
SCR (%)	19.46	11.99	12.35	13.55	9.54	12.81	12.80	10.97	10.16	8.96	6.91	11.17
AJODO												
Cites	6482	8040	7929	8455	8656	8906	8960	9384	10,429	10,616	13,909	101,766
SC	2209	2393	2488	2374	2558	1607	1780	1590	1804	1791	1908	22,502
SCR (%)	34.07	29.76	31.37	28.07	29.55	18.04	19.86	16.94	17.29	16.87	13.71	22.11
AO												
Cites	2413	3353	3178	3462	3620	3702	3904	4276	4548	4994	6168	43,618
SC	571	550	507	466	514	526	538	564	526	506	405	5673
SCR (%)	23.66	16.40	15.95	13.46	14.19	14.20	13.78	13.19	11.56	10.13	6.56	13.00
KJO*												
Cites	-	-	-	153	205	165	111	191	265	287	463	1840
SC	-	-	-	80	91	32	31	36	55	82	96	503
SCR (%)	-	-	-	52.28	44.39	19.39	27.92	18.84	20.75	28.57	20.73	27.33
OCR*												
Cites	-	-	446	542	556	649	680	725	732	746	998	6074
SC	-	-	20	28	11	19	32	13	40	22	93	278
SCR (%)	-	-	4.48	5.16	1.97	2.92	4.70	1.79	5.46	2.94	9.31	4.57
JOO*												
Cites	-	-	388	417	514	508	575	574	593	618	785	4972
SC	-	-	76	76	87	69	83	64	60	59	58	632
SCR (%)	-	-	19.58	18.22	16.92	13.58	14.43	11.15	10.11	9.54	7.38	12.71
AOJ*												
Cites	-	-	-	153	157	164	143	176	180	198	273	1444
SC	-	-	-	10	21	12	-	5	20	-	24	92
SCR (%)	-	-	-	6.53	13.37	7.31	-	2.84	11.11	-	8.79	6.37
SO*												
Cites	-	-	-	-	-	-	-	-	393	405	649	1447
SC	-	-	-	-	-	-	-	-	19	10	41	70
SCR (%)	-	-	-	-	-	-	-	-	4.83	2.46	6.31	4.8

SC, Self-cite; SCR, self-citation rate.
 *Data for some of the included years was not available.

association was found for research articles. As for the main topic, in the EJO, AO, and KJO, bonding and bracket removal showed negative correlations with both citations and impact factor.

DISCUSSION

The aim of this study was to perform a bibliometric analysis of the 8 orthodontic journals listed in JCR, including all issues published during the decade 2007-2017. No other study to date has conducted a complete and extensive review of all these journals together.

All the journals were included in the 2016 JCR ranking, but 5 of the 8 were not included in the JCR throughout 2007-2016. Only the EJO, AJODO, and AO were included in the JCR during the entire decade, with SO being the latest to be incorporated (in 2016). Nevertheless, the study analyzed all issues published during 2007-2017 for all 8 journals, in an attempt to

assess trends and the evolution of different parameters over the past decade. Furthermore, no inferential analysis was carried out because the study sample was the total population.

Some types of articles were excluded because it was thought that the data obtained would be more relevant if the review only focused on studies regarded as being of high scientific value. This is not to say that reply articles are not of high scientific value (higher than letters to editors, retractions, errata), but these were excluded to avoid duplication in certain parameters such as authors, institutions, and topics, which would have been a source of bias.

Regarding author-based parameters, the top 10 first authors published similar numbers of articles with the exception of the first on the list, who published an above average number. These results concur with an earlier study⁵ but do not agree with Hui et al⁷ owing to differences in the period and journals analyzed.

Analyzing first authors' institutional affiliations, Seoul National University, Yonsei University, and the Federal University of Sao Paulo were the most productive institutions, presenting similar percentages. Although the United States was the first country with respect to article production, when the origins of the publications were analyzed, South Korean and Brazilian institutions had more relevance than US institutions. Comparing these results with those of other studies, only the University of North Carolina was found by other authors to be within the 10 most productive institutions.⁷ As for the other institutions appearing on our list, these did not agree with data reported by Prevezanos et al¹ and Hui et al,⁷ which could be attributed to the different periods reviewed and the nonorthodontic publications that these authors included. Although the results generally showed stability regarding production levels in different geographic areas over the study period, the EU group underwent a decrease of 4.34% in the last year analyzed (2017) compared with the mean percentages registered during the previous 9 years. North American production remained stable over the period, with production during the last year increasing slightly in comparison with previous years (Fig 2).

