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The Secret to Receive More Citation in the Field of Orthopedics and Traumatology

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Abstract

Objective: The number of citations is used to determine the relative importance of an article, but there is limited information about the possible factors affecting the citation numbers in the field of orthopedics. *Acta Orthopaedica et Traumatologica Turcica* (AOTT) is one of the most prestigious orthopedic journals published in Turkey, which is also the official publication of the Turkish Association of Orthopaedics and Traumatology and the Turkish Society of Orthopaedics and Traumatology. This study aimed to identify and analyze the 50 most cited articles in *Acta Orthopaedica et Traumatologica Turcica* to determine the factors which might have an effect on citation numbers in the field of orthopedics and traumatology.

Methods: The studies published in *Acta Orthopaedica et Traumatologica Turcica* between January 2008 and December 2020 were examined and the 50 most-cited studies were revealed. The articles were searched using the database of Web of Science Core Collection. The citation density which is defined as the citation number per year was calculated. The articles were classified by study design and the field of study. The parameters such as the level of evidence, country of origin, and the field of the first author were investigated to determine whether they have any effect on the citation numbers of an article.

Results: A total of 1311 articles were reviewed. The most-cited 50 papers included 44 clinical studies, 5 basic science studies, and 1 bibliometric study. The highest number of citations in the list was 71, while the highest citation density was 7.8. The articles with level 1 evidence had significantly higher citation numbers and density ($P < .001$). The studies conducted by non-orthopedic researchers received significantly higher citation numbers ($P = .005$) and density ($P = .012$). The field of study or country of origin did not have a significant effect on citation numbers.

Conclusion: High level of evidence provided significantly higher citation density, pointing out the need for well-designed studies. The articles from non-orthopedic researchers had significantly higher citation numbers and density compared to the articles with an orthopedic surgeon as the first author, indicating the importance of multidisciplinary work in the field of orthopedics and traumatology.

Keywords: Bibliometric analysis, citation, literature, orthopedics, Turkish

Introduction

Bibliometric study is the numerical analysis of publications produced by individuals or institutions in a certain period or a certain region, and the evaluation of the relationship between different parameters such as scientific field, type of study design, level of evidence, citation rates, etc. This term was first described in an article published in the *Journal of Documentation* in 1969 by Alan Pritchard who defined it as the application of mathematical and statistical methods to books and other communication tools.[1] Currently, the number of bibliometric studies in the field of orthopedics has increased as the orthopedic literature increases exponentially in volume. "Citation" is a quotation from or reference to a book, article, or author, especially in a scholarly work. The number of citations is used to determine the impact factor of journals on an area and the relative importance of an article.[2] The citation frequency of a particular journal has a direct impact on the impact factor. The impact factor is the value of the citations received in a journal that year, divided by the number of publications published in the previous 2 years.[3] The evidence for the possible factors affecting the citation numbers in the field of orthopedics is limited. *Acta Orthopaedica et Traumatologica Turcica* (AOTT) was founded in 1962, and it is the official publication of the Turkish Association of Orthopaedics and Traumatology and the Turkish Society of Orthopaedics and Traumatology. It has been indexed in the Index Medicus since 2002 and in the Science Citation Index Expanded since 2008.[4] AOTT is an important medical journal published in Turkey in the field of orthopedic surgery and publishes both basic science and clinical studies related to orthopedic surgery and traumatology. The impact factor of AOTT is on a rise every year indicating an important contribution to the orthopedic literature. *Acta Orthopaedica et Traumatologica Turcica* had an impact factor of 1.121 in 2019 according to the Thomson Reuters Journal Citation Reports. This study aimed to identify and analyze the 50 most-cited articles in AOTT to determine the factors which might have an effect on citation numbers of orthopedic articles.

Methods

All articles published by AOTT (www.aott.org.tr) between January 2008 and December 2020 were examined. The editorials, letters to the editor, retraction notes, supplement issues, and invited review articles were excluded. All AOTT articles were listed through the search conducted on Web of Science Core Collection. The articles were re-listed according to their total number of citations.

