

The Top 50 Most-Cited Knee Arthroscopy Studies



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Purpose: To objectively identify the 50 most influential studies in knee arthroscopy and provide an analysis of their key characteristics. **Methods:** The Clarivate Analytics Web of Knowledge database was used to gather data and metrics of knee arthroscopy research. The search list was sorted by the number of citations, and articles were included or excluded based on relevance to knee arthroscopy. The information extracted for each article included author name, publication year, country of origin, journal name, article type, and the level of evidence. **Results:** For these 50 studies, the total number of citations was calculated to be 12,168, with an average of 243.4 citations per paper. The most-cited article was cited 1,220 times. The 50 studies included in this analysis were published between 1972 and 2013. All 50 articles were published in English and came from 10 different orthopaedic journals. The United States was responsible for the majority of articles (n = 26); however, many other countries were represented. The most prevalent study designs were case series (n = 20). **Conclusions:** The 50 most influential articles in knee arthroscopy were cited a total of 12,168 times. The study designs most commonly used were case series and cohort studies. This article serves as a reference to direct orthopaedic practitioners to the 50 most influential studies in knee arthroscopy. We hope that these 50 studies and the analysis we provide help health care professionals efficiently assess consensus, trends, and needs within the field. **Clinical Relevance:** This analysis of the 50 most influential studies in knee arthroscopy will provide medical students, residents, fellows, and attending physicians with a comprehensive inventory and citation analysis of the most impactful academic contributions to one of the most important fields within orthopaedic surgery.

Arthroscopic surgery has undoubtedly broadened the field of orthopaedic surgery and significantly improved patient outcomes.^{1,2} Arthroscopic procedures are minimally invasive alternatives to open surgery, and, as such, have been associated with decreased recovery times and infection rates.^{3,4} In addition, arthroscopy can be performed on almost any joint, with the knee being the most common.²

In 1912, Severin Nordentoft, became the first physician to visualize the internal structures of a knee joint via endoscope.⁵ By 1920, both Kenju Takagi, and Eugen

Bircher had independently used knee arthroscopy for diagnostic purposes.⁶ As the potential applications grew, new arthroscopic instruments were developed. Kenju Takagi iteratively designed knee arthroscopes, ultimately taking the first color picture of the knee joint in the 1950s.⁷ Masaki Watanabe continued Kenju Takagi's work, introducing the first fiber optic scope in 1967.⁷ These technological advancements led to the rapid adoption of arthroscopic procedures throughout the 1980s and 90s.⁷ Today, knee arthroscopy has become one of the most common orthopaedic procedures performed, with use of the procedure projected to increase through 2025.^{8,9}

The resulting number of publications in knee arthroscopy makes it increasingly difficult to develop a comprehensive foundation in the literature. This requires orthopaedic residents, fellows, and surgeons to prioritize the most important studies. Fortunately, citation analysis has been shown to be an effective tool in identifying impactful papers.¹⁰⁻¹³ Citation analyses have been performed in a variety of specialties within medicine such as neurosurgery, cardiac surgery, pediatrics, radiology, psychiatry, and oncology.¹⁴⁻²⁶ Within orthopaedics, citation analyses are available on topics including unicondylar knee arthroplasty,

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elbow surgery, total ankle arthroplasty, total hip arthroplasty, knee surgery, and recently, shoulder arthroscopy.²⁷⁻³¹

The purpose of this article is to objectively identify the 50 most influential studies in knee arthroscopy and provide an analysis of their key characteristics. These papers will provide medical students, orthopaedic residents, fellows, and surgeons with a solid foundation in knee arthroscopy and an understanding of its evolution over the last several decades. In addition, the hypothesis of this study was that the year of an article's publication would meaningfully impact the total number of citations it was able to accrue.

Methods

Because of the public nature of these data, an institutional review board was not necessary for conduction of this study. As described in previous orthopaedic citation analyses, data were obtained from the Clarivate Analytics Web of Knowledge database using Boolean queries.³²⁻³⁹ While no citation tracking service is perfect, the Clarivate Analytics Web of Knowledge represents a very extensive database that covers more than 21,000 peer-reviewed scholarly journals.⁴⁰ It also includes journal publications and citations dating all the way back to 1900, which few other tracking services are able to do. In addition, the Clarivate Analytics Web of Knowledge database is noted for its high-quality citation links, accuracy, comprehensive coverage, and consistent use among numerous previous citation analyses.^{41,42}

The initial database search took place in December 2020 and incorporated various Boolean search terms to capture all possible iterations of knee arthroscopy. The Boolean search terms that resulted in the greatest number of results were used. More specifically, the Boolean search phrase employed in this analysis

was: [(knee) AND (arthroscopy OR arthroscopic) AND (knee arthroscopy OR arthroscopic knee OR knee arthroscopic)]. The search was carried out with no limitations on date of publication, journal, or country of origin. However, only articles published in English were included. This resulted in a total of 18,531 articles.

