Review Article

Orthodontic Wires: A 12-Year Bibliometric Study

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ABSTRACT

Aims and Objectives: To perform a bibliometric study to identify and evaluate articles associated with "orthodontic wires" indexed in six databases (PubMed, Embase, Cochrane, Scopus, Lilacs, and Google Scholar) from 2010 to 2022. **Materials and Methods:** The search strategy in PubMed combined different medical subject heading terms with free-text words and was adjusted for each selected database. The retrieved documents were original English articles containing the keywords used in the search strategies related to orthodontic wires. Collected data consisted of journal name, nationality, field, JIF-2 and JIF-5, SJR, CiteScore, Q and H-index, and categorization of the study. **Results:** In total, 417 articles were retrieved from the initial search. After the exclusion criteria, 257 articles remained. The most common theme was mechanical properties, with basic studies as the main categorization. **Conclusions:** This bibliometric survey provides an overview of orthodontic wires publications that might help orthodontists to understand the tendency of the studies on this subject. The retrieved papers were published in 100 journals, including 15 orthodontic journals, mainly in the first and second quartiles. Europe and America were the continents with the highest number of papers. The United States was the country with the highest number of journals on the topic. AJODO presented the highest h-index among the retrieved orthodontic journals. Brazil represented the principal institutions of origin of the listed articles. There was a tendency to increase the number of publications on orthodontic wires over the years. These findings indicate that research on orthodontic wires is still contemporary and relevant.

KEYWORDS: *Bibliometrics, citation databases, orthodontic wires, orthodontics*

INTRODUCTION

Despite the emergence of new technologies for orthodontic treatment, orthodontic wires are still widely used and have been a well-known source of biomechanical forces for tooth movement over the years. Orthodontic wires have undergone considerable evolution in their production since the 19th century, which directly influenced clinical applicability and costs over the years. Gradually, the advancement of wire manufacturing technologies and new orthodontic techniques have led to better-quality alloys.[1] Therefore, an abundance of new wires has been raised,[2] turning orthodontic treatment more acceptable, efficient, aesthetic, quicker, and less painful.[3] Some of these wires demonstrate a vast spectrum of mechanical properties and have added versatility to orthodontic treatment.[2]

The bibliometric analysis measures information on published scientific articles that can be collected, retrieved, and explored.[4] This metric can help researchers identify trends, prolific authors, top journals, and countries

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that stand out for their high research and publishing activity.[5,6] Besides, it is a guide to understanding research activity in a field of knowledge, identifying papers with relevant results that have influenced other research and impacted clinical decision-making.[7]

A bibliometric ranking is not related to a paper's quality but to its interest. It also shows the evolution and tendencies of research topics. A frequently cited and commented article is more likely to be an essential paper to science, with a reliable methodology to provide a scientific basis for measuring the paper's impact.[8] The bibliometric study has been broadly employed in several subjects of dentistry.[4,8-10] However, bibliometric studies analyzing orthodontic wires are lacking. This study aimed to investigate and produce a bibliometric study on the topic "orthodontic wires" in the last twelve years.

Subjects and Methods

Search strategy

An electronic literature assessment was performed using the following databases: PubMed, Embase, Cochrane, Scopus, Lilacs, and Google Scholar, from January 2010 to December 2022. Ethics approval is not applicable. The search strategy in PubMed merged the medical subject heading terms with free-text words, and it was adjusted for each database.

The search term used was the truncated term "'orthodon*,'" inserted in the topic field; the Mesh terms used were "orthodontic wires," "shape memory alloys," "alloys," "tooth movement techniques," and "Orthodontics" (including article title, abstract, author, keywords, and Key Words Plus). Additionally, to limit the search only to relevant articles, the authors used the filter "MEDLINE" and "English." The features of the database search and the keywords used as search terms are summarized in Table 1 and provide a flowchart of the article's selection process [Figure 1]. One investigator (A.C) carried out the article selection, and it was double-checked by two others (C.Q. and L.M.M). The inclusion criteria for retrieving the documents were original articles published in English containing the keywords used in the search strategies in the mentioned period. The exclusion criteria were: articles not written in English, texts not found, duplicated articles, books or chapters, patents, conference papers, thesis, studies on wires not related to orthodontics, journals not located in the Scimago Journal and Country Rank (SJCR) and Academic Accelerator (AA) databases.

Data extraction

The researchers performed a custom data extraction, and the following information was recorded: name of the journal, journal nationality, journal field, the impact factor of two (JIF-2 year) and five years (JIF-5 year), Scimago Journal Ranking (SJR), CiteScore, Q and H-index, institution and nationality, the field of study, study categorization, and publication year. The data were double-checked.

Data collection

The data was organized using Excel (Microsoft Excel software, version 16.16.27). A manual database edition was also prepared to eliminate typographic or indexing errors and unify terms. Only articles associated with orthodontic wires were included. The abstract of each paper was investigated to check its suitability. After applying the exclusion criteria, the full records of the retrieved publications were downloaded [Supplementary Table 1]. SJCR and AA were used to extract three sets of parameters: (1) journal-based parameters—journal name and nationality, the field of the journal, JIF-2 year and JIF-5 year, SJR, CiteScore, Quartile (Q) and H-index; (2) author-based parameters—institution name and nationality); (3) article-based parameters—title, field, type of study, and publication year. Articles that were neither part of SJCR nor AA were excluded.

The author's affiliations and country of origin were retrieved from the Scopus database (Elsevier BV, Amsterdam, The Netherlands). The institution and country of origin were based on the articles' first authors. The study design was classified as basic, clinic, or review. The field of the study was determined according to a modified method based on Fardi *et al.*[9] The CiteScore was identified using the Science Citation Index Expanded of the Web of Science (Clarivate Analytics), accessed in December 2022.

Results

The search strategy returned a total of 417 papers that referred to orthodontic wires. After removing duplicated studies and applying other exclusion criteria, 257 articles were selected. Supplementary Table 1 shows the articles associated with orthodontic wires in the past 12 years (presenting publication year, journal identification, and paper title). Table 2 shows the total number of papers per year, expressing the tendency to increase the publication number on orthodontic wires from 2010 to 2022.

The 257 papers on orthodontic wires were published in 100 different journals. Journal field and title, Q index, SJR, H-index, JIF-2 year and JIF-5 year, CiteScore, and the number of articles per journal are summarized in [Supplementary Table 2]. According to the SJCR, 49 journals (49.0%) are positioned in the first and second

Table 1: Search strategies of each database

Electric databases	Search strategy
PubMed	([Orthodontic wires[MeSH Terms]) OR (Orthodontic wires[Title/Abstract])) OR (shape memory alloys[MeSH Terms])) OR (shape memory alloys[Title/Abstract])) OR (Alloys[MeSH Terms])) OR (Alloys[Title/Abstract])) OR (tooth movement techniques[MeSH Terms])) OR (superelasticity[Title/Abstract])) OR (austenite[Title/Abstract])) OR (austenite[Title/Abstract])) OR (nickel[Title/Abstract])) OR (titanium[Title/Abstract])) OR (copper[Title/Abstract])) OR (stainless steel[Title/Abstract])) OR (superelastic[Title/Abstract])) OR (Thermoactivated[Title/Abstract])) OR (Ni-Ti[Title/Abstract])) OR (NiTi[Title/Abstract])) OR (mechanical properties[Title/Abstract])) OR (shape memory effect[Title/Abstract])) OR (ortodont*[Title/Abstract])) AND (Orthodontics[Title/Abstract])
EMBASE via Ovid	("orthodontic wires"/exp OR "orthodontic wires":ti,ab,kw OR "shape memory alloys"/exp OR "shape memory alloys":ti,ab,kw OR "alloys"/exp OR alloys:ti,ab,kw OR "tooth movement techniques"/exp OR "tooth movement techniques":ti,ab,kw OR superelasticity:ti,ab,kw OR austenite:ti,ab,kw OR martensite:ti,ab,kw OR nickel:ti,ab,kw OR nitinol:ti,ab,kw OR niti:ti,ab,kw OR "ni ti":ti,ab,kw OR titanium:ti,ab,kw OR copper:ti,ab,kw OR "stainless steel":ti,ab,kw OR "stainless steel wire":ti,ab,kw OR superelastic:ti,ab,kw OR thermoactivated:ti,ab,kw OR "mechanical properties":ti,ab,kw OR "shape memory effect":ti,ab,kw OR "arch wires":ti,ab,kw OR wires:ti,ab,kw OR ortodont*:ti,ab,kw OR "orthodontic device":ti,ab,kw) AND orthodontics:ti,ab,kw AND [2010-2022]/py OR timolium:ti,ab,kw
The Cochrane Library	orthodontic wires:ti,ab,kw OR shape memory alloys:ti,ab,kw OR Alloys:ti,ab,kw OR tooth movement techniques:ti,ab,kw AND orthodont*:ti,ab,kw
SCOPUS	orthodontic AND wires OR shape AND memory AND alloys OR alloys OR tooth AND movement AND techniques OR superelasticity OR austenite OR martensite OR nickel OR nitinol OR niti OR ni AND ti OR titanium OR copper OR stainless AND steel OR stainless AND steel AND wire OR superelastic OR thermoactivated OR mechanical AND properties OR shape AND memory AND effect OR arch AND wires OR wires OR orthodontic AND device OR orthodontics OR timolium AND orthodontics OR gummetal AND (LIMIT-TO (PUBYEAR , 2022) OR (PUBYEAR , 2021) OR LIMIT TO (PUBYEAR , 2019) OR LIMIT TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR , 2017) OR LIMIT-TO (PUBYEAR , 2016) OR LIMIT-TO (PUBYEAR , 2015) OR LIMIT-TO (PUBYEAR , 2014) OR LIMIT-TO (PUBYEAR , 2013) OR LIMIT-TO (PUBYEAR , 2012) OR LIMIT-TO (PUBYEAR , 2011) OR LIMIT-TO (PUBYEAR , 2010))
Lilacs	Orthodontic wires AND Alloys
Google Scholar	orthodontics + orthodontics wires + shape memory + arch wires + thermoactivated + alloys + superelasticity + shape memory alloys + tooth movement techniques

