

Acetabular fractures from Judet and Letournel to the present

Research trends and global outcomes with bibliometric analysis during 1980 to 2022

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Abstract

Fractures of the acetabulum are one of the most challenging injuries treated by orthopedic surgeons. However, a bibliometric analysis has not been performed in the literature on acetabular fractures, which seriously affect the quality of life of patients. The aim of this study was to summarize the bibliometric and intellectual structure, and determine and map the most recent trends on the topic of acetabular fractures by analyzing the social and structural relationships between the different research components of articles published on the acetabular fractures. 1599 articles on acetabular fractures published between 1980 and 2022 were extracted from the Web of Science (WoS) database and analyzed. Bibliometric visualization maps were used to reveal trending topics, citation analyses, and international collaborations. Spearman correlation analysis was performed for correlation investigations. The trend in the expected number of articles to be published over the next few years was displayed using the exponential smoothing estimator. The top 3 contributing countries to the literature were United States of America (USA) (551, 34.4%), China (170, 10.6%), and Germany (160, 10%). The most active author was Berton R. Moed (n = 29) and the most active institution was the University of California System (n = 41). A high-level statistically significant correlation was found between the number of articles on the topic of acetabular fractures published by nations and the gross domestic product (GDP) and GDP per capita values of those countries ($R = 0.719$, $P < .001$; $R = 0.701$, $P < .001$, respectively). The trending topics researched in recent years were 3D printing, 3-dimensional printing, outcomes, Open Reduction and Internal Fixation (ORIF), mortality, Kocher-Langenbeck, Pararectus approach, tranexamic acid, transfusion, epidemiology, fracture mapping, modified Stoppa approach, post-traumatic osteoarthritis, pelvis fracture, pelvic trauma, fracture reduction, and pelvic ring injury. The leading countries in research on the subject of acetabular fractures were seen to be western countries with large economies (especially the USA, European countries, and Canada) and China, India and Turkey.

Abbreviations: CT = computed tomography, GDP = gross domestic product, NC = number of citations, ORIF = open reduction and internal fixation, UK = United Kingdom, USA = United States of America, WoS = Web of Science.

Keywords: acetabular, acetabulum, bibliometric analysis, fractures, research trends

1. Introduction

Acetabulum fractures occur as a result of pressure applied to the acetabulum from the femoral head.^[1,2] This force is generally a result of high-energy trauma such as a head-on car collision when the knees strike the dashboard, or a fall down stairs or from height onto the hips, or in extreme sports.^[3,4] While there has been a significant decrease in acetabular fractures following the mandatory wearing of seatbelts, there has been an increase in fractures of the acetabulum originating from a fall of <10 feet (3m) probably associated with osteopenia/osteoporosis.^[5-7]

In recent years, there has been reported to be an increase in the incidence of acetabular fractures and in the mean age of patients with such fractures.^[6-8]

As acetabular fractures are generally caused by high energy trauma, there are usually also injuries to other organs and the sciatic nerve resulting from the primary trauma or injuries. Damage to the cartilage in acetabular fractures can cause osteoarthritis in the future, which has high morbidity.^[6,9,10] Recent studies have reported the most important change in complications to be a significant reduction in iatrogenic nerve damage, primarily of the sciatic nerve.^[6] Osteoarthritis following

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trauma continues to be the main complication of these injuries. Heterotopic ossification also continues to be a common problem.^[6]

Diagnosis of an acetabular fracture is possible with a normal X-ray, but as there are multiple organ injuries in many patients, computed tomography (CT) scanning is usually required as it is more definitive than a traditional X-ray. Since the introduction of CT imaging, the diagnosis and classification of acetabular fractures has become easier. Two and 3-dimensional imaging methods can be used to more accurately visualize the fracture pattern and CT scanning can help to reduce the surgical error margin.^[11,12] In the classification of acetabular fractures, the Judet-Letournel system is almost universally used by most radiologists and orthopedists. This classification is a preoperative planning system and is the first step in determining the most appropriate surgical approach.^[1,2,13]

Since the first publications of studies related to the Judet-Letournel system in the surgical treatment of acetabular fractures, the need to treat displaced acetabular fractures with anatomic reduction and stable internal fixation has been widely accepted.^[6,14] Over time, significant changes have been made in the treatment of acetabular fractures and fractures in general. While surgical fixation remains primarily based on standard plate and screw fixation, the use of percutaneous fixation additional to open reduction and internal fixation (ORIF) has continued to expand, new technologies have emerged such as computer navigation and 3D printing, primary arthroplasty has become more common for certain fractures, and rehabilitation has become more aggressive.^[5,6,15] The Kocher-Langenbeck and Letournel ilioinguinal approaches continue to be the main surgical approaches used.^[6,16]

Bibliometric analysis is a popular technique that uses various statistical approaches to investigate and analyze large amounts of scientific data.^[17,18] Bibliometric analyses present the trends emerging in research topics, determine high-impact articles, and evaluate the evolutionary process of a specific area and how it can progress.^[19,20] Therefore, comprehensive bibliometric studies can provide important infrastructure for the progression of a field through specific and meaningful routes. In parallel with the necessity of analyzing the increasing number of articles in the literature, bibliometric studies have been carried out on many different topics in the field of medicine.^[17-21]

Fractures of the acetabulum are one of the most challenging injuries treated by orthopedic surgeons. The 3-dimensional

morphology of the fracture is complex, and the selection of the surgical approach and anatomic reduction can constitute difficulties even for experienced surgeons. However, a bibliometric analysis has not been performed in the literature on acetabular fractures, which seriously affect the quality of life of patients. The aim of this study was to summarize the bibliometric and intellectual structure, and determine and map the most recent trends on the topic of acetabular fractures by analyzing the social and structural relationships between the different research components (authors, countries, institutions, topics) of scientific articles published on the topic of acetabular fractures during 1980 and 2022.