The list of articles was organized by the total number of citations in descending order. The title and abstract of each article were reviewed to determine its relevance to knee arthroscopy. To qualify for selection, the article had to present information on surgical indications, descriptions of procedures, surgical outcomes, or complications of arthroscopic knee procedures. If the article did not address one of these inclusion criteria, it was excluded. In addition, knee arthroscopy had to be the focus of the study to be included. If the study only made peripheral mention of knee arthroscopy, or only used knee arthroscopy in the methodology to diagnose a pathology that was then studied separately, it was excluded. For example, a study that analyzed the patterns of injury and mechanism that resulted in a medial meniscus tear was not included because it only used knee arthroscopy as a diagnostic step in the methodology to confirm the presence of a medial meniscus tear. If the inclusion of a study was in question after review of the title and abstract, a copy of the full article was obtained and reviewed by 2 authors (M.L.M. and J.R.P.) to decide upon inclusion or exclusion.

A total of 415 of the most-cited articles were reviewed to reach the 50 most-cited studies that met the designated inclusion criteria. From these papers, the authors, country of origin, number of citations, journal title, year of publication, and study design (expert opinion, review article, descriptive study, case report, case series, case-control, cohort study, randomized controlled trial) were extracted. Furthermore, the level of

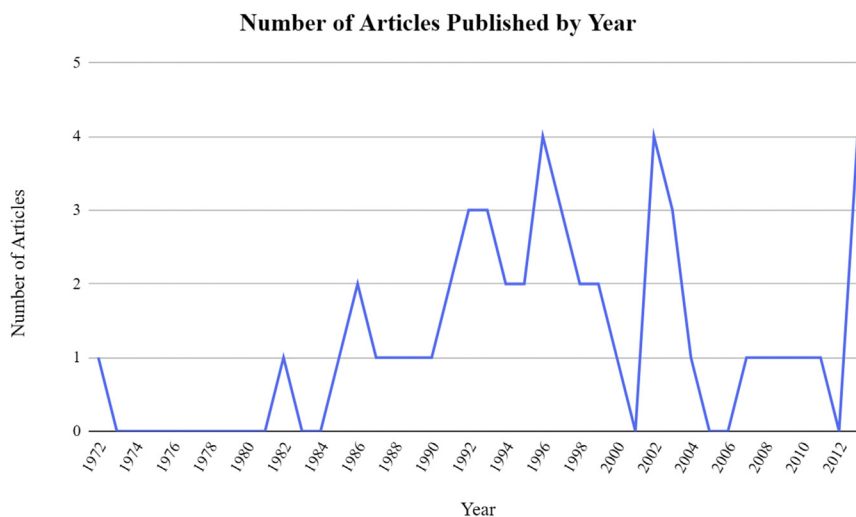


Fig 1. The number of most-cited 50 knee arthroscopy studies published per year.