quartiles and 40 (40%) in the third and fourth quartiles. Eleven journals (11.0%) were not assigned to the SJCR website. Among the 15 orthodontic Journals, nine were ranked in the first and second quartiles (60%). The Q1 and Q2 journals with over three published papers on orthodontic wires are shown in Table 3. The orthodontic journals presenting the highest CiteScores were the European Journal of Orthodontics—EJO (4.3), Progress in Orthodontics (3.7), American Journal of Orthodontics and Dentofacial Orthopedics—AJODO (3.6), and The Angle Orthodontist—AO (3.4). The American Journal of Orthodontics and Dentofacial Orthopedics presented the highest h-index, among the ones in the orthodontic field, with a score of 121, followed by the European Journal of Orthodontics (84) and The Angle Orthodontist (81). The SJR showed EJO as the highest-ranked orthodontic journal, with a 1.37 score.

The United States, the United Kingdom, and Brazil were the countries that published the most on this topic (42, 35, and 34 articles, respectively). Brazil represented the principal institutions of origin of the listed articles, with a total number of 26 in 47 articles. The global distribution of journals on orthodontic wire articles is presented in Figure 2. Europe was the continent that published the most, followed by America.

The categorization of articles in terms of manuscript type (basic, clinical, or review) and study field is presented in Table 4. The main themes were mechanical properties with 106 articles, force (30), friction (18), and composition (16). Basic studies were the majority, with 193 articles.

Discussion

The present research is one of the few bibliometric analyses in the orthodontic wires field. It aimed to identify what was published on orthodontic wires in the past 12 years and to detect the tendencies of future research. A constant update on orthodontic materials, including wires, enables professionals to choose the best treatment choices for treating their patients in more effective, faster, less costly, and safer ways. One

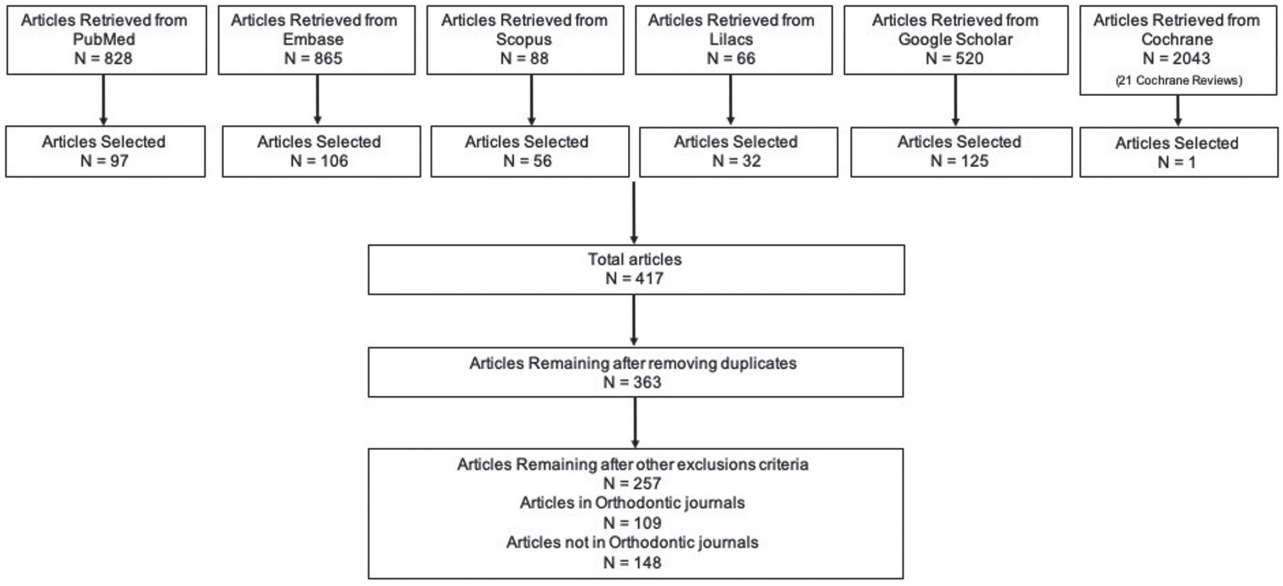

Figure 1: Flowchart of the 257 articles selected on orthodontic wires

Table 2: The total number of articles on orthodontic wires per year (2010–2022)

Year	No. of articles	% of Total
2010	08	3.3
2011	12	4.9
2012	14	5.7
2013	17	6.9
2014	15	6.1
2015	14	5.7
2016	23	9.3
2017	15	6.1
2018	23	9.3
2019	21	8.5
2020	32	13.0
2021	52	21.1
2022	11	4.3
Total	**257**	**100**

hundred different journals published 257 articles on wires from 2010 to 2022 [Supplementary Tables 1 and 2]. Among them, 15 were orthodontic journals, and the others were from different fields: materials, medicine, pharmacology, engineering, and general dentistry. This number of journals might reflect the multidisciplinary interest in orthodontic wires. The theme was published on 4 Continents, mainly in Europe (118) and America (78) [Figure 2]. The United States, the United Kingdom, and Brazil were the countries that published the most on this topic (42, 35, and 34 articles, respectively).

According to the SJCR, a set of journals is ranked within a field and separated into four quartiles, ranging from Q1 to Q4. Q1 involved journals whose positions are in the top 25% of its subject group, whereas Q4 is occupied by journals in the lowermost 25%.[11] Quartiles are settled by the CiteScore percentile of the journal representing the relative standing of a serial title in its theme field.[12] The journals that have the highest impact factor in a subject field are included in the first quartile or Q1. The Q1 orthodontic journals with over three published papers are EJO, AJO, AO, Progress in Orthodontics (PO), and Orthodontics and Craniofacial Research (OCR) [Supplementary Table 2].

The *Journal Impact Factor* (JIF) trials the average amount of citations received by a paper in a specific journal through a predefined timeframe, and it expresses the journal's reputation.[13] The JIF-2 year in which the orthodontic wires articles were published varied from 0 to 9.26 (mean, 1.84; SD, 1.58). Among the journals, the one with the highest JIF-2 year was the Cochrane Database of Systematic Reviews (9.26), with three manuscripts listed. Multidisciplinary journals tend to have a higher JIF than discipline-specific journals due to their broader readership and, consequently, a more significant number o f citations (13). All the ranked orthodontic journals had a JIF-2 lower than 3.0: EJO (3.07) with four articles, Progress in Orthodontics (2.75) with seven articles, AJODO (2.65) with nine articles and AO (2.07) with 15 articles published had the highest JIF-2 [Table 4]. Many important papers reach their highest scientific impact outside the 2-year timeframe.[14] For this reason, JIF-5 year has been introduced in order to counterbalance this metric. The JIF-5 year of the analyzed journals varied from 0 to 6.19 (mean, 1.70; SD, 1.36). EJO (2.67), AO (1.93), and AJODO (1.46) were the top JIF-5 orthodontic journals [Supplementary Table 2].

Table 3: Q1 and Q2 journals, with over three published papers on orthodontic wires (2010–2022), ordered by field, quartile, and SJR. H-index, JIF, cite score, and the number of articles presented

Journal title	Field	Position (Q)	SJR	H-index	JIF (2×)	JIF (5×)	Cite score	No. of articles
European Journal of Orthodontics	Orthodontics	Q1	1.37	88	3.07	2.67	4.3	4
Angle Orthodontist	Orthodontics	Q1	1.19	91	2.07	1.93	3.4	17
Progress in Orthodontics	Orthodontics	Q1	1.14	35	2.75	2.73	3.7	7
American Journal of Orthodontics and Dentofacial Orthopedics	Orthodontics	Q1	1.12	129	2.65	1.46	3.6	9
Orthodontics and Craniofacial Research	Orthodontics	Q1	0.82	58	1.82	1.94	2.8	3
Journal of Orofacial Orthopedics	Orthodontics	Q2	0.76	45	1.93	1.50	2.4	9
Korean Journal of Orthodontics	Orthodontics	Q2	0.70	24	1.37	1.42	2.5	3
Dental Press Journal of Orthodontics	Orthodontics	Q2	0.56	26	1.11	1.43	2.1	23
Journal of Orthodontics	Orthodontics	Q2	0.48	50	0.77	0.82	1.3	7
Journal of Orthodontic Science	Orthodontics	Q2	0.43	13	0	0	0	5
Cochrane Database of Systematic Reviews	Medicine	Q1	1.42	292	9.26	3.39	7.1	3
Journal of Materials Science: Materials in Medicine	Medicine	Q2	0,63	133	3.89	3.42	5.3	3
Journal of the Mechanical Behavior of Biomedical Materials	Materials	Q2	0.75	99	3.90	4.08	6.4	8
Materials	Materials	Q2	0.60	128	3.60	3.34	3.5	8
Dental Materials Journal	Materials	Q2	0.59	59	2.10	2.17	2.9	5
Materials Research Express	Materials	Q2	0.40	43	1.60	1.61	2.5	3
Clinical Oral Investigations	General dentistry	Q1	0.92	88	3.57	3.18	5.0	5
BMC Oral Health	General dentistry	Q1	0.79	56	2.75	2.92	3.2	3
Brazilian Oral Research	General dentistry	Q1	0.74	50	0	0	0	3
Journal of Applied Oral Science	General dentistry	Q1	0.69	49	2.69	2.44	3.5	4