2. Methods

2.1. Search strategy

The WoS (Web of Science, Clarivate Analytics products) was used for the publication search. The search process was carried out for the years 1980 to 2022. As a result of the scan of publications on the subject of acetabular fractures, all the articles were accessed that included acetabulum fracture/fractures or acetabular fracture/fractures in the title (date of access: November 5, 2022). To obtain the documents analyzed in this study (different access dates may yield different search results), the researchers used the repeatability codes of ((acetabulum (Title) OR acetabular (Title)) AND fracture* (Title)).

2.2. Statistical analysis

The data were statistically analyzed by using the SPSS version 22.0 (IBM SPSS Inc., Chicago, IL) software. The normal distribution test of the data was evaluated by Kolmogorov-Smirnov test and graphical methods (histograms and QQ-plots). Correlations between global article productivity on the topic of acetabular fractures and the markers of the economic size of countries, such as Gross Domestic Product (GDP) and GDP per capita were examined with Spearman correlation coefficient (data were obtained from the World Bank^[22]). VOSviewer software (Version 1.6.16, Leiden University) was used for bibliometric network visualization and visualization of citation analyses.^[23] To predict the number of articles in the future according to past publication trends, the Exponential Smoothing predictor was used, considering seasonal adjustments in Microsoft Excel

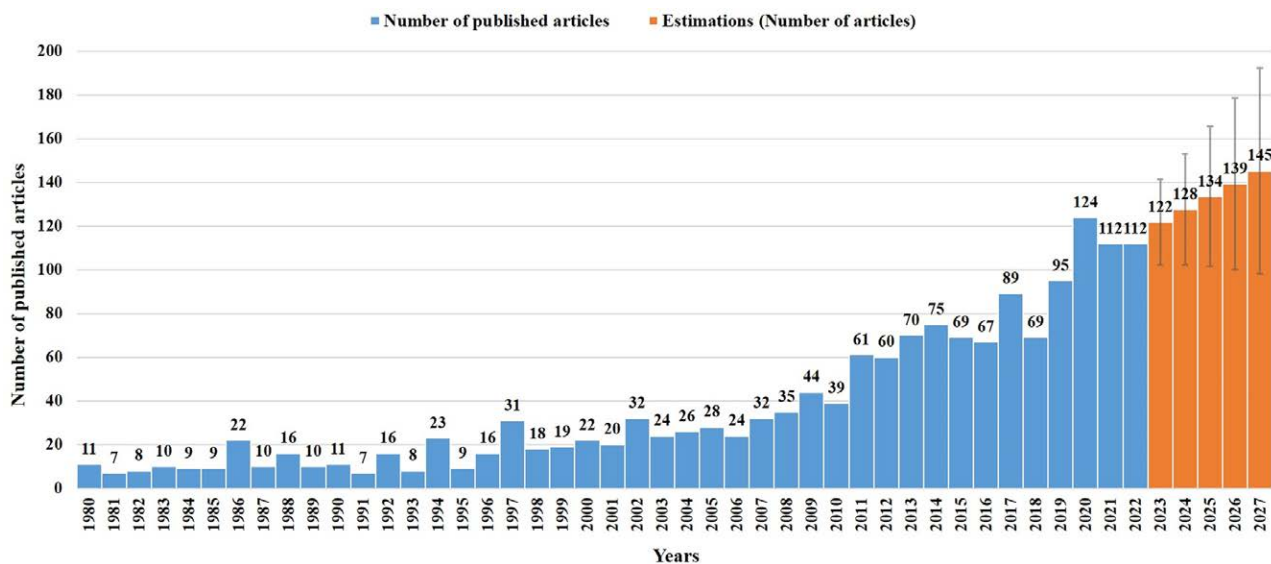


Figure 1. Bar graph showing the distribution of published articles on acetabular fractures by yr and article estimates for the next 5 yr.

software. The world map was created using an open source website <https://app.datawrapper.de>. A correlation was considered statistically significant if the value was $P .05$ or above.

3. Results

A total of 1943 publications on the topic of acetabular fractures, published between 1980 and 2022, were found on the WoS. These publications were 1599 (82.3%) Articles, 95 (4.9%) Review Articles, 77 (4%) Meeting Abstracts, 69 (3.5%) Proceedings Papers, 52 (2.7%) Letters, and the remainder were other types (Editorial Materials, Early Access, Notes, Corrections, Book Chapters, Book, Book Reviews, Discussions). The bibliometric analysis was conducted with the 1599 publications in the Article category. Of these, 1444 (90.3%) were in English and the rest were published in other languages (German: 99, French: 26, Czech: 11, Russian: 8, Spanish: 4, Slovenian: 3, Italian: 2, Greek: 1, Turkish: 1). Almost all of these articles were indexed in the SCI-Expanded (n = 1370, 85.7%) and Emerging Sources Citation Index (ESCI) (n = 215, 13.4%).

3.1. Article development in acetabular fractures by years

The number of articles by year is shown in Figure 1. Figure 1 shows the prediction values obtained from the Exponential Smoothing prediction model, which considered seasonal adjustments into account while predicting the number of articles to be published in 2023 and future years. According to the prediction model results, it was estimated that 122 (95% confidence interval: 102–141) articles on the topic of acetabular fractures would be published in 2023, and 145 (95% confidence interval: 98–192) in 2027 (Fig. 1).

3.2. Active authors on acetabular fractures

The top 20 most productive researchers (with more than 10 articles published) on acetabular fractures were identified as Moed BR. (n = 29), Helfet DL. (n = 24), Pohlemann T. (n = 20), Matta JM. (n = 19), O’toole RV. (n = 18), Giannoudis PV. (n = 15), Archdeacon MT. (n = 14), Zhang YZ. (n = 14), Gansslen A. (n = 13), Siebenrock KA. (n = 13), Stockle U. (n = 13), Bastian JD. (n = 12), Herath SC. (n = 12), Krettek C. (n = 12), Liu XM. (n = 12), Cai XH. (n = 11), Nascone JW. (n = 11), Olson SA. (n = 11), Rommens PM. (n = 11), and Russell GV. (n = 11), respectively.