Table 1. The Top-50 Cited Knee Arthroscopy Articles

Rank	Article	No. of Citations (Citation Density*)	Original Publication Year	Study Design
1	Moseley JB, O'Malley K, Petersen NJ, et al. A controlled trial of arthroscopic surgery for osteoarthritis of the knee. <i>N Engl J Med</i> 2002;347:81-88. ⁴⁴	1220 (64.2)	2002	Randomized controlled trial
2	Freedman KB, D'Amato MJ, Nedeff DD, Kaz A, Bach BR. Arthroscopic anterior cruciate ligament reconstruction: A meta-analysis comparing patellar tendon and hamstring tendon autografts. <i>Am J Sports Med</i> 2003;31:2-11. ⁴⁵	465 (25.8)	2003	Review article
3	Sihvonen R, Paavola M, Malmivaara A, et al. Arthroscopic partial meniscectomy versus sham surgery for a degenerative meniscal tear. <i>N Engl J Med</i> 2013;369:2515-2524. ⁴⁶	414 (51.8)	2013	Randomized controlled trial
4	Kirkley A, Birmingham TB, Litchfield RB, et al. A randomized trial of arthroscopic surgery for osteoarthritis of the knee. <i>N Engl J Med</i> 2008;359:1097-1107. ⁴⁷	404 (31.1)	2008	Randomized controlled trial
5	Marder RA, Raskind JR, Carroll M. Prospective evaluation of arthroscopically assisted anterior cruciate ligament reconstruction: Patellar tendon versus semitendinosus and gracilis tendons. <i>Am J Sports Med</i> 1991;19:478-484. ⁴⁸	367 (12.2)	1991	Cohort study
6	Corry IS, Webb JM, Clingeffer AJ, Pinczewski LA. Arthroscopic reconstruction of the anterior cruciate ligament. <i>Am J Sports Med</i> 1999;27:444-454. ⁴⁹	348 (15.8)	1999	Cohort study
7	Kim S, Bosque J, Meehan JP, Jamali A, Marder R. Increase in outpatient knee arthroscopy in the United States: A comparison of national surveys of ambulatory surgery, 1996 and 2006. <i>J Bone Joint Surg Am</i> 2011;93:994-1000. ⁵⁰	334 (33.4)	2011	Review article
8	Hangody L, Kish G, Kárpáti Z, Szerb I, Udvarhelyi I. Arthroscopic autogenous osteochondral mosaicplasty for the treatment of femoral condylar articular defects: A preliminary report. <i>Knee Surg</i> 1997;5:262-267. ⁵¹	330 (13.8)	1997	Case series
9	Katz JN, Brophy RH, Chaisson CE, et al. Surgery versus physical therapy for a meniscal tear and osteoarthritis. <i>N Engl J Med</i> 2013;368:1675-1684. ⁵²	325 (40.6)	2013	Randomized controlled trial
10	Johnson LL. Arthroscopic abrasion arthroplasty historical and pathologic perspective: Present status. <i>Arthroscopy</i> 1986;2:54-69. ⁵³	320 (9.1)	1986	Expert opinion
11	Matsusue Y, Yamamuro T, Hama H. Arthroscopic multiple osteochondral transplantation to the chondral defect in the knee associated with anterior cruciate ligament disruption. <i>Arthroscopy</i> 1993;9:318-321. ⁵⁴	315 (11.3)	1993	Expert opinion
12	Bobić V. Arthroscopic osteochondral autograft transplantation in anterior cruciate ligament reconstruction: A preliminary clinical study. <i>Knee Surg Sports Traumatol Arthrosc</i> 1996;3:262-264. ⁵⁵	288 (11.5)	1996	Case series
13	Cannon WD Jr, Vittori JM. The incidence of healing in arthroscopic meniscal repairs in anterior cruciate ligament-reconstructed knees versus stable knee. <i>Am J Sports Med</i> 1992;20:176-181. ⁵⁶	277 (9.6)	1992	Cohort study
14	Bach BR, Tradonsky S, Bojchuk J, Levy ME, Bush-Joseph CA, Khan NH. Arthroscopically assisted anterior cruciate ligament reconstruction using patellar tendon autograft. <i>Am J Sports Med</i> 1998;26:20-29. ⁵⁷	274 (11.9)	1998	Case series
15	Adachi N, Ochi M, Uchio Y, Iwasa J, Kuriwaka M, Ito Y. Reconstruction of the anterior cruciate ligament. <i>J Bone Joint Surg Br</i> 2004;86-B:515-520. ⁵⁸	264 (15.5)	2004	Cohort study
16	Small NC. Complications in arthroscopic surgery performed by experienced arthroscopists. <i>Arthroscopy</i> 1988;4:215-221. ⁵⁹	251 (7.6)	1988	Review article
17	O'Neill DB. Arthroscopically assisted reconstruction of the anterior cruciate ligament. A prospective randomized analysis of three techniques. <i>J Bone Joint Surg Am</i> 1996;78:803-813. ⁶⁰	226 (9.0)	1996	Randomized controlled trial
18	Sherman OH, Fox JM, Snyder SJ, et al. Arthroscopy—"no-problem surgery". An analysis of complications in two thousand six hundred and forty cases. <i>J Bone Joint Surg Am</i> 1986;68:256-265. ⁶¹	224 (6.4)	1986	Case series