The SJR score varied from 0 to 1.42 (mean, 0.47; SD, 0.33). The top-ranked orthodontic journal was EJO (1.37), followed by AO (1.19) and AJODO (1.12). The SJR uses an original algorithm to evaluate the number of citations received and ponder the weightiness of the source of the citations.[15] The SJR metric excludes self-citations and calculates, through algorithms, the number of citations received by the journal and the value of the citations' sources. It also offers an extended timeframe of three years for the SJR.[16] For these reasons, this metric should be encouraged in the academic world [Table 3].[4]

The CiteScore is an alternative journal citation-based indicator, while the SJR focuses on document types that tend to be exposed to peer review. The CiteScore includes all document types, both on the citing and on the cited side.15 Consequently, these metrics can measure the supposed quality of published papers in a particular field.4 The CiteScores of the current study list varied from 0.0 to 8.40 (mean, 2.43; SD, 2.05). The orthodontic journals presenting the highest *CiteScores* were *EJO* (4.3), AJODO (3.6), followed by AO (3.4).

Another well-known metric is the h-index, which is equivalent to the number of an author's publications (h) that have h or more mentions.[17] (e.g., if the h-index of a researcher is 50, it means that each of the 50 papers of the author has been cited at least 50 times).[4] The journal h-index of this study list varied from 4 to 292 (mean, 48.8; SD, 46.1) [Table 3]. Five orthodontic journals were represented in the first quartile; the top three were AJODO (h-index = 129), AO (h-index = 91), and the EJO (h-index = 88).

Regarding the study design, papers were classified as basic, clinical, or review [Table 4]. The majority were basic studies (193), followed by clinic studies (39) and general reviews (25). The most frequent field of study was mechanical properties (106 articles), force (30), and friction (18). The basic studies were mainly related to wires' mechanical properties. In our opinion, this reflects the orthodontist's concern in knowing the material's properties to apply controlled and adequate force distribution with minimum undesirable side effects on teeth and adjacent tissues.

Since 2010, orthodontic wire publications have grown [Table 2]. There was a significant increase between 2019

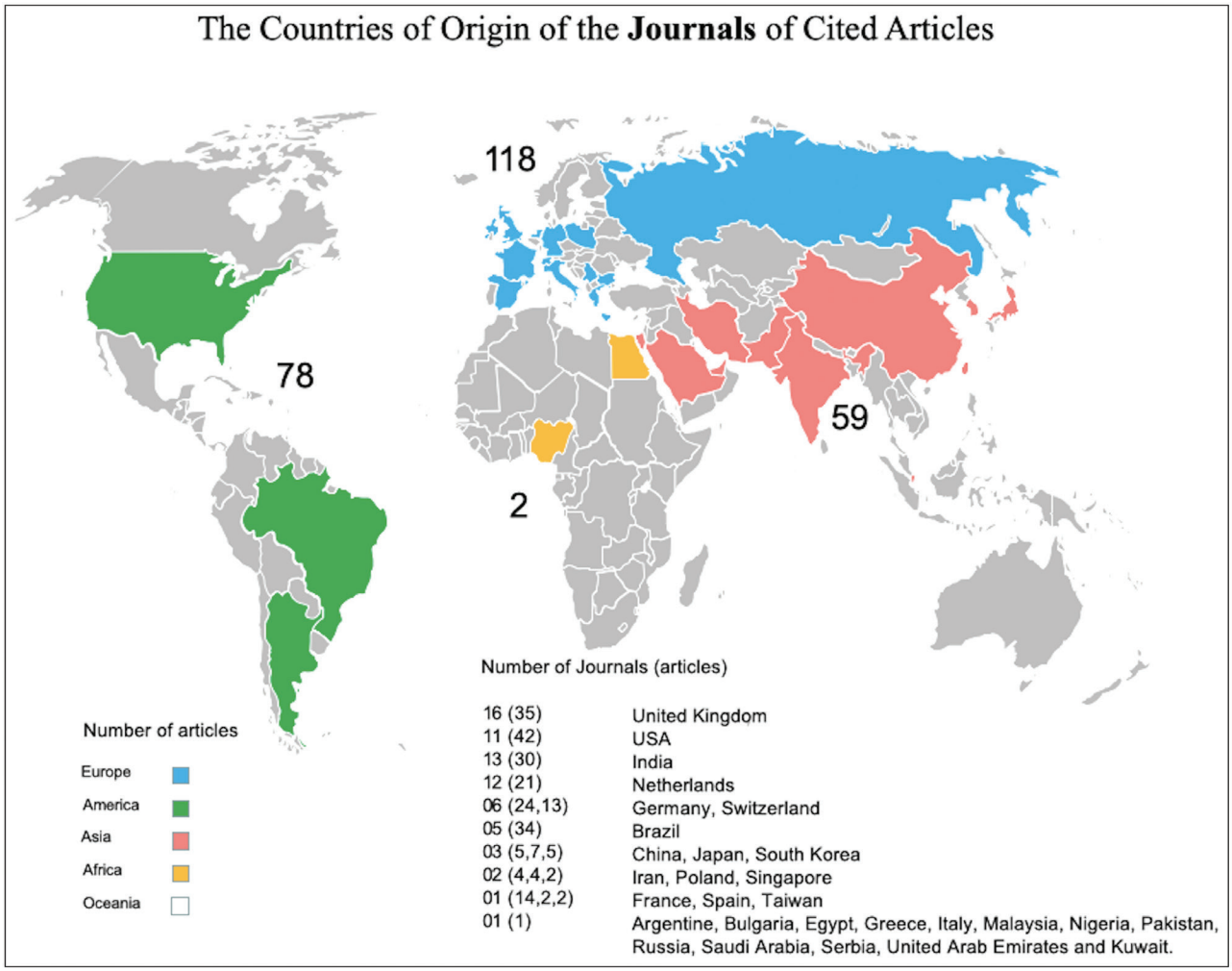

Figure 2: Continents distribution of the papers on orthodontic wires (2010–2022)

Table 4: Manuscript categorization and the number of papers per field and type of study

Type of manuscript, no.				
Field of the study	**Basic**	**Clinic**	**Review**	**Total**
Alignment	5	2	2	9
Wire composition	11	2	3	16
Esthetic wires	12	5	–	17
Force	29	1	–	30
Friction	17	1	–	18
Literature review	–	–	7	7
Mechanical properties	83	14	9	106
Pain	–	4	1	5
Pulpal blood flow	–	1	–	1
Retainer	4	6	1	11
Superelasticity	9	–	1	10
Wire Surface	12	3	1	16
Transition temperature	3	–	–	3
Torque	8	–	–	8
Total	193	39	25	**257**

and 2022. Years 2020 and 2021 were the most prolific on this topic, with 37.1% of all publications with a major focus on mechanical properties. Since orthodontic wires have improved and evolved over the years, it is natural that the studies concentrate on testing their properties. In 2020 and 2021, 32 and 52 articles were published,

respectively. The addressed topics were mainly wire properties on comparison of resistance,[18,19] clinical applications,[20,21] surface morphology,[22,23] activated forces,[24,25] and esthetic wires.[26] Such interest in properties is also noticed with the increasing number of researches comparing types of retainers (10 articles), three published in 2020 and four in 2021. On the other hand, topics that were of greater interest in the past tended to be less frequently addressed as alignment (9) and superelasticity studies (10). Force and friction are still topics of interest, as in 2021, there were 11 articles in these fields.

Concluding, bibliometric analysis is useful for deciphering and mapping the cumulative scientific knowledge and evolutionary nuances of well-established fields by making sense of large volumes of unstructured data in rigorous ways.[27] Although, this kind of investigation is dependent on frequent updating in collected data. The authors of the present study investigated articles' publications up to December 2022 in order to avoid a date gap between submission and publication. As far as we are concerned, this bibliometric analysis is a pioneer on the topic and could bring an overview of the most important studied issues related to orthodontic wires in the field of orthodontics. The quality of the included papers was not part of the present research objectives. The considerable number of published papers on the topic over the years shows that orthodontic wires studies are constantly updating, reflecting the theme's relevance.

Conclusions

This bibliometric study on orthodontic wires, from 2010 to 2022, revealed:

1. The 257 retrieved papers on orthodontic wires were published in 100 journals (15 orthodontic journals and 85 in nonorthodontics journals), which might reflect the multidisciplinary interest in orthodontic wires.
2. Most of the orthodontic journals were positioned in the first and second quartiles of the orthodontics field, according to SJCR, which might reflect the relevance of the theme and its research.
3. The most frequent theme was mechanical properties, with basic studies as the main categorization.
4. The United States was the country with the highest number of journals on the topic.
5. Brazil represented the principal institutions of origin of the listed articles.
6. There was a tendency to increase the number of publications on orthodontic wires over the years, highlighting its relevance in orthodontics.

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Conflicts of interest

There are no conflicts of interest.

Authors contributions

Cátia Quintão: Conceptualization, Methodology, Writing - Review & Editing, Supervision.

Arthur Cunha: Conceptualization, Methodology, Investigation, Writing - Original Draft, Writing - Review & Editing.