Table 1
The 63 most active journals with 5 or more articles on acetabular fractures.

Journals	RC	C	AC	Journals	RC	C	AC
Journal of Orthopaedic Trauma	184	4149	22.55	Ulusal Travma ve Acil Cerrahi Dergisi-Turkish Journal of Trauma & Emergency Surgery	9	21	2.33
Injury-International Journal of the Care of the Injured	132	2797	21.19	Biomed Research International	8	72	9.00
Clinical Orthopaedics and Related Research	74	3501	47.31	Journal of Orthopaedic Surgery	8	34	4.25
International Orthopaedics	59	616	10.44	Journal of the American Academy of Orthopaedic Surgeons	8	57	7.13
Journal of Bone and Joint Surgery-American Volume	53	3495	65.94	Journal of Trauma and Acute Care Surgery	8	131	16.38
Archives of Orthopaedic and Trauma Surgery	45	494	10.98	Medicine	8	20	2.50
Orthopedics	37	378	10.22	Minerva Ortopedica E Traumatologica	8	2	0.25
Journal of Bone and Joint Surgery-British Volume	35	2027	57.91	Plos One	8	72	9.00
Journal of Trauma-Injury Infection and Critical Care	35	966	27.60	Trauma Monthly	8	13	1.63
Unfallchirurg	34	313	9.21	Chinese Journal of Traumatology	7	20	2.86
Orthopaedics & Traumatology-Surgery & Research	31	396	12.77	Malaysian Orthopaedic Journal	7	9	1.29
European Journal of Trauma and Emergency Surgery	26	120	4.62	Operative Orthopadie und Traumatologie	7	81	11.57
Journal of Arthroplasty	25	613	24.52	Skeletal Radiology	7	184	26.29
European Journal of Orthopaedic Surgery and Traumatology	24	45	1.88	Veterinary Surgery	7	100	14.29
BMC Musculoskeletal Disorders	20	97	4.85	International Journal of Surgery Case Reports	7	6	0.86
Journal of Orthopaedic Surgery and Research	20	211	10.55	Canadian Journal of Surgery	6	74	12.33
Acta Chirurgiae Orthopaedicae et Traumatologiae Cechoslovaca	16	114	7.13	Chirurg	6	15	2.50
Orthopaedic Surgery	16	55	3.44	Cureus	6	13	2.17
Revue de Chirurgie Orthopedique et Reparatrice De L Appareil Moteur	16	129	8.06	Medical Science Monitor	6	21	3.50
Bone & Joint Journal	15	276	18.40	Radiology	6	313	52.17
Orthopedic Clinics of North America	15	284	18.93	World Journal of Orthopedics	6	18	3.00
Acta Orthopaedica Belgica	13	27	2.08	Acta Orthopaedica	5	66	13.20
American Journal of Roentgenology	13	332	25.54	Clinics in Orthopedic Surgery	5	46	9.20
Orthopade	13	84	6.46	Emergency Radiology	5	7	1.40
Trauma und Berufskrankheit	13	11	0.85	Geriatric Orthopaedic Surgery & Rehabilitation	5	24	4.80
Indian Journal of Orthopaedics	13	45	3.46	Journal of Evolution of Medical and Dental Sciences-Jemds	5	1	0.20
Acta Orthopaedica Scandinavica	12	197	16.42	Journal of Orthopaedic Research	5	96	19.20
Hip International	12	106	8.83	Journal of Orthopaedics	5	14	2.80
Zeitschrift fur Orthopadie und Unfallchirurgie	12	53	4.42	Journal of Orthopaedics and Traumatology	5	54	10.80
Current Orthopaedic Practice	11	6	0.55	International Journal of Clinical and Experimental Medicine	5	21	4.20
Operative Techniques in Orthopaedics	10	19	1.90	International Journal of Computer Assisted Radiology and Surgery	5	67	13.40
Journal of Orthopaedic Science	9	88	9.78				

AC = average citation per document, C = number of citation, RC = record count.

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3.3. Active institutions on acetabular fractures

Institutions that published the most articles (20 or more) on acetabular fractures were University of California System (n = 41), University of Texas System (33), Egyptian Knowledge Bank EKB (31), University of Bern (31), University of Maryland Baltimore (31), University System of Maryland (31), Southern Medical University China (30), Hosp Special Surg (29), Saint Louis University (27), Udice French Research Universities (26), University of Washington (26), University of Washington Seattle (26), University Hospital of Bern (24), Eberhard Karls University of Tubingen (23), Harborview Medical Center (22), University of Toronto (22), Mayo Clinic (21), and University of Southern California (20), respectively.

3.4. Active journals on acetabular fractures

1599 articles on acetabular fractures were published in 283 different journals. The 63 most productive journals publishing 5 or more publications on the topic of acetabular fractures are presented in Table 1, together with the total number of citations (NC) the journals have received and the average NC per article.

3.5. Active countries on acetabular fractures

The color intensity world map showing distribution of the numbers of articles according to countries, and the bar graph showing the 20 most productive countries are shown in Figure 2. The 20 countries contributing the most to literature with the publication of 14 or more articles about acetabular fractures were determined to be the United States of America (USA) (551, 34.4%), China (170, 10.6%), Germany (160, 10%), the United Kingdom (UK) (116, 7.2%), France (72, 4.5%), Switzerland (69, 4.3%), India (61, 3.8%), Canada (51, 3.1%), Turkey (45, 2.8%), South Korea (41, 2.5%), the Netherlands (40, 2.5%), Italy (37, 2.3%), Japan (34, 2.1%), Egypt (33, 2%), Taiwan (24, 1.5%), Austria (19, 1.1%),

Sweden (16, 1%), Australia (15, 0.9%), Spain (15, 0.9%) and Iran (14, 0.8%).