(continued)

Table 1. Continued

Rank	Article	No. of Citations (Citation Density*)	Original Publication Year	Study Design
19	Herrlin S, Hållander M, Wange P, Weidenhielm L, Werner S. Arthroscopic or conservative treatment of degenerative medial meniscal tears: A prospective randomised trial. <i>Knee Surg Sports Traumatol Arthrosc</i> 2007;15:393-401. ⁶²	209 (14.9)	2007	Cohort study
20	Pinczewski LA, Deehan DJ, Salmon LJ, Russell VJ, Clingeleffer A. A five-year comparison of patellar tendon versus four-strand hamstring tendon autograft for arthroscopic reconstruction of the anterior cruciate ligament. <i>Am J Sports Med</i> 2002;30:523-536. ⁶³	204 (10.7)	2002	Cohort study
21	Morgan CD, Wojtys EM, Casscells CD, Casscells SW. Arthroscopic meniscal repair evaluated by second-look arthroscopy. <i>Am J Sports Med</i> 1991;19:632-637; discussion 637-638. ⁶⁴	204 (6.8)	1991	Case series
22	Stein T, Mehling AP, Welsch F, Eisenhart-Rothe R von, Jäger A. Long-term outcome after arthroscopic meniscal repair versus arthroscopic partial meniscectomy for traumatic meniscal tears. <i>Am J Sports Med</i> 2010;38:1542-1548. ⁶⁵	203 (18.5)	2010	Cohort study
23	Rangger C, Klestil T, Gloetzer W, Kemmler G, Benedetto KP. Osteoarthritis after arthroscopic partial meniscectomy. <i>Am J Sports Med</i> 1995;23:240-244. ⁶⁶	203 (7.8)	1995	Case series
24	Buss DD, Warren RF, Wickiewicz TL, Galinat BJ, Panariello R. Arthroscopically assisted reconstruction of the anterior cruciate ligament with use of autogenous patellar-ligament grafts. Results after twenty-four to forty-two months. <i>J Bone Joint Surg Am</i> 1993;75:1346-1355. ⁶⁷	193 (6.9)	1993	Case series
25	Eggl S, Wegmüller H, Kosina J, Huckell C, Jakob RP. Long-term results of arthroscopic meniscal repair: An analysis of isolated tears. <i>Am J Sports Med</i> 1995;23:715-720. ⁶⁸	189 (7.3)	1995	Case series
26	Jackson DW, Schaefer RK. Cyclops syndrome: Loss of extension following intra-articular anterior cruciate ligament reconstruction. <i>Arthroscopy</i> 1990;6:171-178. ⁶⁹	186 (6.0)	1990	Case series
27	Rubman MH, Noyes FR, Barber-Westin SD. Arthroscopic repair of meniscal tears that extend into the avascular zone. <i>Am J Sports Med</i> 1998;26:87-95. ⁷⁰	184 (8.0)	1998	Case series
28	Ikeuchi H. Arthroscopic treatment of the discoid lateral meniscus. Technique and long-term results. <i>Clin Orthop Relat Res</i> 1982;(167):19-28. ⁷¹	183 (4.7)	1982	Case series
29	Duquin TR, Wind WM, Fineberg MS, Smolinski RJ, Buyea CM. Current trends in anterior cruciate ligament reconstruction. <i>J Knee Surg</i> 2009;22:7-12. ⁷²	178 (14.8)	2009	Expert opinion
30	Yim J-H, Seon J-K, Song E-K, et al. A comparative study of meniscectomy and nonoperative treatment for degenerative horizontal tears of the medial meniscus. <i>Am J Sports Med</i> 2013;41:1565-1570. ⁷³	177 (22.1)	2013	Randomized controlled trial
31	Burks RT, Metcalf MH, Metcalf RW. Fifteen-year follow-up of arthroscopic partial meniscectomy. <i>Arthroscopy</i> 1997;13:673-679. ⁷⁴	177 (7.4)	1997	Case series
32	Fanelli GC, Edson CJ. Arthroscopically assisted combined anterior and posterior cruciate ligament reconstruction in the multiple ligament injured knee: 2- to 10-year follow-up. <i>Arthroscopy</i> 2002;18:703-714. ⁷⁵	176 (9.3)	2002	Case series
33	Noyes FR, Mangine RE, Barber S. Early knee motion after open and arthroscopic anterior cruciate ligament reconstruction. <i>Am J Sports Med</i> 1987;15:149-160. ⁷⁶	175 (5.2)	1987	Cohort study
34	Fanelli GC, Giannotti BF, Edson CJ. Arthroscopically assisted combined posterior cruciate ligament/posterior lateral complex reconstruction. <i>Arthroscopy</i> 1996;12:521-530. ⁷⁷	174 (7.0)	1996	Case series
35	Kartus J, Magnusson L, Stener S, Brandsson S, Eriksson BI, Karlsson J. Complications following arthroscopic anterior cruciate ligament reconstruction. A 2-5-year follow-up of 604 patients with special emphasis on anterior knee pain. <i>Knee Surg</i> 1999;7:2-8. ⁷⁸	172 (7.8)	1999	Case series