José Augusto Miguel: Manuscript review. Juan Martin Palomo: Manuscript review.

Luciane Macedo de Menezes: Conceptualization, Methodology, Writing - Review & Editing, Supervision.

Ethical policy and institutional review board statement

Not applicable.

Patient declaration of consent

Not applicable.

Data availability statement

Not applicable.

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Supplementary Table 1: The total articles related to orthodontic wires, with the year of publication, journal, and paper title

Year	Journal	Paper title
2022	Microscopy Research and Technique	Assessment of frictional resistance and surface roughness in orthodontic wires coated with two different nanoparticles
2022	Angle Orthodontist	Comparative assessment of relapse and failure between CAD/CAM stainless steel and standard stainless steel fixed retainers in orthodontic retention patients
2022	Angle Orthodontist	Super-elasticity in vitro assessment of CuNiTi wires according to their Austenite finish temperature and the imposed displacement
2022	Pesquisa Brasileira em Odontopediatria e Clinica Integrada	Comparison of the High Cycle Fatigue Behavior of the Orthodontic NiTi Wires: An in Vitro Study
2022	Surface & Coatings Technology	Graphene oxide nanocoating for enhanced corrosion resistance, wear resistance and antibacterial activity of nickel–titanium shape memory alloy
2022	Friction	Robust low-friction performance of graphene sheets embedded carbon films coated orthodontic stainless steel archwires
2022	Materials Today Communications	Superelastic and shape memory equi-atomic nickel–titanium (Ni–Ti) alloy in dentistry: A systematic review
2022	Journal of Dental Sciences	Effect of thermocycling-induced stress on properties of orthodontic NiTi wires
2022	Journal of Orthodontic Science	The MH-WIRE, a novel coil-springe wire system: A prototype design
2022	Heliyon	In vitro wearing away of orthodontic brackets and wires in different conditions: A review
2022	Pertanika Journal of Science and Technology	Development of Regression Models for the Prediction of NiTi Archwire Forces in an Orthodontic Bracket System Using Response Surface Methodology
2021	Dental and Medical Problems	Influence of orthodontic brackets and permanent retainers on the diagnostic image quality of MRI scans: A preliminary study
2021	Materials (Basel)	Vertical and Orovestibular Forces Generated by Beta-Titanium and Stainless-Steel Rectangular Wires in Labial and Fully Customized Lingual Bracket Systems
2021	American Journal of Orthodontics and Dentofacial Orthopedics	Comparative finite element analysis of bracket deformation in tie wings and slot region during simulated torque
2021	Journal of Orofacial Orthopedics	Comparison of multiforce nickel–titanium wires to multistrand wires without force zones in bending and torque measurements
2021	Journal of Orofacial Orthopedics	Friction behavior of the wire material Gummetal®
2021	Journal of Orofacial Orthopedics	Comparative analysis of passive play and torque expression in self-ligating and traditional lingual brackets
2021	Journal of Orthodontics	Comparison between traditional and alternative biocompatible welding techniques used in orthodontic devices
2021	BMC Oral Health	Mechanical force system of double key loop with finite element analysis
2021	Journal of Periodontal and Implant Science	Clinical factors affecting the longevity of fixed retainers and the influence of fixed retainers on periodontal health in periodontitis patients: a retrospective study
2021	Angle Orthodontist	In vitro Streptococcus mutans adhesion and biofilm formation on different esthetic orthodontic archwires
2021	Dental Press Journal of Orthodontics	Can we expect similar behavior among CuNiTi 35°C wires?
2021	Progress in Orthodontics	Impact of the prefabricated forms of NiTi archwires on orthodontic forces delivered to the mandibular dental arch
2021	Indian Journal of Forensic Medicine and Toxicology	Evaluating the effect of air abrasive polishing on friction and surface micromorphology of ceramic brackets using different wires
2021	Journal of Biomechanics	Evaluation of orthodontic loads and wire–bracket contact configurations in a three-bracket setup: Comparison of in vitro experiments with numerical simulations
2021	Acta Medica Bulgarica	Physicochemical research of clinically retrieved CU-NI-TI orthodontic archwires
2021	BioMed Research International	Clinical features and physical properties of gummetal orthodontic wire in comparison with dissimilar archwires: A critical review

Supplementary Table 1: Continued

Year	Journal	Paper title
2021	BioMed Research International	Influence of Physical Dimension and Morphological-Dependent Antibacterial Characteristics of ZnO Nanoparticles Coated on Orthodontic NiTi Wires
2021	Head and Face Medicine	What causes failure of fixed orthodontic retention? – systematic review and meta-analysis of clinical studies
2021	Materials (Basel)	Tooth movement efficacy of retraction spring made of a new low elastic modulus material, gum metal, evaluated by the finite element method
2021	Journal of Oral Biology and Craniofacial Research	Comparative evaluation of T-Loop with different amount of pre-activation curvatures in lingual orthodontics—A finite element study
2021	Trends in Biomaterials and Artificial Organs	Review of superelastic archwires in orthodontics
2021	Clinical Oral Investigations	Evaluation of magnetic resonance imaging artifacts caused by fixed orthodontic CAD/CAM retainers—an in vitro study
2021	Dental Press Journal of Orthodontics	Stress distribution analysis in anterior teeth caused by several retraction mechanics
2021	Trends in Biomaterials and Artificial Organs	Analysis of frictional forces in orthodontic bracket-archwires combinations: An experimental study
2021	Trends in Biomaterials and Artificial Organs	Effect of different sterilization methods on load-deflection characteristics of two grades of copper NiTi wires with different transition temperature range: A
2021	Materials Research Express	The effect of Cu-doping on the corrosion behavior of NiTi alloy arch wires under simulated clinical conditions
2021	Dental Press Journal of Orthodontics	Effect of fluoride on mechanical properties of NiTi and CuNiTi orthodontic archwires: an in vitro study
2021	Journal of Orofacial Orthopedics	Comparison of force loss during sliding of low friction and conventional TMA orthodontic archwires
2021	Journal of Orofacial Orthopedics	Effect of anodization on friction behavior of β-titanium orthodontic archwires
2021	Materials (Basel)	Frictional Properties of the TiNbTaZrO Orthodontic Wire—A Laboratory Comparison to Popular Archwires
2021	Journal of Orthodontic Science	Comparison of surface topography of low-friction and conventional TMA orthodontic arch wires using atomic force microscopy
2021	Journal of Orofacial Orthopedics	Effectiveness of medical coating materials in decreasing friction between orthodontic brackets and archwires
2021	Dental Materials Journal	Development of a new evaluation method for orthodontic forces generated in individual patients
2021	Journal of Orthodontic Science	Comparison of two different initial archwires for tooth alignment during fixed orthodontic treatment—A randomized clinical trial
2021	BMC Oral Health	Tooth alignment and pain experience with A-NiTi versus CuNiTi: a randomized clinical trial
2021	Trends in Biomaterials and Artificial Organs	Comparative Evaluation of Dimensional Accuracy and Load Deflection Attributes of Orthodontic Superelastic Archwires from Four Popular Manufacturers
2021	Orthodontic Waves	Effect of laser welding on mechanical properties of round-rectangular nickel titanium (NiTi) orthodontic wires
2021	International Orthodontics	Comparative evaluation of Stainless-steel wires and brackets coated with nanoparticles of Chitosan or zinc-oxide upon friction: An in vitro study
2021	International Orthodontics	In vitro comparison of the mechanical behaviour of archwires after computer-assisted and conventional bracket positioning protocols
2021	Clinical Oral Investigations	Effect of gastric acids on surface topography and bending properties of esthetic coated nickel–titanium orthodontic archwires
2021	Angle Orthodontist	Influence of intraoral application of antiseptics and fluorides during orthodontic treatment on corrosion and mechanical characteristics of nickel–titanium alloy in orthodontic appliances
2021	Journal of Engineering Research	Simulation of superelastic NiTi wire force application on orthodontic alignment case
2021	Journal of Orthodontic Science	The effect of fluoride gel on tensile properties, surface morphology and chemical composition of two types of orthodontic wires (an in vitro study)