From the 70 countries publishing articles on the acetabular fractures, cluster analysis was applied to 39 countries with international collaboration between authors (Fig. 3A). According to the results of the cluster analysis, 8 different clusters were formed related to international collaboration. The total link strength scores were calculated showing the collaboration strength of the 39 countries and the international scientific collaboration density map was created using these scores (Fig. 3B) (Top 10 countries with the highest cooperation strength: USA = 79, Germany = 38, England (in UK) = 35, Switzerland = 34, China = 22, France = 19, Canada = 16, Austria = 14, Australia = 13, Netherlands = 13). A high-level statistically significant correlation was found between the number of articles on the topic of acetabular fractures published by nations and the GDP and GDP per capita values of those countries ($R = 0.719, P < .001$; $R = 0.701, P < .001$, respectively).

3.6. Citation analysis on acetabular fractures

The top 20 most cited articles according to the overall NC of 1599 articles published on acetabular fractures and the annual average NC received by these articles are shown in Table 2.

3.7. Co-citation analysis on acetabular fractures

In the References sections of all the 1599 articles published on the topic of acetabular fractures, there were found to be a total of 12853 publications cited. Of these, the 9 articles with more than 150 co-citations were determined to be studies by Matta (1996) (NC = 571), Judet et al (1964) (NC = 429), Letournel et al (1993) (NC = 313), Letournel (1980) (NC = 277), Giannoudis et al (2005) (NC = 237), Brooker et al (1973) (NC = 228), Matta et al (1986) (NC = 170), Mears

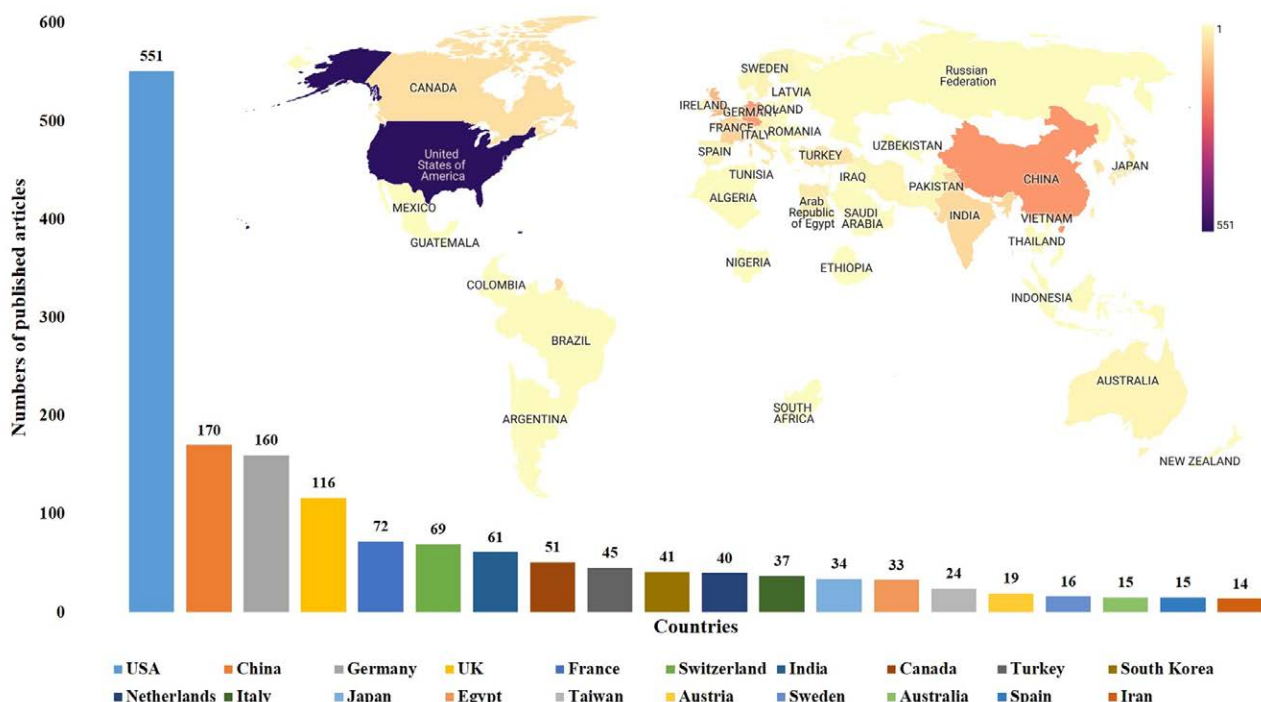


Figure 2. A world productivity map showing the distribution of articles published on acetabular fractures by country, and a bar graph showing the top 20 countries with the most articles.