(continued)

Table 1. Continued

Rank	Article	No. of Citations (Citation Density*)	Original Publication Year	Study Design
36	Herrlin SV, Wange PO, Lapidus G, Hällander M, Werner S, Weidenhielm L. Is arthroscopic surgery beneficial in treating non-traumatic, degenerative medial meniscal tears? A five year follow-up. <i>Knee Surg Sports Traumatol Arthrosc</i> 2013;21:358-364. ⁷⁹	170 (21.3)	2013	Case series
37	Aglietti P, Buzzi R, Giron F, Simeone AJ, Zaccherotti G. Arthroscopic-assisted anterior cruciate ligament reconstruction with the central third patellar tendon. A 5-8-year follow-up. <i>Knee Surg Sports Traumatol Arthrosc</i> 1997;5:138-144. ⁸⁰	170 (7.1)	1997	Randomized controlled trial
38	DeLee JC. Complications of arthroscopy and arthroscopic surgery: Results of a national survey. <i>Arthroscopy</i> 1985;1:214-220. ⁸¹	168 (4.7)	1985	Expert opinion
39	Fanelli GC, Giannotti BF, Edson CJ. The posterior cruciate ligament arthroscopic evaluation and treatment. <i>Arthroscopy</i> 1994;10:673-688. ⁸²	166 (6.2)	1994	Expert opinion
40	Andersson-Molina H, Karlsson H, Rockborn P. Arthroscopic partial and total meniscectomy: A long-term follow-up study with matched controls. <i>Arthroscopy</i> 2002;18:183-189. ⁸³	163 (8.6)	2002	Cohort study
41	Erggelet C, Sittinger M, Lahm A. The arthroscopic implantation of autologous chondrocytes for the treatment of full-thickness cartilage defects of the knee joint. <i>Arthroscopy</i> 2003;19:108-110. ⁸⁴	157 (8.7)	2003	Expert opinion
42	Chang RW, Falconer J, Stulberg SD, Arnold WJ, Manheim LM, Dyer AR. A randomized, controlled trial of arthroscopic surgery versus closed-needle joint lavage for patients with osteoarthritis of the knee. <i>Arthritis Rheum</i> 1993;36:289-296. ⁸⁵	155 (5.5)	1993	Cohort study
43	Ogilvie-Harris DJ, McLean J, Zarnett ME. Pigmented villonodular synovitis of the knee. The results of total arthroscopic synovectomy, partial, arthroscopic synovectomy, and arthroscopic local excision. <i>J Bone Joint Surg Am</i> 1992;74:119-123. ⁸⁶	154 (5.3)	1992	Case series
44	Bert JM, Maschka K. The arthroscopic treatment of unicompartmental gonarthrosis: A five-year follow-up study of abrasion arthroplasty plus arthroscopic debridement and arthroscopic debridement alone. <i>Arthroscopy</i> 1989;5:25-32. ⁸⁷	154 (4.8)	1989	Cohort study
45	Armstrong RW, Bolding F, Joseph R. Septic arthritis following arthroscopy: Clinical syndromes and analysis of risk factors. <i>Arthroscopy</i> 1992;8:213-223. ⁸⁸	150 (5.2)	1992	Case control
46	Chatain F, Adeleine P, Chambat P, Neyret P. A comparative study of medial versus lateral arthroscopic partial meniscectomy on stable knees: 10-year minimum follow-up. <i>Arthroscopy</i> 2003;19:842-849. ⁸⁹	148 (8.2)	2003	Case series
47	Adachi N, Ochi M, Uchio Y, Sumen Y. Anterior cruciate ligament augmentation under arthroscopy. <i>Arch Orth Traum Surg</i> 2000;120:128-133. ⁹⁰	148 (7.1)	2000	Case series
48	Bach BR, Jones GT, Sweet FA, Hager CA. Arthroscopy-assisted anterior cruciate ligament reconstruction using patellar tendon substitution: Two- to four-year follow-up results. <i>Am J Sports Med</i> 1994;22:758-767. ⁹¹	146 (5.4)	1994	Case series
49	Hubbard MJ. Articular debridement versus washout for degeneration of the medial femoral condyle. A five-year study. <i>J Bone Joint Surg Br.</i> 1996;78:217-219. ⁹²	145 (5.8)	1996	Cohort study
50	Jackson RW, Abe I. The role of arthroscopy in the management of disorders of the knee. The Journal of Bone and Joint Surgery British volume. 1972;54-B:310-322. ⁹³	141 (2.9)	1972	Expert opinion