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The top 50 most-cited articles that qualified for inclusion underwent bibliometric analysis with the full-text review. All review and data extraction were performed independently by two co-authors (E.S. and B.K.). The data extraction for bibliometric and quality analysis included the following parameters: the number of authors, publication year, the time from submission to acceptance, the total number of citations, the number of institutions, the number of article pages, study design, study topic, and the level of evidence. The study topic of the articles was classified as basic science or clinical studies. The clinical studies were further classified according to the field of study. The level of evidence of each clinical article was determined based on the guidelines published by *The Journal of Bone and Joint Surgery* (American Volume).[5] The citation density of the articles was calculated as the citation number per year.[6] The conflicts between the 2 authors reviewing the data were resolved by receiving the opinion of a third author (A.Ş).

Statistical Analysis

Statistical analysis was performed with Statistical Package for Social Sciences 22.0 software (IBM SPSS Corp., Armonk, NY, USA). Quantitative variables were given as mean and standard deviation. The distribution of the values was evaluated by Levene's test. The Student's *t*-test was used to compare means when normally distributed and nonparametric Mann–Whitney U-test otherwise. If the values were normally distributed, the ANOVA test was used to identify any association between the recorded variables and the number of citations. If not normally distributed, nonparametric Kruskal–Wallis test was used. A post hoc test was applied to detect significant differences between multiple means. Pearson's correlation test was performed to determine the relationship between the variables. A *P* value of <.05 was considered statistically significant. There was no missing data, and the required information for all articles was available.

Results

The search yielded a total of 1311 articles published between 2008 and 2020. The top 50 most-cited articles were identified and included for evaluation (Table 1). Forty-four articles (88%) were clinical studies and 5 (10%) were basic science studies. One study was a bibliometric analysis without any clinical or experimental design. The most common publication year among the most-cited articles was 2010 with 15 articles. In 2014 and 2015, only one article was included in the list for each year. No articles published in 2018 and 2019 were among the most-cited articles (Figure 1). The average time passed since publication was 8.8 years ± 2.1 (range, 3-12 years).

The highest number of citations on the list was 71 and the last 6 studies on the list received 18 citations each. The average citation number was 25.9 ± 9.7 (range, 18-71). The average citation number per author was 7.1 ± 7.5 (range, 0.95-46). The highest citation density was 8.3, while the average citation density was 3.2 ± 1.6 (range, 1.6-7.8) (Table 2). The average number of article pages was 6.64 ± 1.3 (range, 5-11). The average time from submission to acceptance was 208.1 days ± 94.9 (range, 51-403 days) (Table 2).

The first authors of 43 (86%) studies were from Turkey, while in 7 (14%) studies, the first author was working in a different country. These 7 studies were sent from Germany (3), Turkish Republic of Northern Cyprus (1), Iran (1), China (1), and Greece (1). There was no statistical difference regarding citation numbers between the studies sent from Turkey and different countries (*P* = .94). Forty-eight studies were conducted as single-centric and 2 studies as multi-centric. Two studies were published by a single author and 4 studies were published by 2 authors, while the highest number of authors was detected as 22 in a multicentric study. The average author number was 5.3 ± 3.1 (range, 1-22).

When the articles were classified by the field of study, "Trauma" was the leading subject with 12 articles, followed by "Knee" and "Shoulder" with 6 articles each (Table 3). Basic science studies included 3 animal studies, 1 biomechanical study, and 1 cadaveric study. No significant difference was detected regarding the average citation numbers according to the field of study.

The distribution of the level evidence was as follows: level 1: 6, level 2: 13, level 3: 8, level 4: 14. The statistical evaluation revealed that level 1 studies had significantly higher average citation numbers and density compared to others (Table 4). When the clinical studies were classified according to study design, there were 13 prospective cohort studies, 10 case series, 6 randomized controlled trials, 7 cross-sectional studies, 7 retrospective cohort studies, and 1 case-control study (Table 5). Among 7 cross-sectional studies, 3 were validation studies, 3 were surveillance studies, and 1 was a descriptive study. Randomized controlled studies showed significantly higher average citation numbers compared to other study designs (*P* < .001). But when average citation density was considered, randomized controlled studies performed better compared to only case series (*P* = .013) (Table 5).

Among the articles analyzing the results of therapeutic interventions, 18 articles reported surgical interventions, while 7 articles reported the results of rehabilitation protocols. Four out of 6 articles reporting rehabilitation procedures were about shoulder disorders. The articles about rehabilitation protocols performed significantly better compared to the articles with surgical interventions when the average citation numbers (*P* = .008) and citation density (*P* = .006) of the articles were compared (Table 5).