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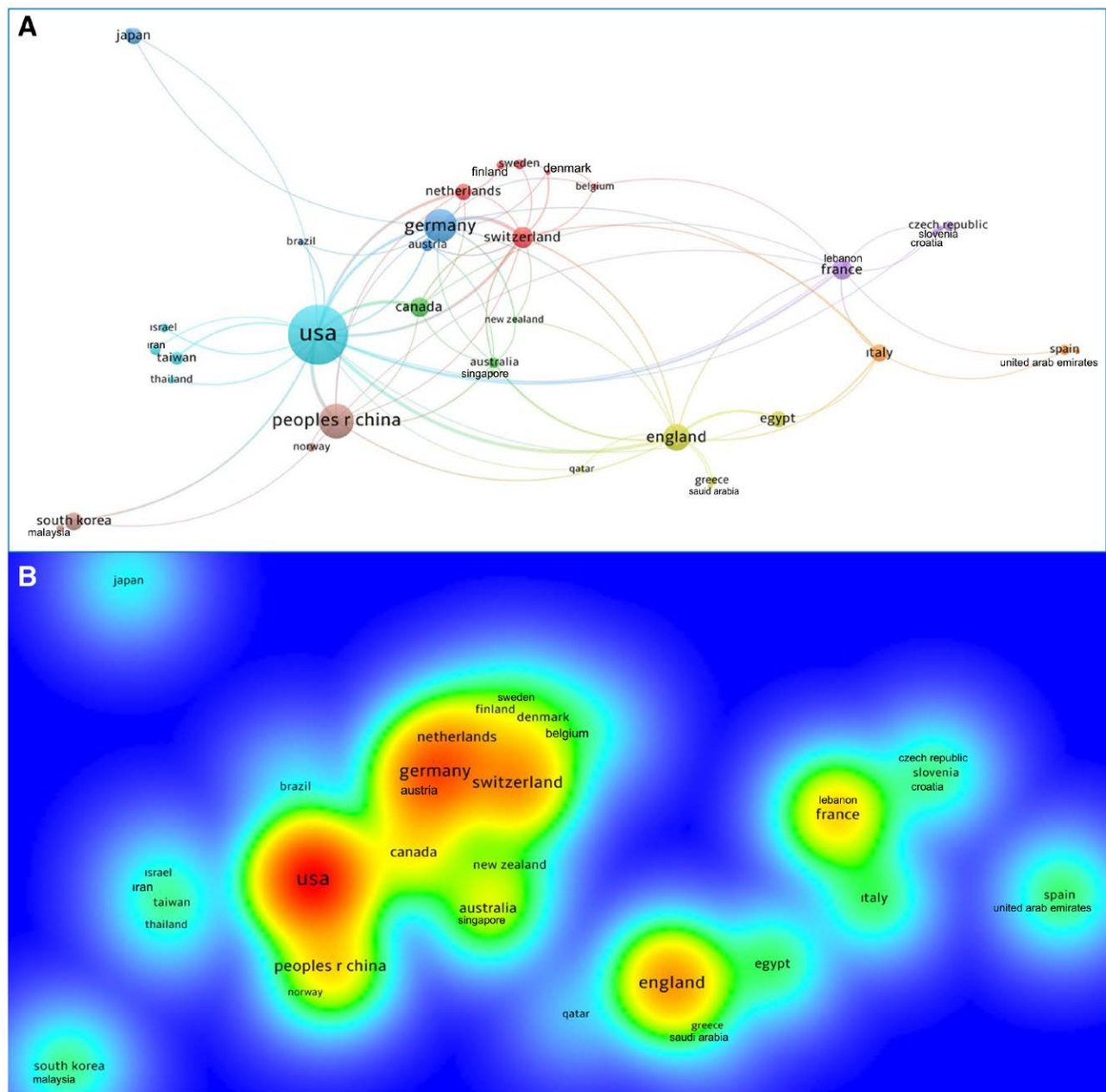


Figure 3. (A) Network visualization map showing international scientific collaboration on acetabular fractures. Footnote: Different clusters are shown in different colors. The size of the circle varies according to the number of articles in the country. The circle representing the country that has published more articles is larger. (B) A density map showing the level of international cooperation on acetabular fractures between countries. Footnote: Colors indicating the degree of global cooperation change from blue to red (blue-green-yellow-red).

et al (2003) (NC = 165), and Ferguson et al (2010) (NC = 161).^[1–3,8,10,24–27]

3.8. Trend topics on acetabular fractures

A total of 1991 different keywords were used in the 1599 articles published on the topic of acetabular fractures. The 75 different keywords (115 different keywords were combined under similar headings) used in more than 5 articles are presented in Table 3. Keyword analysis was performed to determine the use of these words according to year and to determine the trend topics in recent years. The trend network visualization map obtained as a result of the keyword analysis is shown in Figure 4. The citation network visualization map obtained as a result of the citation analysis performed

to determine the topics receiving the most citations is shown in Figure 5.

4. Discussion

When the trends of the articles on acetabular fractures in the 1980 to 2022 period were examined according to years, it was observed that there were 3 different publication trend periods consisting of the 1980 to 2010, 2011 to 2018, and 2019 to 2022 periods. In the period of 1980 to 2010, mean 19 (range, 7–44) articles per year were published. An increasing trend in the number of articles started in 2011, and in the period of 2011 to 2018, mean 70 (range, 60–89) articles per year were published. A second increase trend started in 2019 and in the period of 2019 to 2022, mean 111 (range, 95–124) articles per year were

Table 2
The top 20 most cited articles (more than 134 citations) on the acetabular fractures.