*Number of citations per year since publication.

evidence was determined based on guidelines published in *The Journal of Bone and Joint Surgery*.⁴³ The level of evidence of a study is not a measure of quality but more accurately reflects an article's relative risk of bias. The study design and level of evidence was classified by the consensus opinion between 2 authors (M.L.M. and

J.R.P.). If a consensus could not be obtained, the senior author was consulted for a final decision. The final list of the 50 most-cited papers was then organized based on total citations and presented in descending order. The data included in this analysis are current up to December 14, 2020. Citation density was then

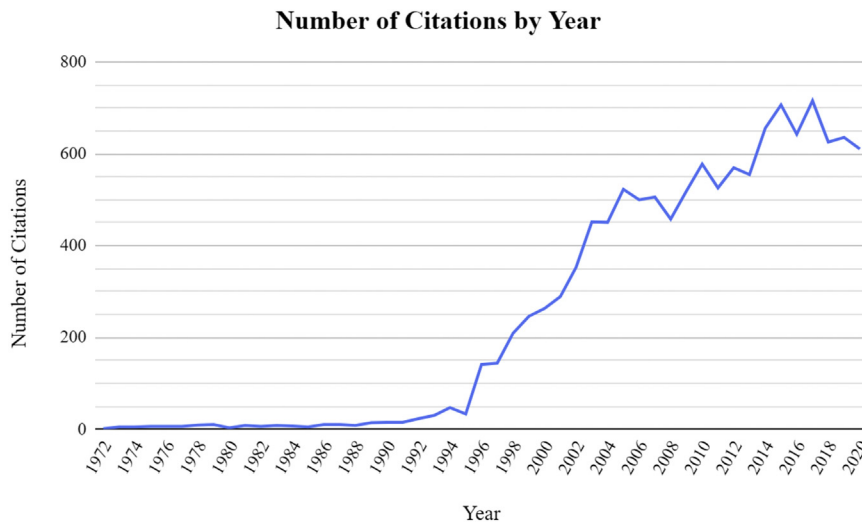


Fig 2. The number of citations accrued by the top 50 knee arthroscopy papers over time.

calculated by the total number of citations divided by the years since the paper was published.¹⁰

Results

The 50 most-cited knee arthroscopy articles were published between 1972 and 2013. A majority of the papers were published after 1996, and nearly one half were published in the 1990s. Three years, 1996, 2002, and 2013, were particularly productive, with 4 articles published in each year (Fig 1). In total, the number of citations for these 50 studies numbered 12,168. This averaged to 243.4 citations per paper. The total number of citations for the top 50 articles ranged from 141 to 1,220 (Table 1).⁴⁴⁻⁹³

Citation density was analyzed in addition to total citation. The most-cited article, published in 2002, accumulated 1,220 citations. It was also the most citation dense, averaging 64.2 citations per year. The least citation-dense article,⁹³ with an average of 2.9 citations per year, was the oldest article in our study (1972). This article also ranked 50th in total citations with 141 total citations at the time of this analysis. In addition, the year each citation occurred was recorded. In general, the number of citations increased from 1972 to 2020. The most citations in any one calendar year were 716 in 2017, followed by 700 in 2015 (Fig 2).