The articles were classified according to the specialty of the first author as orthopedic surgeon or non-orthopedic researcher. Thirteen articles belonged to non-orthopedic researcher first authors. Among these, 11 articles were from Physical Therapy and Rehabilitation, 1 from Anatomy, and 1 from Dermatology. When the contributions of orthopedic surgeons and non-orthopedic researchers' were compared, average citation numbers (*P* = .005) and density (*P* = .012) were significantly higher in articles with non-orthopedic researcher first authors (Table 6).

The authors were from 74 different institutions, of which 58 were from Turkey and 16 were from different countries. The mean number of the institution was 2.3 ± 2.9 (range, 1-20). The most productive institutions were Hacettepe University with 8 articles and Istanbul University with 7 articles. The authors with the highest contribution were Atay AO and Ozturk I with 3 articles for each. Two of the studies were funded by public foundations, while 2 studies were funded by commercial companies. The studies with public funding had 50 and 31 citation numbers and 7.1 and 2.5 citation density, respectively. The studies with commercial funding had 21 and 20 citation numbers and 1.7 and 5 citation density, respectively.

Pearson's correlation analysis revealed a significant correlation between citation number and citation density (*P* < .001) and number of authors and number of institutions (*P* < .001). But no correlation was found between the age of the article, number of authors, institutions or pages with citation number or density.

Discussion

AOTT is one of the leading scientific journals originating from Turkey, not only in the field of orthopedics but also among all medical literature. AOTT has almost 60-year-long history and its impact factor is on a regular rise. The results of this study indicate that the contributions to AOTT from other science fields received

Table 1. Top 50 Most-Cited Articles in *Acta Orthopaedica et Traumatologica Turcica*