No	Article	Author	Journal	PY	TC	AC
1	Fractures of the acetabulum: Accuracy of reduction and clinical results in patients managed operatively within 3 weeks after the injury	Matta JM.	Journal of Bone and Joint Surgery-American Volume	1996	824	30.52
2	Acetabulum fractures - classification and management	Letournel E.	Clinical Orthopaedics and Related Research	1980	403	9.37
3	Fractures of the acetabulum - a retrospective analysis	Matta JM. et al	Clinical Orthopaedics and Related Research	1986	233	6.3
4	Fractures of the acetabulum in patients aged 60 years and older an epidemiological and radiological study	Ferguson TA. et al	Journal of Bone and Joint Surgery-British Volume	2010	231	17.77
5	Acetabular fracture fixation via a modified stoppa limited intrapelvic approach - description of operative technique and preliminary treatment results	Cole JD. and Bolhofner BR.	Clinical Orthopaedics and Related Research	1994	230	7.93
6	Displaced acetabular fractures managed operatively: Indicators of outcome	Mears DC. et al	Clinical Orthopaedics and Related Research	2003	213	10.65
7	The treatment of acetabular fractures through the ilioinguinal approach	Letournel E.	Clinical Orthopaedics and Related Research	1993	199	6.63
8	Two to twenty-year survivorship of the hip in 810 patients with operatively treated acetabular fractures	Tannast M. et al	Journal of Bone and Joint Surgery-American Volume	2012	186	16.91
9	Results of operative treatment of fractures of the posterior wall of the acetabulum	Moed BR. et al	Journal of Bone and Joint Surgery-American Volume	2002	170	8.1
10	Diagnosis and management of closed internal degloving injuries associated with pelvic and acetabular fractures: The Morel-Lavallee lesion	Hak DJ. et al	Journal of Trauma-Injury Infection and Critical Care	1997	159	6.12
11	Fractures of the acetabulum - early results of a prospective-study	Matta JM. et al	Clinical Orthopaedics and Related Research	1986	158	4.27
12	Open reduction and internal-fixation of fractures of the acetabulum - results in 163 fractures	Mayo KA.	Clinical Orthopaedics and Related Research	1994	157	5.41
13	Acetabular fractures - A 16-year prospective epidemiological study	Laird A. and Keating JF.	Journal of Bone and Joint Surgery-British Volume	2005	154	8.56
14	The anterior intra-pelvic (Modified Rives-Stoppa) approach for fixation of acetabular fractures	Sagi HC. et al	Journal of Orthopaedic Trauma	2010	141	10.85
15	Displaced acetabular fractures	Matta JM. and Merritt PO.	Clinical Orthopaedics and Related Research	1988	141	4.03
16	Operative treatment of acetabular fractures through the ilioinguinal approach - a 10-year perspective	Matta JM.	Clinical Orthopaedics and Related Research	1994	139	4.79
17	Acute total hip arthroplasty for selected displaced acetabular fractures - Two to twelve-year results	Mears DC. And Velyvis JH.	Journal of Bone and Joint Surgery-American Volume	2002	137	6.52
18	Total hip-arthroplasty after fracture of the acetabulum - long-term results	Romness DW. and Lewallen DG.	Journal of Bone and Joint Surgery-British Volume	1990	136	4.12
19	Outcomes of acetabular fracture fixation with ten years' follow-up	Briffa N. et al	Journal of Bone and Joint Surgery-British Volume	2011	134	11.17
20	Determinants of functional outcome after simple and complex acetabular fractures involving the posterior wall	Kreder HJ. et al	Journal of Bone and Joint Surgery-British Volume	2006	134	7.88

AC = average citations per year, PY = publication year, TC = total citation.

published. When the prediction findings were evaluated for the 5 years following 2022, it can be said that the increasing trend for scientific productivity on the subject of acetabular fractures will continue.

When the article productivity of world countries was examined, of the 20 most productive nations on acetabular fractures, 15 were seen to be developed countries (USA, Germany, UK, France, Switzerland, Canada, South Korea, Netherlands, Italy, Japan, Taiwan, Austria, Sweden, Australia, Spain) and 5 were developing countries (China, India, Turkey, Egypt, Iran). Despite these 5 being developing countries, they were countries with large economies. The fact that a highly significant correlation was determined between the number of articles published by countries and the GDP and GDP per capita values of those countries shows that the size of the economy has an impact on the global article productivity on the subject of acetabular fractures. In a previous bibliometric study in literature on the topic of open fractures, a moderate-level significant correlation was determined.^[17] The reason for the higher correlation on the subject of acetabular fractures could be said to be the increased incidence of acetabular fractures associated with the increase in the elderly population in developed countries in addition to the relationship between economic power and the necessary source of finance for research.

The density map created using the overall cooperation scores between the countries was evaluated and the countries engaged in the most cooperation were seen to be the USA, Germany, England, Switzerland, China, France, Canada, Austria, Australia, and the Netherlands. When the collaboration between authors of countries was examined, it was seen that although geographic proximity was an effective factor in collaboration in Europe, global collaboration was also common (Cluster 1: Belgium, Denmark, Finland, Netherlands, Sweden, Switzerland. Cluster 2: Australia, Canada, New Zealand, Scotland, Singapore. Cluster 3: Austria, Brazil, Germany, Japan, Russia. Cluster 4: Egypt, England, Greece, Qatar, Saudi Arabia. Cluster 5: Croatia, Czech Republic, France, Lebanon, Slovenia. Cluster 6: Iran, Israel, Taiwan, USA. Cluster 7: Argentina, Italy, Spain, United Arab Emirates. Cluster 8: Malaysia, Norway, China, South Korea).

The journals with the highest number of articles in the literature on the topic of acetabular fractures were the Journal of Orthopaedic Trauma, Injury, Clinical Orthopaedics and Related Research, International Orthopaedics, Journal of Bone and Joint Surgery-American Volume, Archives of Orthopaedic and Trauma Surgery, Orthopedics, Journal of Bone and Joint Surgery-British Volume, and Journal of Trauma-Injury Infection and Critical Care. It can be said that these journals are at the

Table 3
The 75 most frequently used keywords in articles on the acetabular fractures.