Supplementary Table 1: Continued

Year	Journal	Paper title
2021	World Journal of Dentistry	Assessment of Roughness of Fiber-reinforced Polymer Composite Wires and Other Coated Esthetic Archwires
2021	Orthodontic Waves	Effects of dental arch size variation on orthodontic forces delivered by preformed Ni–Ti archwires
2021	Dental Materials Journal	Effect of different media on frictional forces between tribological systems made from self-ligating brackets in combination with different stainless steel wire dimensions
2021	Angle Orthodontist	Evaluation of torque moment in esthetic brackets from bendable alloy wires
2021	Dental Press Journal of Orthodontics	Effects of stress relaxation in beta-titanium cantilevers used in orthodontic mechanics
2021	International Journal of Dentistry	Evaluating the Mechanical Properties of Zinc-Coated Stainless Steel Orthodontic Wires Using Physical Vapor Deposition
2021	American Journal of Orthodontics and Dentofacial Orthopedics	Treatment of Class II malocclusion with the improved superelastic nickel–titanium alloy wire and long hooks for mandibular molar protraction
2021	Clinical Oral Investigations	The effect of intraoral aging of the working stainless steel archwire on the rate of premolar extraction space closure: a randomized clinical trial
2021	Materials (Basel)	A Critical Appraisal of the Use and Properties of Nickel–Titanium Dental Alloys
2020	Journal of Applied Biomaterials and Functional Materials	Resistance to sliding of orthodontic archwires under increasing applied moments
2020	Dental Press Journal of Orthodontics	Evaluation of zinc-oxide nanocoating on the characteristics and antibacterial behavior of nickel–titanium alloy
2020	Dental Press Journal of Orthodontics	Attractiveness of different esthetic orthodontic wires
2020	Journal of Orofacial Orthopedics	Stainless steel and NiTi torque archwires and apical root resorption
2020	Journal of Orthodontics	In vitro comparison of the torsional load transfer of various commercially available stainless-steel wires used for fixed retainers in orthodontics
2020	Progress in Orthodontics	Clinical comparison between multi-stranded wires and single strand ribbon wires used for lingual fixed retainers
2020	Journal of the College of Physicians and Surgeons Pakistan	Effectiveness of two types of fixed lingual retainers in preventing mandibular incisor relapse
2020	Journal of the Mechanical Behavior of Biomedical Materials	Research paper: The three-dimensional mechanical response of orthodontic archwires and brackets in vitro during simulated orthodontic torque
2020	Journal of Contemporary Dental Practice	An in vivo randomized clinical evaluation of the surface morphology of nickel–titanium, beta–titanium, and copper–nickel–titanium
2020	Progress in Orthodontics	Dimensional variability of orthodontic slots and archwires: an analysis of torque expression and clinical implications
2020	Materials (Basel)	Functional coatings for orthodontic archwires—A review
2020	American Journal of Orthodontics and Dentofacial Orthopedics	Correction of bilateral heavily impacted second molar with improved superelastic nickel–titanium alloy wires
2020	International Orthodontics	The influence of cigarette smoke on colour stability and friction property of aesthetic orthodontic wires—In vitro study
2020	Journal of Dental Research, Dental Clinics, Dental Prospects	Evaluation of biofilm accumulation on and deactivation force of orthodontic Ni–Ti archwires before and after exposure to an oral medium: A prospective clinical study
2020	Journal of Dental Research, Dental Clinics, Dental Prospects	DSC analysis and evaluation of forces released on deactivation of 0.40-mm (0.016“) orthodontic thermo-activated NiTi wires: An in vitro study
2020	International Orthodontics	Comparison of three methods for measuring the Edge Bevel Radius of rectangular orthodontic wires: An in vitro study
2020	BMC Oral Health	Finite element analysis of archwire parameters and activation forces on the M/F ratio of vertical, L- and T-loops
2020	International Orthodontics	Effects of cold chemical (glutaraldehyde) versus autoclaving sterilization on the rate of coating loss of aesthetic archwires: A double-blind randomized clinical trial
2020	Clinical Oral Investigations	A comparative study of initial changes in pulpal blood flow between conventional and self-ligating fixed orthodontic brackets during leveling and alignment stage

Supplementary Table 1: Continued

Year	Journal	Paper title
2020	Journal of the World Federation of Orthodontists	Evolution, clinical applications, and prospects of nickel–titanium alloys for orthodontic purposes
2020	Clinica Terapeutica	Dental monitoring application: Is it a valid innovation in the orthodontics practice?
2020	Drug Invention Today	The effect of Teflon coating on the resistance to sliding of orthodontic archwires
2020	Journal of Pharmaceutical Sciences and Research	Advancements in technology in the field of orthodontics
2020	Series on Biomechanics	Comparison of mechanical properties of last generation multi-force nickel–titanium archwires
2020	Materials Science & Engineering Technology	Force-deflection behavior of NiTi archwire at different configurations of bracket system
2020	Metals	New bactericide orthodontic archwire: NiTi with silver nanoparticles
2020	Advanced Structured Materials	Binding friction of NiTi archwires at different size and shape in 3-bracket bending configuration
2020	Journal of the Mechanical Behavior of Biomedical Materials	The effect of annealing temperature on microstructure and mechanical properties of dissimilar laser welded superelastic NiTi to austenitic stainless steels orthodontic archwires
2020	Journal of the Mechanical Behavior of Biomedical Materials	Thermomechanical characterization of NiTi orthodontic archwires with graded actuating forces
2020	Journal Clinical of Orthodontics	SmartArch multi-force superelastic archwires: A new paradigm in orthodontic treatment efficiency
2020	Russian Journal of Biomechanics	Nanoindentation and surface characterization of clinically retrieved multi-force niti orthodontic archwires
2020	International Orthodontics	Influence of different storage temperatures on the mechanical properties of NiTi, Cu-NiTi and SS orthodontic archwires: An in vitro study
2019	Dental Press Journal of Orthodontics	Do laypersons perceive aesthetic differences between coated and uncoated orthodontic archwires?
2019	Dental Press Journal of Orthodontics	Influence of heat treatment on the mechanical properties of CrNi stainless steel orthodontic wires
2019	Open Dentistry	Effect of clinical use and sterilization process on the transition temperature range of thermally NiTi alloys
2019	Materials (Basel)	Magnetic resonance imaging and Its effects on metallic brackets and wires: Does It alter the temperature and bonding efficacy of orthodontic devices?
2019	Materials (Basel)	A comparison of the compositional, microstructural, and mechanical characteristics of Ni-Free and conventional stainless steel orthodontic wires
2019	Journal of Orofacial Orthopedics	Torque efficiency of a customized lingual appliance: Performance of wires with three different ligature systems
2019	International Orthodontics	Surface topography of plain nickel–titanium (NiTi), as-received aesthetic (coated) NiTi, and aesthetic NiTi archwires sterilized by autoclaving or glutaraldehyde immersion: A profilometry/SEM/AFM study
2019	Odontology/ the Society of the Nippon Dental University	Oral antiseptics and nickel–titanium alloys: mechanical and chemical effects of interaction
2019	Journal of Clinical and Diagnostic Research	An examination of bacterial colonization on nickel–titanium arch-wires with different surface properties
2019	Dental and Medical Problems	The effect of simulated erosive conditions on the frictional behavior of different orthodontic bracket-wire combinations
2019	Journal of Clinical and Diagnostic Research	Evaluation of sensibility threshold of dental pulp to electric pulp test (EPT) in the teeth under fixed orthodontic treatment with 0.014 and 0.012 initial NiTi archwire
2019	Technology and Health Care	A three-dimensional finite element analysis of the effect of archwire characteristics on the self-ligating orthodontic tooth movement of the canine
2019	Progress in Orthodontics	A comparative assessment of clinical efficiency between premium heat-activated copper nickel–titanium and superelastic nickel–titanium archwires during initial orthodontic alignment in adolescents: A randomized clinical trial
2019	Materials Research Express	Computational study on the effect of contact friction towards deactivation force of superelastic NiTi arch wire in a bracket system

Supplementary Table 1: Continued

Year	Journal	Paper title
2019	Journal of Orofacial Orthopedics	Mechanical properties of multi-force vs. conventional NiTi archwires
2019	Coatings	Characterization of NiTi orthodontic archwires surface after the simulation of mechanical loading in CACO2-2 cell culture
2019	Brazilian Journal of Oral Sciences	The effect of heat treatment on sliding mechanics of stainless steel orthodontic wires
2019	Drug Invention Today	Pain perception and patient discomfort between various dimensional initial nickel–titanium wires—A review
2019	Angle Orthodontist	Flexural properties of rectangular nickel–titanium orthodontic wires when used as ribbon archwires
2019	Metals and Materials International	Modeling of hydrogen diffusion towards a NiTi arch wire under cyclic loading
2019	Journal Clinical of Orthodontics	Lingual orthodontics redefined with automation and friction-free mechanics
2018	Dental Press Journal of Orthodontics	Welding strength of NiTi wires
2018	Contemporary Clinical Dentistry	Comparative evaluation of frictional resistance of silver-coated stainless steel wires with uncoated stainless steel wires: an in vitro study
2018	European Journal of Orthodontics	Does long-term intraoral service affect the mechanical properties and elemental composition of multi stranded wires of lingual fixed retainers?
2018	Journal of Materials Science: Materials in Medicine	Thermo-mechanical properties of glass fiber reinforced shape memory polyurethane for orthodontic application
2018	Current Osteoporosis Reports	Review of superelastic differential force archwires for producing ideal orthodontic forces: an advanced technology potentially applicable to orthognathic surgery and orthopedics
2018	Journal of Oral Science	Effect of the vertical position of the canine on the frictional/orthodontic force ratio of Ni–Ti archwires during the levelling phase of orthodontic treatment
2018	Nigerian Journal of Clinical Practice	Mandibular dental arch changes with active self-ligating brackets combined with different archwires
2018	Orthodontics and Craniofacial Research	A prospective cohort study assessing the appearance of retrieved aesthetic orthodontic archwires
2018	Dental Materials Journal	Corrosion resistance and mechanical properties of titanium nitride plating on orthodontic wires
2018	Journal of Clinical and Experimental Dentistry	Comparison of spring characteristics of titanium–molybdenum alloy and stainless steel
2018	Chinese Journal of Tissue Engineering Research	Frictional force of different ligations with niti archwires of different sizes
2018	Journal of Biomaterials and Tissue Engineering	Comparative study to evaluate load deflection of various nickel–titanium alignment wires
2018	Journal of Intelligent Material Systems and Structures	Finite element analysis of hydrogen effects on superelastic NiTi shape memory alloys: Orthodontic application
2018	Orthodontic Waves	Comparison of the load-deflection characteristics of 0.012″ heat-activated, superelastic and bent superelastic nickel titanium wires
2018	Cochrane Database of Systematic Reviews	Initial arch wires used in orthodontic treatment with fixed appliances
2018	Korean Journal of Orthodontics	Evaluation of the alignment efficiency of nickel titanium and copper-nickel–titanium archwires in patients undergoing orthodontic treatment over a 12-week period: A single-center, randomized controlled clinical trial
2018	Archives of Materials Science and Engineering	Fretting in orthodontics and its test methods
2018	Procedia Computer Science	Comparison of load deflection properties and force level of newly introduced M5TM thermal copper NiTi with other orthodontic NiTi wires: An in vitro study
2018	Materials Research Express	Numerical simulation of the force generated by a superelastic NiTi orthodontic archwire during tooth alignment phase: comparison between different constitutive models
2018	Journal of the Mechanical Behavior of Biomedical Materials	Force delivery of NiTi orthodontic arch wire at different magnitude of deflections and temperatures: a finite element study
2018	International Orthodontics	Clinical comparison of two initial arch wires (A-NiTi and Heat Activated NiTi) for amount of tooth alignment and perception of pain: A randomized clinical trial