Rank		Number of Citations (Citation Density)
1	The effects of additional kinesio taping over exercise in the treatment of patellofemoral pain syndrome. Eda Akbas, Ahmet Ozgur Atay, Inci Yuksel	71 (7.8)
2	Does Kinesio taping in addition to exercise therapy improve the outcomes in subacromial impingement syndrome? A randomized, double-blind, controlled clinical trial. Hacer Hicran Simsek, Selvin Balki, Sinem Suner Keklik, Hayati Ozturk, Hasan Elden	50 (7.1)
3	Comparison between operative and nonoperative treatment methods in the management of comminuted fractures of the clavicle. Fardin Mirzatolooei	46 (5.1)
4	Validity of the Turkish version of the Kujala patellofemoral score in patellofemoral pain syndrome. Tugba Kuru, Elif Elcin Dereli, Ayse Yaliman	42 (4.2)
5	Comparison of slow and accelerated rehabilitation protocol after arthroscopic rotator cuff repair: pain and functional activity. Irem Duzgun, Gul Baltacı, O. Ahmet Atay	40 (4.4)
6	The effectiveness of manual therapy in supraspinatus tendinopathy. Gamze Senbursa, Gul Baltaci, O. Ahmet Atay	31 (3.4)
7	Evaluation of the medial longitudinal arch: a comparison between the dynamic plantar pressure measurement system and radiographic analysis. Nadir Yalcin, Erdinc Esen, Ulunay Kanatli, Haluk Yetkin	31 (3.1)
8	Effect of hyperbaric oxygen and ozone preconditioning on oxidative/nitrosative stress induced by tourniquet ischemia/reperfusion in rat skeletal muscle. Kenan Koca, Yuksel Yurttas, Cemil Yildiz, Tuncer Cayci, Bulent Uysal, Ahmet Korkmaz	31 (3.1)
9	The prevalence of low back pain and risk factors among adult population in Afyon region, Turkey. Levent Altinel, Kamil Cagri Kose, Volkan Ergan, Cengiz Isik, Yusuf Aksoy, Aykut Ozdemir, Dilek Toprak, Nurhan Dogan	31 (2.5)
10	Long-term results of major upper extremity replantations. Tahir Sadik Sugun, Kemal Ozaksar, Sait Ada, Firdevs Kul, Fuat Ozerkan, Ibrahim Kaplan, Yalcin Ademoglu, Murat Kayalar, Emin Bal, Tulgar Toros, Aslan Bora	30 (2.7)
11	Comparison of platelet-rich plasma and steroid injection in the treatment of plantar fasciitis. Ferhat Say, Deniz Gurler, Erkan Inkaya, Murat Bulbul	30 (5)
12	Complications encountered in proximal humerus fractures treated with locking plate fixation. Neslihan Aksu, Abdullah Gogus, Ayhan Nedim Kara, Zekeriya Ugur Isıklar	30 (3)
13	What do patients recall from informed consent given before orthopedic surgery? Namik Sahin, Alpaslan Ozturk, Yuksel Ozkan, Aysegul Demirhan Erdemir	29 (2.9)
14	Immobilization of the shoulder in external rotation for prevention of recurrence in acute anterior dislocation. Huseyin Taskoparan, Servet Tunay, Volkan Kilincoglu, Serkan Bilgic, Yuksel Yurttas, Mahmut Komurcu	29 (2.9)
15	Comparison of the outcomes of two different exercise programs on frozen shoulder. Derya Celik	27 (2.7)
16	Functional outcome and complications following PHILOS plate fixation in proximal humeral fractures. Emanuel V. Geiger, Marcus Maier, Arne Kelm, Sebastian Wutzler, Caroline Seebach, Ingo Marzi	27 (2.7)
17	Comparison of efficiency of Kinesio® taping and electrical stimulation in patients with patellofemoral pain syndrome. Tugba Kuru, Ayse Yaliman, E. Elcin Dereli	26 (3.2)
18	Intraobserver reliability of modified Ashworth scale and modified Tardieu scale in the assessment of spasticity in children with cerebral palsy. Ayse Numanoglu, Mintaze Kerem Gunel	26 (3.2)
19	Patellar tendon mechanical properties change with gender, body mass index and quadriceps femoris muscle strength. Serkan Tas, Seval Yilmaz, Mehmet Ruhi Onur, Abdullah Ruhi Soylu, Onur Altuntas, Feza Korkusuz	25 (8.3)
20	Dislocation after total hip arthroplasty: risk factors and treatment options. Ulf Gunther Leichtle, Carmen Ina Leichtle, Ferdane Taslaci, Patrik Reize, Markus Wünschel	25 (3.5)
21	Comparison of early results of vascularized and nonvascularized fibular grafting in the treatment of osteonecrosis of the femoral head. Cihangir Tetik, Hakan Basar, Murat Bezer, Bulent Erol, Ismail Agir, Tanıl Esemenli	25 (2.7)
22	Effect of platelet-rich plasma on tendon-to-bone healing after rotator cuff repair in rats: an in vivo experimental study. Onur Hapa, Husamettin Cakici, Aysel Kukner, Hayati Aygun, Nazli Sarkalkan, Gokhan Baysal	24 (3)
23	The relation between sagittal morphology of the lumbosacral spine and the degree of lumbar intervertebral disc degeneration Tarkan Ergun, Hatice Lakadamyali, Mehmet Sukru Sahin	24 (2.4)
24	Anatomic and reverse shoulder prostheses in fracture sequelae of the humeral head. Mustafa Kılıc, Alexander Berth, Georges Blatter, Uwe Fuhrmann, Katja Gebhardt, Olaf Rott, Peter Zenz, Ulrich Irlenbusch	24 (2.4)
25	Comparison of phenol applications of different durations for the cauterization of the germinal matrix: an efficacy and safety study. Kansu Cilli, Gunduz Tezeren, Turan Tas, Okay Bulut, Hayati Ozturk, Zekeriya Oztemur, Tansel Unsaldi	24 (2.1)

(*Contnued*)

Table 1. Top 50 Most-Cited Articles in *Acta Orthopaedica et Traumatologica Turcica* (*Continued*)