Keywords	Number of uses	Keywords	Number of uses	Keywords	Number of uses
Acetabular or acetabulum fracture (s)	866	Quadrilateral plate	19	Obesity	8
Fracture (s) or fractures, bone	180	Pelvic ring or pelvic ring injury	17	Periprosthetic fracture	8
Pelvic, pelvic trauma, pelvic fracture (s), pelvis or pelvis fracture (s)	111	Three-dimensional or 3-dimensional printing	16	Tranexamic acid	8
THA, total hip arthroplasty or total hip replacement	111	Finite element analysis	15	Anterior approach	7
Posterior wall, posterior wall fracture (s) or posterior column	74	Posttraumatic arthritis or osteoarthritis	15	Blood loss	7
Open reduction or open reduction and internal fixation (or ORIF)	55	Functional outcome	14	Bone	7
Elderly patient (s)	51	Arthroplasty	13	Femoral neck fracture	7
Internal or internal fixation	50	Hip joint	13	Insufficiency fracture	7
Surgery, surgical approach, surgical technique or surgical treatment	43	Quality of life	13	Minimally invasive	7
Fixation or fracture fixation	42	Anterior column	12	Operative treatment	7
Outcome (s)	41	Navigation	12	Polytrauma	7
Complication (s)	40	Reduction	12	Reconstruction	7
Trauma	40	Dislocation	11	Transfusion	7
Hip or hip fracture	34	Pararectus approach	11	Treatment	7
Percutaneous, percutaneous fixation or percutaneous screw fixation	29	Modified Stoppa approach	10	Treatment outcome	7
Stoppa or Stoppa approach	29	Mortality	10	Approach	6
Computed tomography or CT (28)	28	Preoperative planning	10	Avascular necrosis	6
Heterotopic ossification	28	Classification	9	Both-column fracture	6
Iliioinguinal or Iliioinguinal approach	27	Computer-assisted surgery	9	Case report	6
Kocher-langenbeck or Kocher-langenbeck approach	26	Deep vein thrombosis	9	Femoral head	6
Osteosynthesis	23	Hip arthroplasty	9	Fracture mapping	6
Geriatric or geriatric trauma	22	Hip dislocation	9	Hip arthroscopy	6
3D printing	21	Epidemiology	8	Infection	6
Osteoporosis	21	Fracture reduction	8	Marginal impaction	6
Biomechanics	20	Harris hip score	8	MRI	6

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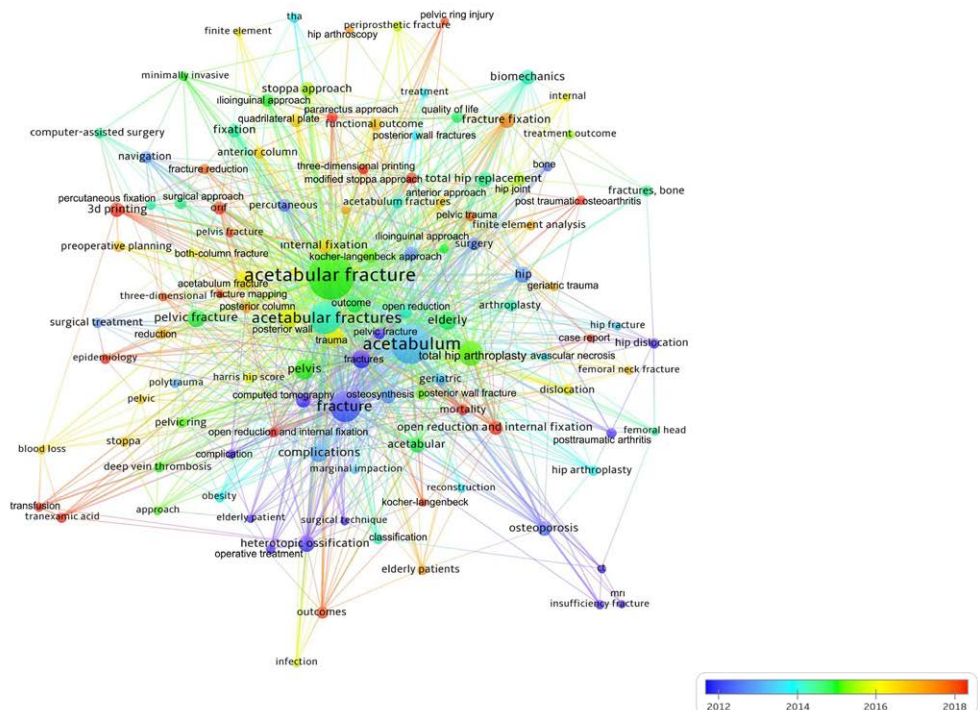


Figure 4. Network visualization map showing past and current trends in acetabular fractures based on trend keyword analysis Footnote: The indicator in the lower right corner of the figure showing the current use of keywords in articles from previous years to the following years changes from blue to red (blue-green-yellow-red). The size of the circle varies according to the frequency of use of keywords in different articles.

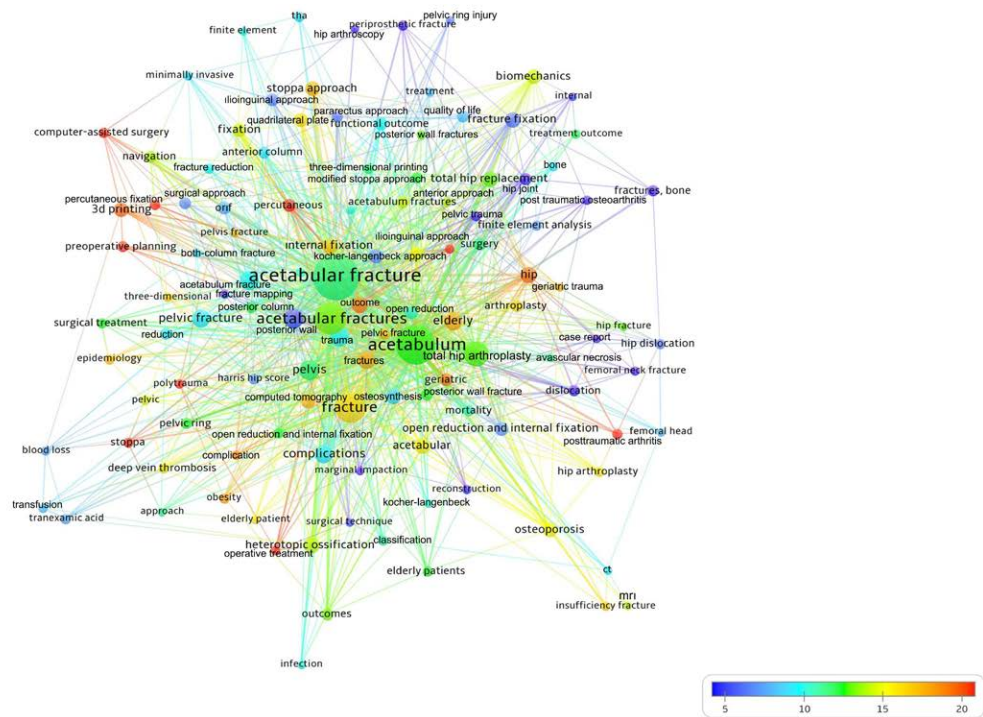


Figure 5. Network visualization map showing the most cited topics in acetabular fractures based on trend keyword analysis. Footnote: The indicator in the lower right corner of the figure, which shows the number of citations received by keywords, changes from blue to red (blue-green-yellow-red). The size of the circle varies according to the frequency of use of keywords in different articles.

forefront for researchers when preparing publications on this subject.