Supplementary Table 1: Continued

Year	Journal	Paper title
2018	The Kaohsiung Journal of Medical Sciences	A novel β-titanium alloy orthodontic wire
2018	Angle Orthodontist	Tooth and bone changes after initial anterior dental alignment using preformed vs customized nickel titanium archwires in adults: A randomized clinical trial
2017	Dental Press Journal of Orthodontics	Stability of beta-titanium T-loop springs preactivated by gradual curvature
2017	American Journal of Orthodontics and Dentofacial Orthopedics	Alignment efficiency and esthetic performance of 4 coated nickel–titanium archwires in orthodontic patients over 8 weeks: A multicenter randomized clinical trial
2017	Journal of Medical and Biological Engineering	Feasible evaluation of the thermo-mechanical properties of shape memory polyurethane for orthodontic archwire
2017	International Orthodontics	Effect of esthetic coating on surface roughness of orthodontic archwires
2017	Materials (Basel)	Load-deflection and friction properties of PEEK wires as alternative orthodontic wires
2017	Journal of Contemporary Dental Practice	Wire roughness assessment of 0.016 "× 0.022" the technique lingual orthodontics
2017	Journal of Contemporary Dental Practice	Ion release and galvanic corrosion of different orthodontic brackets and wires in artificial saliva
2017	International Orthodontics	Comparison of friction forces between stainless orthodontic steel brackets and TiNi wires in wet and dry conditions
2017	Progress in Orthodontics	Torque differences due to the material variation of the orthodontic appliance: A finite element study
2017	Journal of Contemporary Dental Practice	An in vitro evaluation of friction characteristics of conventional stainless steel and self-ligating stainless steel brackets with different dimensions of archwires in various bracket-archwire combination
2017	Orthodontics and Craniofacial Research	In vitro evaluation of the influence of velocity on sliding resistance of stainless steel arch wires in a self-ligating orthodontic bracket
2017	Key Engineering Materials	Loading and unloading forces following addition of 5% Cu in nickel–titanium alloy used for orthodontics
2017	Progress in Orthodontics	Force level of small diameter nickel–titanium orthodontic wires ligated with different methods
2017	Solid State Phenomena	Mechanical properties of curved nickel–titanium orthodontic archwires prepared by cold bending and heat bending techniques
2017	Brazilian Oral Research	Evaluation of deflection forces of orthodontic wires with different ligation types
2016	Dental Press Journal of Orthodontics	The influence of distal-end heat treatment on deflection of nickel–titanium archwire
2016	Dental Press Journal of Orthodontics	Deflection test evaluation of different lots of the same nickel–titanium wire commercial brand
2016	Journal of Orthodontic Science	Fluoride influences nickel–titanium orthodontic wires' surface texture and friction resistance
2016	Dental Materials	Comparison of the transformation temperatures of heat-activated Nickel–Titanium orthodontic archwires by two different techniques
2016	Dental Press Journal of Orthodontics	Evaluation of force released by deflection of orthodontic wires in conventional and self-ligating brackets
2016	Journal of Oral Biology and Craniofacial Research	Nickel release from stainless steel and nickel titanium archwires—An in vitro study
2016	Journal of Clinical and Diagnostic Research	Evaluation of mechanical and physical properties of clinically used and recycled superelastic NiTi wires
2016	Journal of Orthodontics	Torque resistance of different stainless steel wires commonly used for fixed retainers in orthodontics
2016	Journal of Clinical and Experimental Dentistry	In vitro comparative study on the friction of stainless steel wires with and without Orthospeed® (JAL 90458) on an inclined plane
2016	Angle Orthodontist	In vitro biocompatibility of nickel–titanium esthetic orthodontic archwires
2016	Saudi Dental Journal	Evaluation of the fit of preformed nickel titanium archwires on normal occlusion dental arches

Supplementary Table 1: Continued

Year	Journal	Paper title
2016	American Journal of Orthodontics and Dentofacial Orthopedics	Archwire diameter effect on tooth alignment with different bracket-archwire combinations
2016	Angle Orthodontist	Effects of stress relaxation in beta-titanium orthodontic loops: Part II
2016	Research Journal of Pharmacy and Technology	Beta titanium - Review
2016	Angle Orthodontist	Nickel titanium T-loop wire dimensions for en masse retraction
2016	Journal of Pharmaceutical Sciences and Research	Wires in orthodontics—A short review
2016	Journal of Contemporary Dental Practice	Evaluating the Surface Characteristics of Stainless Steel, TMA, Timolium, and Titanium-niobium Wires: An In vivo Scanning Electron Microscope Study
2016	Journal of Materials Science: Materials in Medicine	Comparison of the superelasticity of different nickel–titanium orthodontic archwires and the loss of their properties by heat treatment
2016	Brazilian Journal of Oral Sciences	Influence of aesthetic coating on the load-deflection ratio of nickel titanium archwires
2016	Acta odontologica latinoamericana: AOL	Comparison of frictional resistance among conventional active and passive self-ligating brackets with different combinations of arch wires: A finite element study
2016	Journal of Applied Oral Science	Evaluation of the force generated by gradual deflection of orthodontic wires in conventional metallic, esthetic, and self-ligating brackets
2016	Smart Materials and Structures	Modeling of hydrogen effect on the superelastic behavior of Ni-Ti shape memory alloy wires
2016	International Orthodontics	Improvement of mechanical and biological properties of TiNi alloys by addition of Cu and Co to orthodontic archwires
2015	Dental Press Journal of Orthodontics	Deflection test evaluation of different lots of the same nickel–titanium wire commercial brand
2015	Journal of Dental Research, Dental Clinics, Dental Prospects	Galvanic corrosion of and Ion release from various orthodontic brackets and wires in a fluoride-containing mouthwash
2015	Journal of Clinical and Diagnostic Research	Clinical implications of preformed archwire selection on the treatment of angle Class I/II division 1 malocclusions in Thais
2015	Progress in Orthodontics	An evaluation of two types of nickel–titanium wires in terms of micromorphology and nickel ions' release following oral environment exposure
2015	International Orthodontics	Tensile test and interface retention forces between wires and composites in lingual fixed retainers
2015	Journal of International Oral Health	A comparative study of bio degradation of various orthodontic arch wires: an in vitro study
2015	Contemporary Clinical Dentistry	Estimation of changes in nickel and chromium content in nickel–titanium and stainless steel orthodontic wires used during orthodontic treatment: An analytical and scanning electron microscopic study
2015	Angle Orthodontist	Contemporary esthetic nickel–titanium wires: Do they deliver the same forces?
2015	American Journal of Orthodontics and Dentofacial Orthopedics	Effect of archwire cross-section changes on force levels during complex tooth alignment with conventional and self-ligating brackets
2015	Materials Today: Proceedings	Comparative study of NiTi orthodontic wires
2015	Journal of Dental Sciences	Orthodontic wires and Its corrosion—The specific case of stainless steel and beta-titanium
2015	Srpski arhiv za celokupno lekarstvo	The correlation between pain perception among patients with six different orthodontic archwires and the degree of dental crowding
2015	Journal of Thermal Analysis and Calorimetry	DSC and three-point bending test for the study of the thermo-mechanical history of NiTi and NiTi-based orthodontic archwires
2015	The Scientific World Journal	Clinical efficiency of two sequences of orthodontic wires to correct crowding of the lower anterior teeth
2014	Journal of Clinical and Diagnostic Research	Evaluation of friction in orthodontics using various brackets and archwire combinations—an in vitro study
2014	Angle Orthodontist	Influence of bracket-slot design on the forces released by superelastic nickel–titanium alignment wires in different deflection configurations