Rank		Number of Citations (Citation Density)
26	Effects of intra-articular administration of autologous bone marrow aspirate on healing of full-thickness meniscal tear: an experimental study on sheep. Fuat Duygulu, Metin Demirel, Gultekin Atalan, F. Figen Kaymaz, Yavuz Kocabey, Turan Cihan Dulgeroglu, Hande Candemir	23 (2.8)
27	Functional results of lower extremity lengthening by motorized intramedullary nails. Hakan Dinçyürek, Mehmet Kocaoglu, I. Levent Eralp, F. Erkal Bilen, Goksel Dikmen, Ilker Eren	23 (2.8)
28	Fate of abstracts presented at a National Turkish Orthopedics and Traumatology Congress: publication rates and consistency of abstracts compared with their subsequent full-text publications. Merter Yalcinkaya, A. Erdem Bagatur	22 (3.1)
29	Radiographic and functional results of osteosynthesis using the proximal femoral nail antirotation PFNA in the treatment of unstable intertrochanteric femoral fractures. Suner Sahin, Erden Erturer, Irfan Ozturk, Serdar Toker, Faik Seckin, Senol Akman	22 (2.2)
30	Biomechanical effect of medial cortical support and medial screw support on locking plate fixation in proximal humeral fractures with a medial gap: a finite element analysis. Pan Yang, Ying Zhang, Jian Liu, Jin Xiao, Li Min Ma, Chang Rong Zhu	21 (4.2)
31	The effect of medial side repair in terrible triad injury of the elbow. Ufuk Ozkaya, Ayhan Kilic, Umit Ozdogan, Kubilay Beng, Yavuz Kabukcuoglu	21 (2.6)
32	The relationship of muscle strength and pain in subacromial impingement syndrome. Derya Celik, Bilsen Sirmen, Mehmet Demirhan	21 (2.3)
33	School screening for scoliosis in Sivas Turkey. Semih Tatlican, Burcu Yamangokturk, Cemile Eren, Fatma Eskioglu, Sinan Adiyaman	21 (1.9)
34	Venous thromboembolism prophylaxis in major orthopaedic surgery: A multicenter prospective observational study. Faik Altintas, Hakan Gurbuz, Bulent Erdemli, Bulent Atilla, Recep Gur Ustaoglu, Ugur Ozic, Oner Savk, Huseyin Bayram, Recep Memik, Isık Akgun, Abdullah Gogus, Fatih Pestilci, Adnan Konal, Mahmut Argun, Irfan Ozturk, Nevzat Dabak, Omer Faruk Bilgen, Erhan Serin, Cetin Onder, Aykın Simsek, Remzi Tozun, Hakan Kinik	21 (1.7)
35	Proprioception of the knee joint in patellofemoral pain syndrome. Devrim Akseki, Gokhan Akkaya, Mehmet Erduran, Halit Pinar	21 (1.7)
36	Clinical and pathological results of denosumab treatment for giant cell tumors of bone: Prospective study of 14 cases. Mehmet Ali Deveci, Semra Paydas, Gulfiliz Gonlusen, Cenk Ozkan, Omer Sunkar Bicer, Mustafa Tekin	20 (6.6)
37	Adult spinal deformity: a very heterogeneous population of patients with different needs. Rıfat Emre Acaroglu, Ozgur Dede, Ferran Pellıse, Umıt Guler, Montse Domıngo-Sabat, Ahmet Alanay, Francisco Sanchez Perez-Grueso	20 (5)
38	Calcium phosphate cement augmentation in the treatment of depressed tibial plateau fractures with open reduction and internal fixation. Yusuf Ozturkmen, Mustafa Caniklioglu, Mahmut Karamehmetoglu, Erhan Sukur	20 (2)
39	Comparison between the results of open and arthroscopic repair of isolated traumatic anterior instability of the shoulder. Mahir Mahirogulları, Huseyin Ozkan, Mustafa Akyuz, Ali Akin Ugras, Ahmet Guney, Mesih Kuskucu	20 (2)
40	Coracoclavicular ligament repair and screw fixation in acromioclavicular dislocations. Cem Zeki Esenyel, Kahraman Ozturk, Murat Bulbul, Semih Ayanoglu, Hasan Huseyin Ceylan	20 (2)
41	Normal hip, knee and ankle range of motion in the Turkish population. Hasan Hallaceli, Vedat Uruc, Halil Hakan Uysal, Raif Ozden, Cigdem Hallaceli, Ferhan Soyuer, Tuba Ince Parpuc, Erhan Yengil, Ugur Cavlak	19 (3.1)
42	Prediction of the quadruple hamstring autograft thickness in ACL reconstruction using anthropometric measures. Mustafa Celiktas, Alper Golpinar, Ozkan Kose, Zeynel Sutoluk, Kamile Celebi, Yaman Sarpel	19 (2.7)
43	Comparison between locked intramedullary nailing and plate osteosynthesis in the management of adult forearm fractures. Tulgar Toros, Kemal Ozaksar, Tahir Sadik Sugun, Murat Kayalar, Emin Bal, Sait Ada	19 (1.7)
44	The effect of group exercise on postmenopausal osteoporosis and osteopenia. Ender Angin, Zafer Erden	19 (1.7)
45	Anatomical evaluation of the superficial veins of the upper extremity as graft donor source in microvascular reconstructions: a cadaveric study. Amac Kiray, Ipek Ergur, Hamid Tayefi, H. Alper Bagriyanik, A. Kadir Bacakoglu	18 (2.5)
46	Predictive value of Tokuhashi and Tomita scores in patients with metastatic spine disease. Sotiris Papastefanou, Kalliopi Alpantaki, Gabriel Akra, Pavlos Katonis	18 (2.2)
47	Negative pressure wound therapy in patients with diabetic foot. Ali Engin Ulusal, M. Sukru Sahin, Betul Ulusal, Gokhan Cakmak, Cengiz Tuncay	18 (2)
48	Prevalence of bone soft tissue tumors. Guven Yuceturk, Dundar Sabah, Burcin Kececi, Ahmet Duran Kara, Selcuk Yalcinkaya	18 (2)
49	The results of conservatively treated simple elbow dislocations. Hayrettin Kesmezacar, İlker Abdulah Sarikaya	18 (1.8)
50	Long-term radiographic complications following treatment of unstable intertrochanteric femoral fractures with the proximal femoral nail and effects on functional results. Metin Uzun, Erden Ertürer, Irfan Ozturk, Senol Akman, Faik Seckin, I. Bulent Ozcelik	18 (1.6)