When the journals were compared according to the average NC per article, it was seen that the most influential journals were the Journal of Bone and Joint Surgery (Average NC per article: American Volume = 65.9 and British Volume = 57.9), Radiology (52.2), Clinical Orthopaedics and Related Research (47.3), Journal of Trauma-Injury Infection and Critical Care (27.6), Skeletal Radiology (26.3), American Journal of Roentgenology (25.5), Journal of Arthroplasty (24.5), Journal of Orthopaedic Trauma (22.5), Injury (21.2), Journal of Orthopaedic Research (19.2), Orthopedic Clinics of North America (18.9), and Bone & Joint Journal (18.4). These journals can be said to be a priority for researchers for whom it is important to receive citations after publication.

When the evaluation was made according to the overall NC, it was determined that the most cited article was the article written by Matta (1996), entitled “Fractures of the acetabulum: Accuracy of reduction and clinical results in patients managed operatively within 3 weeks after the injury,” published in the Journal of Bone and Joint Surgery-American Volume,^[24] followed by “Acetabulum fractures - classification and management” by Letournel (1980) published in Clinical Orthopaedics and Related Research,^[2] and “Fractures of the acetabulum - a retrospective analysis” by Matta et al (1986) published in Clinical Orthopaedics and Related Research.^[26] The fourth and fifth most influential papers were by Ferguson et al (2010), and Cole and Bolhofner (1994).^[8,28]

The most influential paper, as determined by the average NC per year, was written by Matta (1996).^[26] The second most influential was the article entitled “Fractures of the acetabulum in patients aged 60 years and older an epidemiological and radiological study” by Ferguson et al (2010) published in the Journal of Bone and Joint Surgery-British Volume,^[8] followed by “Two to Twenty-Year Survivorship of the Hip in 810 Patients with Operatively Treated Acetabular Fractures” by Tannast et al (2012) published in the Journal of Bone and

Joint Surgery-American Volume.^[29] The fourth and fifth most influential papers were by Zeng et al (2016) and Briffa et al (2011).^[30,31]

The most influential papers were by Matta (1996), Judet et al (1964), Letournel et al (1993), Letournel (1980), Giannoudis et al (2005), Brooker et al (1973), Matta et al (1986), Mears et al (2003), and Ferguson et al (2010) as measured by the number of co-citations across all analyzed studies.^[1-3,8,10,24-27] It is suggested that those researchers who are interested in this topic first read these works.

Keyword analysis was performed to determine trend topics. When the analysis results were evaluated, the keywords most frequently researched in recent years were 3-dimensional (3D) printing, outcomes, ORIF, mortality, Kocher-Langenbeck, Pararectus approach, tranexamic acid, transfusion, epidemiology, fracture mapping, modified Stoppa approach, post-traumatic osteoarthritis, pelvis fracture, pelvic ring injury, fracture reduction, and pelvic ring injury. Throughout the whole period from 1980–2022, the most cited keywords were determined to be percutaneous, percutaneous fixation, computer-assisted surgery, preoperative planning, operative treatment, Stoppa, polytrauma, post-traumatic arthritis, ili-oinguinal approach, hip, geriatric, complications, outcome and obesity.

To the best of our knowledge, there is no previous bibliometric study on the subject of acetabular fractures in literature. Therefore, this study can be said to have the strength of being the first such study. One of the limitations of our study is that only WoS database was utilized for literature review. However, this database is recommended for bibliometric investigations since citation/co-citation analyses cannot be conducted on the PubMed database.^[17,18] The Scopus database includes some low-impact journals, While the WoS includes articles published in higher impact journals (the majority are SCI-Expanded) than other databases. Therefore, the WoS has been extensively employed in other bibliometric articles in literature.^[17-21]

5. Conclusions

A statistical summary of 1599 articles published between 1980 and 2022 is presented in this extensive bibliometric study on acetabular fractures, which has been on the rise in research in recent years. According to the analysis conducted to identify trending topics, the keywords most frequently researched in recent years were 3D printing, 3-dimensional printing, outcomes, ORIF, mortality, Kocher-Langenbeck, Pararectus approach, tranexamic acid, transfusion, epidemiology, fracture mapping, modified Stoppa approach, post-traumatic osteoarthritis, pelvis fracture, pelvic trauma, fracture reduction, and pelvic ring injury.

The leading countries in research on the subject of acetabular fractures were seen to be western countries with large economies (especially the USA, European countries, and Canada) and China, India and Turkey. These countries are the leaders in research and scientific collaboration. Although there was seen to be globally significant international cooperation, it can be considered that research about acetabular fractures should be encouraged in undeveloped countries. The results of this bibliometric study will be of guidance in providing new ideas for future researchers.

Author contributions

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Formal analysis: Abdulrahim Dündar, Deniz İpek, Şehmuz Kaya.

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Software: Abdulrahim Dündar, Deniz İpek, Şehmuz Kaya.

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Validation: Abdulrahim Dündar.

Visualization: Abdulrahim Dündar, Deniz İpek, Şehmuz Kaya.

Writing – original draft: Abdulrahim Dündar, Deniz İpek, Şehmuz Kaya.

Writing – review & editing: Abdulrahim Dündar, Deniz İpek, Şehmuz Kaya.

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