Supplementary Table 1: Continued

Year	Journal	Paper title
2014	Dental Research Journal	Evaluation of load-deflection properties of fiber-reinforced composites and its comparison with stainless steel wires
2014	Journal of International Society of Preventive and Community Dentistry	Evaluation of nickel ion release from various orthodontic arch wires: An in vitro study
2014	Journal of Orofacial Orthopedics	Different bracket-archwire combinations for simulated correction of two-dimensional tooth malalignment: Leveling outcomes and initial force systems
2014	Dental Press Journal of Orthodontics	Determining shapes and dimensions of dental arches for the use of straight-wire arches in lingual technique
2014	Journal of Applied Oral Science	Frictional resistance of self-ligating versus conventional brackets in different bracket arch wire-angle combinations
2014	Journal of Orthodontics	Effect of wire size on maxillary arch force/couple systems for a simulated high canine malocclusion
2014	Dental Materials Journal	Evaluation of torque moment in a novel elastic bendable orthodontic wire
2014	Orthodontics and Craniofacial Research	A systematic review and meta-analysis of experimental clinical evidence on initial aligning archwires and archwire sequences
2014	Dental Press Journal of Orthodontics	Comparison of frictional resistance between self-ligating and conventional brackets tied with elastomeric and metal ligature in orthodontic archwires
2014	Dental Press Journal of Orthodontics	Mechanical properties of NiTi and CuNiTi wires used in orthodontic treatment. Part 2: Microscopic surface appraisal and metallurgical characteristics
2014	Journal of Applied Oral Science	Transition temperature range of thermally activated nickel–titanium archwires
2014	Journal of Biomechanics	Finite element modeling of superelastic nickel–titanium orthodontic wires
2014	Trends in Biomaterials and Artificial Organs	An overview of orthodontic wires
2013	Dental Press Journal of Orthodontics	Clinical evaluation of dental alignment and leveling with three different types of orthodontic wires
2013	Cochrane Database of Systematic Reviews	Initial archwires for tooth alignment during orthodontic treatment with fixed appliances
2013	Journal of Orthodontics	An in vivo study on the incidence and location of fracture in round orthodontic archwires
2013	Journal of International Oral Health	Comparison of superelasticity of nickel titanium orthodontic arch wires using mechanical tensile testing and correlating with electrical resistivity
2013	Dental Press Journal of Orthodontics	Determination of the force systems produced by different configurations of tear drop orthodontic loops
2013	American Journal of Orthodontics and Dentofacial Orthopedics	Cross-section dimensions and mechanical properties of esthetic orthodontic coated archwires
2013	Indian Journal of Dental Research	A comparison of tensile weld strength and microstructural changes in four arch wires, before and after immersion in 1.23% acidulated phosphate fluoride solution: An in-vitro study
2013	Dental Press Journal of Orthodontics	Assessment of the dimensions and surface characteristics of orthodontic wires and bracket slots
2013	Dental Press Journal of Orthodontics	Mechanical evaluation of quad-helix appliance made of low-nickel stainless steel wire
2013	Chinese Medical Journal	Mechanical properties of NiTi and CuNiTi shape memory wires used in orthodontic treatment. Part 1: Stress–strain tests
2013	Advanced Materials Research	Comparison of loading and unloading behavior of commercial and locally made copper–nickel–titanium (NiTiCu) orthodontic archwire
2013	Chinese Medical Journal	Mechanical properties of nickel–titanium archwire used in the final treatment phase of Tip-Edge plus technique: An in vitro study
2013	Materials letters	NiTi superelastic orthodontic wires with variable stress obtained by ageing treatments
2013	European Journal of Orthodontics	Load-deflection characteristics of superelastic and thermal nickel–titanium wires
2013	Journal of the Mechanical Behavior of Biomedical Materials	Study of thermomechanical treatment on mechanical-induced phase transformation of NiTi and TiNiCu wires
2013	Angle Orthodontist	The effect of temperature on the mechanical behavior of nickel–titanium orthodontic initial archwires

Supplementary Table 1: Continued

Year	Journal	Paper title
2013	Colloids and Surfaces B: Biointerfaces	Influence of TiN coating on the biocompatibility of medical NiTi alloy
2012	Indian Journal of Dental Research	Influence of fluoride-containing acidic artificial saliva on the mechanical properties of Nickel–Titanium orthodontics wires
2012	Clinical Oral Investigations	Biofilm formation on stainless steel and gold wires for bonded retainers in vitro and in vivo and their susceptibility to oral antimicrobials
2012	Korean Journal of Orthodontics	Variations in surface roughness of seven orthodontic arch wires: an SEM-profilometry study
2012	European Journal of Orthodontics	Aesthetic nickel titanium wires—how much do they deliver?
2012	Angle Orthodontist	Deflection load characteristics of laser-welded orthodontic wires Deflection load characteristics of laser-welded orthodontic wires
2012	Dental and Medical Problems	Contemporary NiTi archwires—mechanical properties
2012	Angle Orthodontist	Load deflection characteristics and force level of nickel titanium initial archwires
2012	Journal of Biomaterials Applications	Calorimetric and thermomechanical properties of titanium-based orthodontic wires: DSC-DMA relationship to predict the elastic modulus
2012	Quintessence International	Pain perception following first orthodontic archwire placement-Thermoelastic vs superelastic alloys: A randomized controlled trial
2012	Dental Press Journal of Orthodontics	Nickel–titanium alloys: a systematic review
2012	Journal of the Mechanical Behavior of Biomedical Materials	Variation of the superelastic properties and nickel release from original and reused NiTi orthodontic archwires
2012	Dental Press Journal of Orthodontics	In vitro force delivery of nickel–titanium superelastic archwires in vertical displacement
2012	Journal of Orthodontics	Comparison of deactivation forces between thermally activated nickel–titanium archwires
2012	Bulletin of Materials Science	Phase transitions in coated nickel titanium arch wires: A differential scanning calorimetric and X-ray diffraction analysis
2011	Journal Clinical of Orthodontics	An in-office wire-bending robot for lingual orthodontics
2011	Journal of the Mechanical Behavior of Biomedical Materials	Combined effects of different heat treatments and Cu element on transformation behavior of NiTi orthodontic wires
2011	Brazilian Oral Research	Mechanical evaluation of space closure loops in orthodontics
2011	Chinese Journal of Tissue Engineering Research	Corrosion and anticorrosion of nickel–titanium arch wires in orthodontics
2011	Angle Orthodontist	Mechanical properties of beta–titanium wires
2011	Journal of Orthodontics	Alignment efficiency and discomfort of three orthodontic archwire sequences: A randomized clinical trial
2011	International orthodontics	Wire load-deflection characteristics relative to different types of brackets.
2011	Journal of Applied Oral Science	Friction between different wire bracket combinations in artificial saliva - An in vitro evaluation
2011	Journal of Mechanics in Medicine and Biology	Friction of stainless steel, nickel–titanium alloy, and beta–titanium alloy archwires in two commonly used orthodontic brackets
2011	Journal of Materials Science: Materials in Medicine	Reduction of Ni release and improvement of the friction behaviour of NiTi orthodontic archwires by oxidation treatments
2011	American Journal of Orthodontics and Dentofacial Orthopedics	Influence of bending mode on the mechanical properties of nickel–titanium archwires and correlation to differential scanning calorimetry measurements
2011	Dental Materials Journal	Transformation behavior of nickel–titanium orthodontic wires under tensile load
2010	American Journal of Orthodontics and Dentofacial Orthopedics	Martensitic transformation of austenitic stainless steel orthodontic wires during intraoral exposure
2010	International Orthodontics	Towards slide enhancement with the titanium–molybdenum wire?
2010	European Journal of Orthodontics	An evaluation of clinicians' choices when selecting archwires.
2010	Seminars in Orthodontics	Nickel–titanium (NiTi) arch wires: The clinical significance of super elasticity
2010	Angle Orthodontist	Torsional superelasticity of NiTi archwires: Myth or reality?
2010	Brazilian Journal of Oral Sciences	Analysis of mechanical properties and forces produced by transpalatal bars made from low-nickel alloy
2010	Brazilian Oral Research	Evaluation of frictional forces between ceramic brackets and archwires of different alloys compared with metal brackets
2010	WSEAS Transactions on Biology and Biomedicine	Mechanical behavior of orthodontic TMA wires

Supplementary Table 2: Journals data (in alphabetic order) containing title, field, Q position, SJR, H-index, JIP, Cite Score, and the number of articles on orthodontic wires from 2010 to 2022. (Orthodontic journals are highlighted in boldface)