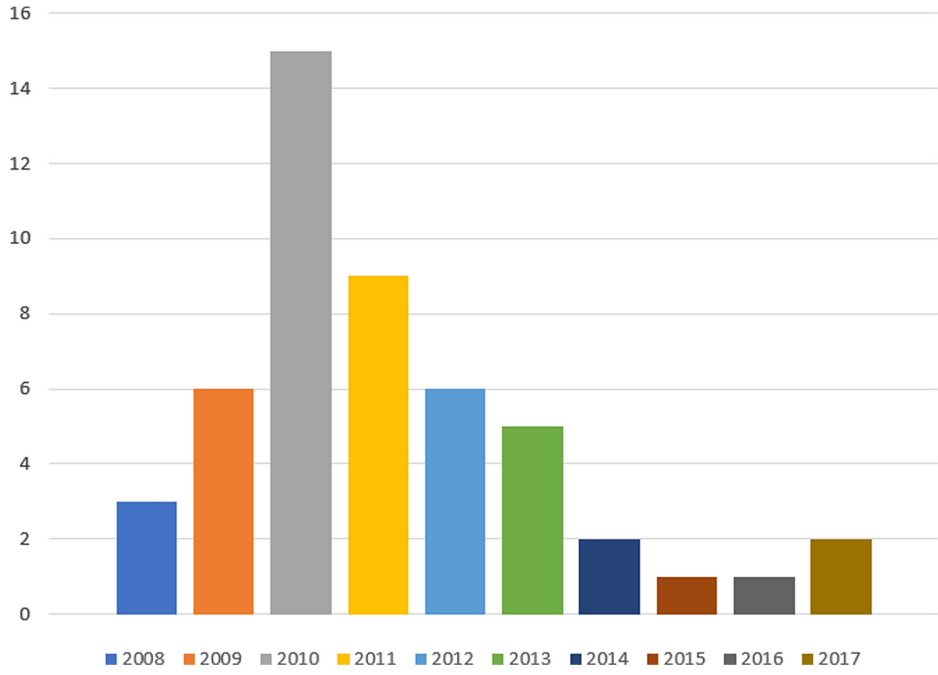

Figure 1. Distribution of the 50 most-cited articles by year.

higher citation numbers compared to the studies conducted by orthopedic surgeons. The studies analyzing rehabilitation protocols were more frequently cited than the studies reporting surgical outcomes. The level of evidence was found as an important factor, and level 1 studies provided a higher citation number and density. This study will undoubtedly give insight to orthopedic surgeons pursuing academic careers who wish to be cited more in the literature.