The data obtained on first authors' sex could not be compared with any other studies because no other has analyzed this factor. Sex determination was not possible in 1 of the journals (OCR) because only the authors' initials were provided. Because some authors had uncommon or sex-nonspecific names, a more extensive search was conducted in the corresponding institutional databases (where detailed information and photographs are usually available) to ascertain their sex. The percentage of female authors showed an ongoing tendency to increase, which may respond to the increasing number of women joining the orthodontic specialty and research groups. By contrast, SO showed the lowest percentage of female authors, which could be related to different factors not investigated in the present study. The sex of the first author varied when comparing different geographic areas. North America had the lowest average percentage of female authors over the decade, peaking in 2010 and 2015 (35%). A major difference was found between North America and the European non-EU group, which showed a high percentage of female authors in 2017 (60%) in sharp contrast to North America (<30%).

With respect to the number of authors, no maximum number of authors per article was established as in other studies,^{3,5,6,12,16} but to compare our results with Kanavakis et al,³ articles with more than 6 authors were included in the same group. Our results showed that there was a tendency for the number of authors per article to increase, as in previous studies.^{5,16-18} The

present review found higher numbers than Kanavakis et al.¹² The number of authors per article has increased recently as a result of the increased frequency of multidisciplinary treatments in dentistry.²

Only publications of academic origins were analyzed, without determining whether collaborations took place within the same center or between different centers and countries. In this regard, the categorization used in our study was similar to Kanavakis et al,³ but the present results showed a lower percentage of publications with more than 1 affiliation than Kanavakis et al.^{3,12} These differences might be due to variations in the periods and journals assessed.

As for first author affiliations, the present study found that academic affiliations prevailed over nonacademic ones, as in other studies.^{3,12} Moreover, an increase in academic orthodontic affiliation was also observed, a similar finding to Kanavakis et al.^{3,12}

Regarding the geographic origin of first author affiliations, the EJO, KJO, OCR, JOO, AOJ, and SO articles were closely linked to the geographic areas where they were published. This connection was also found in the AJODO and AO, although it was weaker. These results were similar to data reported by Kanavakis et al.³ In relation to authors' origins, the United States was found to be the first producer, as reported in other studies.^{5,6} Other high-producing countries—South Korea, Brazil, Germany, or Turkey—increased production over the period reviewed. Comparing the different studies, these countries present varying numbers of articles and are ranked differently from the present study because of the different selections of journals reviewed.^{5,6} As in other studies,^{3,4,15,19} the geographic area of Central and South America was considered an independent group, unlike some studies which included these areas in the group “others” or “rest of the world.”^{6,12} Similar to Farjo et al⁴ and Baumgartner et al,⁶ the present study observed an increase in articles from Central and South America, showing an overall upward trend but presenting occasional slight decreases in certain years.

Focusing on the article-based parameter results, the classification of main topics in the present review was similar to that used by other authors,^{2,4,7} although with less categories.

In 2017, at the end of the review period, the most published topics were biomechanics, bone and periodontal biology, techniques, stability, and relapse. An important decreasing tendency could be observed over the decade in the topics relating to bonding and bracket removal, archwires, resins and other materials, and malocclusion etiology. Likewise, bone anchorage topics showed a slight tendency to decrease. By contrast, topics involving stability and relapse, and genetics, hormones,

and chemical transmitters showed a marked tendency to increase throughout the decade. Topics such as lip and cleft palate, airways, and sleep apnea, which were uncommon at the beginning of the decade, increased significantly in frequency (Fig 3, B).

As for the different types of articles published, when articles published in SO were analyzed, many articles did not fit into any of the categories proposed by Baumgartner et al⁶ and Allareddy et al.¹⁵ Therefore, a group called narrative review was created especially for the purposes of the present study. Research articles were the most frequently published article type, with higher numbers than in the study by Kanavakis et al.¹² The percentage of clinical cases identified in the present study was similar to Kanavakis et al.¹² With regard to research design, nearly half of the articles analyzed were observational studies, a finding similar to other authors⁴ who studied AJODO and *Dentofacial Orthopedics* (a journal not included in the JCR list). Although the present review found a high number of randomized clinical trials (RCTs), a tendency for numbers of clinical trials to decrease over the decade could be observed, unlike other authors¹⁰ who have reported an increasing (though not statistically significant) tendency in reviews of the AJODO, EJO, AO, and *Journal of Orthodontics* (the latter not included in the present study). According to our results, the lowest percentage of RCTs was found in the AJODO, unlike other studies⁹ that have found the highest values of RCTs in the AJODO (between 1979 and 2011). The decrease in the number of RCTs in AJODO could be attributed to the fact that the selection process is stricter for this type of article; RCTs are considered the gold standard in medical research,²⁰ and thus, their methodology, execution, and reporting must be highly accurate.²¹ Although the AJODO followed the Consolidated Standards of Reporting Trials guidelines in 2004, recently, reporting requirements for RCTs have been reformatted with the introduction of subheadings to promote complete reporting, allowing more efficient data extraction during the systematic review process.^{22,23}