Journal title	Field	Position (Q)	SJR	H-index	JIF (2X)	JIF (5X)	Cite Score	No. of Articles
Acta Odontologica Latinoamericana: AOL	Medicine	*	0	19	0	0.47	0	1
Acta Medica Bulgarica	Medicine	Q4	0.12	6	0.20	0.22	0.3	1
Advanced Materials Research	Materials	*	0	43	0	0	0	1
Advanced Structured Materials	Materials	*	0	20	0,61	0.61	1.0	1
American Journal of Orthodontics and Dentofacial Orthopedics	**Orthodontics**	**Q1**	**1.12**	**129**	**2.65**	**1.46**	**3.6**	**9**
Angle Orthodontist	**Orthodontics**	**Q1**	**1.19**	**91**	**2.07**	**1.93**	**3.4**	**17**
Archives of Materials Science and Engineering	Engineering	Q3	0.25	22	0.95	0.93	1.5	1
BioMed Research International	Medicine	Q2	0.65	1.47	3.41	3.13	4.1	2
BMC Oral Health	General dentistry	Q1	0.79	56	2.75	2.92	3.2	3
Brazilian Journal of Oral Sciences	General dentistry	Q4	0.15	12	0.18	0.19	0.2	3
Brazilian Oral Research	General dentistry	Q1	0.74	50	0	0	0	3
Bulletin of Materials Science	Materials	Q3	0.33	76	1.78	1.64	2.0	1
Chinese Journal of Tissue Engineering Research	Medicine	Q4	0.11	11	0.07	0.07	0.1	2
Chinese Medical Journal	Medicine	Q2	0.67	68	2.62	1.25	3.2	2
Clinica Terapeutica	Medicine	Q3	0.44	27	2.27	1.17	2.9	1
Clinical Oral Investigations	General dentistry	Q1	0.92	88	3.57	3.18	5.0	5
Coatings	Materials	Q2	0.48	48	2.86	2.89	3.0	1
Cochrane Database of Systematic Reviews	Medicine	Q1	1.42	292	9.26	3.39	7.1	3
Colloids and Surfaces B: Biointerfaces	Medicine	Q1	0.88	169	5.26	5.12	8.2	1
Contemporary Clinical Dentistry	General dentistry	Q3	0.27	29	1.49	1.73	3.3	2
Current Osteoporosis Reports	Medicine	Q1	1.14	62	5.09	5.15	7.5	1
Dental and Medical Problems	Medicine	Q3	0.35	11	1.03	0.89	1.2	3
Dental Materials	Materials	Q1	1.34	159	5.30	5.58	8.4	1
Dental Materials Journal	Materials	Q2	0.59	59	2.10	2.17	2.9	5
Dental Press Journal of Orthodontics	**Orthodontics**	**Q2**	**0.56**	**26**	**1.11**	**1.43**	**2.1**	**23**
Dental Research Journal	General dentistry	Q3	0.32	21	1.28	1.28	1.8	1
Drug Invention Today	Pharmacology	*	0	20	0.32	0.32	0	2
European Journal of Orthodontics	**Orthodontics**	**Q1**	**1.37**	**88**	**3.07**	**2.67**	**4.3**	**4**
Friction	Engineering	Q1	1.28	35	6.16	6.19	7.7	**1**
Head and Face Medicine	Head and Face Medicine	Q2	0.41	41	1.94	2.11	2.6	1
Heliyon	Materials	Q1	0.55	46	2.85	2.84	2.1	1
Indian Journal of Dental Research	General dentistry	Q3	0.30	48	2.34	2.19	2.2	2
Indian Journal of Forensic Medicine and Toxicology	Medicine	*	0	12	0.24	0.24	0.1	1
International Journal of Dentistry	General dentistry	Q2	0.50	39	2.44	2.40	2.8	1
International Orthodontics	**Orthodontics**	**Q3**	**0.30**	**14**	**0.72**	**0.71**	**0.8**	**14**
Journal Clinical of Orthodontics	**Orthodontics**	**Q3**	**0.26**	**43**	**0.29**	**0.28**	**0.5**	**3**
Journal of Applied Biomaterials and Functional Materials	Materials	Q3	0.47	35	2.46	2.51	4.0	1
Journal of Applied Oral Science	General dentistry	Q1	0.69	49	2.69	2.44	3.5	4
Journal of Biomaterials and Tissue Engineering	Medicine	*	0	24	0.28	0	0	1
Journal of Biomaterials Applications	Biomaterials	Q3	0.48	58	2.64	2.58	4.1	1
Journal of Biomechanics	Biomechanics	Q1	0.75	208	2.71	2.77	4.3	2

Supplementary Table 2: Continued

Journal title	Field	Position (Q)	SJR	H-index	JIF (2X)	JIF (5X)	Cite Score	No. of Articles
Journal of Clinical and Diagnostic Research	Medicine	*	0	56	0	0	0	5
Journal of Clinical and Experimental Dentistry	General dentistry	Q2	0.48	28	1.72	1.72	2.5	2
Journal of Contemporary Dental Practice	General dentistry	Q3	0.29	46	0.90	0.93	1.3	5
Journal of Dental Research, Dental Clinics, Dental Prospects	General dentistry	Q4	0.10	4	0	0	0	3
Journal of Dental Sciences	General dentistry	Q2	0.51	24	2.08	1.45	2.2	2
Journal of Engineering Research	Engineering	Q3	0.17	9	0.62	0.65	0.9	1
Journal of Intelligent Material Systems and Structures	Materials	Q2	0.62	118	2.56	2.78	5.2	1
Journal of International Oral Health	General dentistry	Q3	0.17	9	0.67	0.94	1.1	2
Journal of International Society of Preventive and Community Dentistry	General dentistry	Q3	0.3	23	1.38	1.65	2.3	1
Journal of Materials Science: Materials in Medicine	Medicine	Q2	0,63	133	3.89	3.42	5.3	3
Journal of Mechanics in Medicine and Biology	Medicine	Q4	0.21	33	0.89	1.01	1.7	1
Journal of Medical and Biological Engineering	Engineering	Q3	0.5	39	1.55	1.76	2.6	1
Journal of Oral Biology and Craniofacial Research	General dentistry	Q2	0.45	23	2.45	2.34	21	2
Journal of Oral Science	General dentistry	Q3	0.39	54	1.55	1.82	2.4	1
Journal of Orofacial Orthopedics	**Orthodontics**	**Q2**	**0.76**	**45**	**1.93**	**1.50**	**2.4**	**9**
Journal of Orthodontic Science	**Orthodontics**	**Q2**	**0.43**	**13**	**0**	**0**	**0**	**5**
Journal of Orthodontics	**Orthodontics**	**Q2**	**0.48**	**50**	**0.77**	**0.82**	**1.3**	**7**
Journal of Periodontal and Implant Science	General dentistry	Q2	0.59	29	2.61	2.03	3.3	1
Journal of Pharmaceutical Sciences and Research	Pharmacology	*	0	30	0.64	0.66	0	2
Journal of the College of Physicians and Surgeons Pakistan	Medicine	Q4	0.22	35	0.71	0.48	0.6	1
Journal of the Mechanical Behavior of Biomedical Materials	Materials	Q2	0.75	99	3.90	4.08	6.4	8
Journal of the World Federation of Orthodontists	**Orthodontics**	**Q3**	**0.34**	**10**	**0.73**	**0.68**	**0.8**	**1**
Journal of Thermal Analysis and Calorimetry	Physics	Q2	0.64	101	4.62	3.73	5.1	1
Key Engineering Materials	Materials	Q4	0.20	55	0.45	0.43	0.8	1
Korean Journal of Orthodontics	**Orthodontics**	**Q2**	**0.70**	**24**	**1.37**	**1.42**	**2.5**	**3**
Materials	Materials	Q2	0.60	128	3.60	3.34	3.5	8
Materials Letters	Materials	Q2	0.66	155	3.42	3.32	5.8	1
Materials Research Express	Materials	Q2	0.40	43	1.60	1.61	2.5	3
Materials Science & Engineering Technology	Materials	Q3	0.29	38	0.85	0.87	1.3	1
Materials Today Communications	Engineering	Q2	0.62	30	3.38	3.27	2.6	1
Materials Today: Proceedings	Materials	*	0.36	56	0	0	0	1
Metals	Materials	Q1	0.57	36	2.41	2.35	2.7	1
Metals and Materials International	Materials	Q1	0.79	47	3.64	2.52	3.9	1
Microscopy Research and Technique	Medicine	Q2	0.55	122	2.76	2.54	3.8	1

Supplementary Table 2: Continued

Journal title	Field	Position (Q)	SJR	H-index	JIF (2X)	JIF (5X)	Cite Score	No. of Articles
Nigerian Journal of Clinical Practice	Medicine	Q3	0.28	29	0.96	0.89	1.2	1
Odontology/ The Society of the Nippon Dental University	General dentistry	Q2	0.62	36	2.63	2.34	3.8	1
Open Dentistry	General dentistry	Q3	0.29	28	1.31	1.44	2.3	1
Orthodontic Waves	**Orthodontics**	**Q4**	**0.15**	**13**	**0.23**	**0.24**	**0.4**	**3**
Orthodontics and Craniofacial Research	**Orthodontics**	**Q1**	**0.82**	**58**	**1.82**	**1.94**	**2.8**	**3**
Pertanika Journal of Science and Technology	Engineering	Q3	**0.21**	**19**	**0.79**	**0.70**	**1.1**	
Pesquisa Brasileira em Odontopediatria e Clinica Integrada	General dentistry	Q3	0.20	12	1.55	1.41	1.3	1
Procedia Computer Science	Computer Science	*	0.57	92	0	0	0	1
Progress in Orthodontics	**Orthodontics**	**Q1**	**1.14**	**35**	**2.75**	**2.73**	**3.7**	**7**
Quintessence International	Medicine	Q2	0.58	74	1.67	1.54	2.6	1
Research Journal of Pharmacy and Technology	Pharmacology	Q3	0.23	47	1.20	1.19	1.3	1
Russian Journal of Biomechanics	Biotechnology	Q4	0.25	6	0.44	0.42	0.8	1
Saudi Dental Journal	General dentistry	Q2	0.49	28	2.57	2.91	3.8	1
Seminars in Orthodontics	**Orthodontics**	**Q2**	**0.57**	**45**	**0.97**	**0.88**	**1.2**	**1**
Series on Biomechanics	Biotechnology	Q4	0.2	6	0.46	0.40	0.6	1
Smart Materials and Structures	Engineering	Q1	0.89	161	3.58	3.84	6.1	1
Solid State Phenomena	Materials	Q3	0.23	40	0.66	0.62	1.1	1
Srpski Arhiv Za Celokupno Lekarstvo	Medicine	Q4	0.12	18	0.20	0.17	0.3	1
Surface & Coatings Technology	Materials	Q1	0.92	182	4.15	4.13	6.6	1
Technology and Health Care	Medicine	Q4	0.24	48	1.28	1.34	2.1	1
The Kaohsiung Journal of Medical Sciences	Medicine	Q3	0.44	36	2.74	1.21	1.8	1
The Scientific World Journal	Medicine	Q2	0.4	103	2.10	2.22	2.4	1
Trends in Biomaterials and Artificial Organs	Biomaterials	Q4	0.11	36	0.15	0.11	0.1	5
World Journal of Dentistry	General dentistry	Q4	0.13	11	1.35	1.99	2.1	1
WSEAS Transactions on Biology and Biomedicine	Biomaterials	*	0	11	0	0	0	1