Bibliometric studies are being conducted in almost all science fields and orthopedics is no exception. There are studies reporting bibliographic characteristics of publications whether from a particular subspecialty[6-8] or a journal.[9-11] These studies tried to determine the factors which might have an impact on the citation rates of an article.

Most of the bibliometric studies conducted in the orthopedic research field focused on the highest impact articles on a particular subspecialty, but there are also studies reporting the citation characteristics of a particular journal. a study analyzing 100 most-cited papers from *Injury-International Journal of Care of the Injured* reported that the level of evidence was not found associated with the citation numbers.[11] But the level of evidence was 4 in 62%, 2 in 24%, and 1 in only 4% of the articles. Our study revealed that AOTT had a slightly higher percentage of high level of evidence studies among its most-cited papers, with 12% level 1 and 26% level 2 studies. Our study found that the papers with level 1 evidence or randomized controlled study design had significantly higher average citation numbers, indicating the importance of high-quality studies. Similar to our results, Bhandari et al[12] also pointed out that meta-analyses, randomized trials, and basic science papers are more likely to be cited due to their high

Table 2. General Specifications of the Top 50 Most-Cited Articles of *Acta Orthopaedica et Traumatologica Turcica*

	Average ± SD (range)
Author number	5.3 ± 3.1 (1-22)
Institution number	2.3 ± 2.9 (1-20)
Page number	6.64 ± 1.3 (5-11)
Time from submission to acceptance	208.1 days ± 94.9 (51-403 days)
Time since publication	8.8 years ± 2.1 (3-12 years)
Citation number	25.9 ± 9.7 (18-71)
Citation per author	7.1 ± 7.5 (0.9-46)
Citation density	3.2 ± 1.6 (1.6-7.8)

Table 3. Classification of Articles According to the Field of Study

Field of Study	*N* (%)	Average Citation	Average Citation Density
Trauma	12 (24%)	24.2 ± 8	2.5 ± 1
Knee	6 (12%)	34 ± 19.9	4.6 ± 2.6
Shoulder and elbow	6 (12%)	32.2 ± 10.9	3.7 ± 1.8
General Orthopedics	5 (10%)	22 ± 4.1	2.5 ± 0.7
Spine	5 (10%)	22.8 ± 5.1	2.8 ± 1.3
Basic science	5 (10%)	23.4 ± 4.8	3.1 ± 0.6
Foot and ankle surgery	4 (8%)	25.8 ± 6	3.1 ± 1.4
Tumor	2 (4%)	19 ± 1.4	4.3 ± 3.3
Hip	2 (4%)	25	3.1 ± 0.6
Hand	1 (2%)	30	2.7
Deformity	1 (2%)	23	2.8
Pediatric orthopedics	1 (2%)	26	3.2
P value		.65	.58

Table 4. Average Citation Numbers According to the Level of Evidence

	n (%)	Average Citation	Average Citation Density
Level 1	6 (12%)	43.2 ± 17.2	4.9 ± 2.3
Level 2	13 (26%)	24.5 ± 3.8	3.5 ± 19
Level 3	8 (16%)	22.4 ± 4.2	2.4 ± 0.7
Level 4	14 (28%)	26.1 ± 10.2	2.5 ± 0.9
P value		<.001**	.009*

*$P < .05$, **$P < .001$. Posthoc test revealed that the average citation number and density values were significantly higher in level 1 studies compared to levels 2, 3, and 4 ($P < .001$).

level of evidence, in their study on the articles published in *Journal of Bone and Joint Surgery, (American Volume)*.

Erivan et al[9] analyzed the most-cited 100 articles in *Orthopaedics & Traumatology: Surgery & Research* (OTSR) The most common fields of study were found as Hip–Pelvis, Knee, Shoulder–Elbow, and Trauma. The authors reported no difference in citation numbers according to the field of study. The results were similar to our study in which we found Trauma, Knee, and Shoulder, respectively, as the most common fields of study. We also were unable to find any association between citation rates and the field of the study.