Other investigations have analyzed both article type and study design together and, therefore, cannot be compared with the data obtained in the present study.^{10,11,14}

An interesting and also critical aspect of the publications investigated is the practice of self-citation, which can distort the journal's impact factor.²⁴ The present study registered self-citation rates for the top 10 authors and the individual journals. Because orthodontics is a fairly narrow field, self-citation may play an important role. The present study found an overall self-citation rate of 12.75% over the study period. This value is similar

to the rate found for dental journals from 2014 to 2016.²⁵ The top 10 authors' self-citation rates were also registered (Table VII) but as these authors also publish papers in other fields, the results of the analysis cannot be accurately interpreted or compared with other studies.

The associations between citation counts and other variables (geographic origin, type of article, study design, and main topic) showed some correlations (both positive and negative). Although the study found heterogeneity among the journals, it is evident that some parameters might influence the number of citations in orthodontic journals; this agrees with other studies in other medical fields that have found that the subject of the articles and study design are predictors of citation counts.^{26,27}

This study suffered several limitations. First, the last authors were not considered. These data could provide interesting information because the last author is usually the research coordinator. Second, only JCR orthodontic journals were included. Presently, there are many orthodontic articles published in JCR nonorthodontic journals, a result of the increasingly multidisciplinary nature of treatments and research. This limitation has been reported by several other authors.^{1,2} It should also be noted that data for some of the parameters analyzed could have been influenced by the nature of some journals, such as SO, which only publishes specially commissioned articles, although the number of articles provided by this journal was not high compared with other journals. Finally, early e-publication articles were not considered in our study because not all the studied journals include this section and also to avoid duplicity. This issue may influence citation count and impact factor.

CONCLUSIONS

1. Three leading journals (AJODO, AO, and EJO) published three-fourths of global production.
2. There is a tendency for the rate of collaboration to increase.
3. Most articles were produced by orthodontic departments belonging to public institutions, with the United States being the most productive country.
4. The most recurrent topic was bone anchorage, and most of articles were research observational cross-sectional studies.
5. Study design, the geographic origin of the article, article type, and main subject of the article are associated with citation count.

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SUPPLEMENTARY DATA

Supplementary data associated with this article can be found, in the online version, at <https://doi.org/10.1016/j.ajodo.2019.01.019>.

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Supplemental Table. Associations between number of cites (C)/Impact Factor (IF) and study variables

Study variables	EJO		AJODO		AO		KJO		OCR		JOO		AOJ		ALL		
	C	IF	C	IF	C	IF	C	IF	C	IF	C	IF	C	IF	C	IF	
Geographic origin																	
North America	+	+	-	-													+
EU			-	-					-	-							
Europe non-EU	-	-					-	-			+						
Oceania/Pacific			+								+						
Other countries																	
Central and South America					+	+					+						+
Article type																	
Research	-	-															
Systematic review and meta-analysis	+	+					+										
Case report					-	-											
Others																	
Narrative review			-														
Research design																	
Basic studies																	
Translational studies		-			-	-				+							
Clinical control trials																	
Clinical observational		+								+							
Topic																	
Bone anchorage	+									-							
Upper airways, sleep apnea			+								+						
Biomechanics																	
Class II appliances																	
TMJ and craniomandibular dysfunction																	
Demineralization	+	+								+							
Root resorption							+					+					
Maxillary expansion											-						
Bonding and bracket removal	-	-			-	-	-	-									
Cephalometry, radiology, CBCT, scanners																	
Facial growth														+			
Indexes and measurements											+		+				
Stability and relapse																	
Eruption problems																	
Vertical alterations																	
Lip and cleft palate			+	+				-									
Dental transplant																	
Malocclusion etiology		-															
Extraction and non--extraction therapy																	
Social professional aspects, opinions					+	+				+							
Soft tissues - profile, smile																	
Mastication and malocclusion																	
Archwires, resins and other materials			-	-													
Deepbite																	
Injuries and complications																	
Orthopedic- functional Class III appliances																	
Psychological and psychosocial aspects			+	+						+							
Skeletal asymmetries																	
Skeletal Class III	+													+			
Second phase of treatment																	
Bracket design			-	-													
Genetics, hormones, medications																	
Syndromes and systematic diseases																	
Skeletal Class II																	
Others	+		+							-							
Periodontics																	
Cariology/trauma/sensitivity/prevention	-	-															
Class II extraoral appliances																	
			-	-													

Note: + means positive correlation and -negative correlation.