Table 5. Clinical Articles Classified by Study Design

Study Design	*N* (%)	Average Citation	Average Citation Density
Randomized controlled trials	6 (12%)	43.2 ± 17.2	4.9 ± 2.3
Prospective cohort	13 (26%)	24.5 ± 3.8	3.5 ± 1.9
Retrospective cohort	7 (14%)	22.5 ± 4.5	2.5 ± 0.6
Case–control	1 (2%)	21	1.7
Case series	10 (20%)	22.6 ± 4.7	2.3 ± 0.5
Cross-sectional	7 (14%)	25.3 ± 8.7	3.2 ± 1.1
P value		<.001**	.015*

*$P < .05$, **$P < .001$, Post hoc test revealed that the average citation number was significantly higher in randomized controlled studies compared to all other study designs ($P < .001$). The average citation density was significantly higher in randomized controlled studies compared to only case series ($P = .013$).

Table 6. Average Citation Numbers According to the Type of Intervention Reported in the Study and the Specialty of the First Author

	Surgical Intervention (*n* = 18)	Rehabilitation Protocol (*n* = 7)	*P*
Average citation	23.8 ± 6.5	37.7 ± 17.8	.008*
Average citation density	2.5 ± 0.8	4.3 ± 2.3	.006*
	Orthopedic Surgeon (*n* = 37)	**Non-Orthopedic Researcher (*n* = 13)**	***P***
Average citation	23.7 ± 5.7	32.3 ± 15	.005*
Average citation density	2.8 ± 1.1	4.1 ± 2.2	.012*

*$P < .05$.

The vast majority of most-cited AOTT articles were clinical studies similar to other orthopedic journals .[10,11,13] The mean number of authors per article was slightly higher (5.3) but similar compared to other orthopedic journals like *Injury, International Orthopedics*, and *European Journal of Orthopedic Surgery and Traumatology* (EJOST), which were 3.9, 4, and 5, respectively.[10,11,13] In the French orthopedic journal OTSR, the rate of French authors as the leading author was 89% among its most-cited papers. This rate was also similar in AOTT, the rate of the first author working in a clinic in Turkey was 86%. The citation numbers did not change according to the first authors' country of origin.

One of the most striking results of this study was the contribution of non-orthopedic researchers. Although the articles from non-orthopedic researchers were fewer in number, they had significantly higher citation numbers ($P = .005$) and density ($P = .012$) compared to the articles by orthopedic surgeons. This finding marks the importance of collaborations with other fields of science, especially with physical therapy and rehabilitation, to make more valuable contributions to the orthopedic literature. A similar conclusion can be made according to the treatment protocols reported by the most-cited AOTT papers. The studies investigating rehabilitation protocols were cited significantly more, both in number ($P = .008$) and density ($P = .006$), compared to the studies reporting the results of surgical interventions. This also shows that the contribution of physical therapy and rehabilitation is an inseparable part of orthopedic research.

The citation density, which is defined as number of citations per year, is a useful and standardized tool to measure the impact of an article throughout the years.[6] The comparison of old-dated and newly published papers according to their citation numbers might not be an appropriate way and the citation density can provide more valuable information regarding their impact on the literature. The most-cited 2 articles in our list also had the highest citation density values and the correlation between the citation number and density had a similar trend throughout the whole list. However, it is worth to mention that 11th, 19th, 30th, 36th, and 37th articles in the list had notably higher citation density values compared to their preceding articles, which puts them into the top 10 articles when the articles were re-ordered according to their citation density values. The correlation analyses did not reveal any significance between citation numbers and number of authors, institutions and article pages, similar to EJOST.[10]

This study has several limitations. First of all, the citation numbers were retrieved through the database of Web of Science Core Collection, but it might vary with the use of other databases like Scopus or Google Scholar.[9] The total citation number might not reflect the actual impact of the study since some of the studies were older and some of them were newly published. To prevent this source of bias, the citation density was also calculated which indicates the number of citations per year. The self-citations by researchers might increase the citation number of an article but we did not exclude or analyze the self-citations of the researchers.

The current evidence shows that the studies with high-level evidence can further increase its impact in the orthopedic literature. The contribution from non-orthopedic study groups receives higher number of citations indicating the necessity of multidisciplinary work in the field of orthopedics and traumatology. The studies reporting the outcomes of rehabilitation protocols also get more citation compared to surgical procedures; thus, the

importance of rehabilitation protocols should not be overlooked by orthopedic surgeons.

Ethics Committee Approval: The study complied with the Helsinki Declaration, which was revised in 2013. Ethics committee approval is not required as there is no human or animal research.

Informed Consent: The study is a bibliometric analysis research, participant informed consent is not required.

Peer-review: Externally peer-reviewed.

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