The articles were also analyzed for their author, journal, and country of origin. Of all the authors represented, 4 authors had more than one first author work on the 50 publications included in this study. Fanelli had 3 papers, whereas Adachi, Bach, and Herrlin had 2 papers each. Overall, 10 different journals were represented. The journals with the most studies from the top 50 articles were the *American Journal of Sports Medicine* and *Arthroscopy*, each with 14 citations (Table 2). In total, there were 14 different countries of origin represented by these articles. The United States

represented 26 of the 50 articles (52%). Japan and Sweden were both tied for second with 4 articles (8% each) (Fig 3).

There were 6 different study types represented in the 50 articles: randomized control, cohort study, case–control study, case series, review article, and descriptive articles. Of these, case series design was the most used, with 20 articles. Nonrandomized controlled trial and case reports were not represented (Table 3). In addition, the levels of evidence used in the articles were reported (Fig 4). Level IV was the most common level of evidence included in these articles with 21 articles. The next most common was Level II with 10 articles, followed closely by Levels I and V with 8 and 7 articles, respectively.

Discussion

The 50 most-cited studies in orthopaedic knee arthroscopy represent a wide range of topics with publication years ranging from 1972 to 2013. These 50 articles were cumulatively cited more than 12,000 times, with the most-cited article receiving 1,220

Table 2. The Number of 50 Most-Cited Knee Arthroscopy Papers Published per Journal

Journal Title	Number of Articles
<i>American Journal of Sports Medicine Arthroscopy</i>	14
<i>Journal of Bone and Joint Surgery</i>	-
American Volume	5
British Volume	3
<i>Knee Surgery, Sports Traumatology, Arthroscopy</i>	6
<i>New England Journal of Medicine</i>	4
<i>Archives of Orthopaedic and Trauma Surgery</i>	1
<i>Arthritis and Rheumatism</i>	1
<i>Clinical Orthopaedics and Related Research</i>	1
<i>Journal of Knee Surgery</i>	1
Total journals: 10	

Number of Articles by Country of Origin

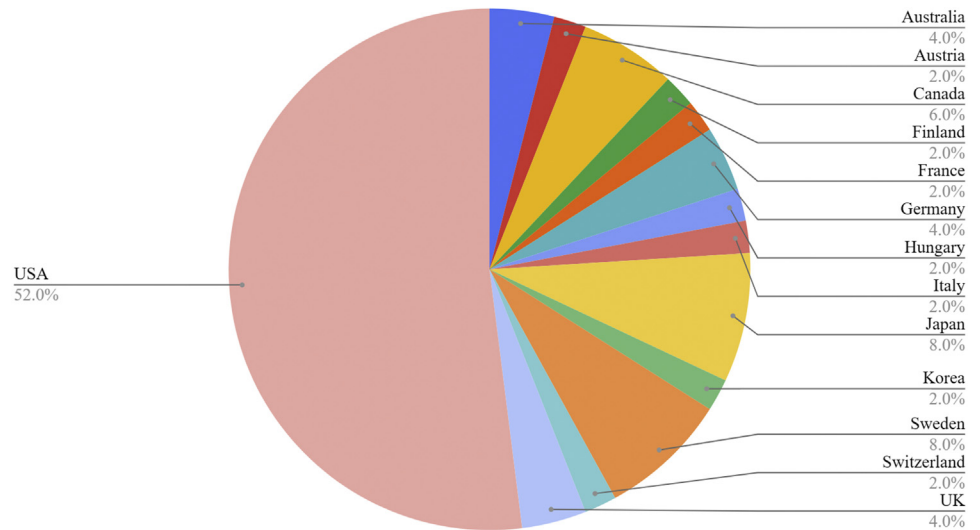


Fig 3. The percent of the top 50 knee arthroscopy papers originating from each country.

citations. In addition, most of the articles included in this analysis originated from the United States (n = 26), were case series (n = 20), and had Level IV evidence (n = 21).

Citation analyses objectively identify studies that shaped the field and offer valuable insight into the history and evolution of a specialty. Knee arthroscopy is not only the first type of arthroscopy to be performed, it is one of the most common orthopaedic procedures performed in the United States today.^{2,5,8,9} The most-cited literature in knee arthroscopy is expected to reflect the trends and growth of the field itself. Students, residents, fellows, and surgeons can use these papers to examine the characteristics of the most-cited studies in knee arthroscopy, gain an understanding of the innovation over time, and focus their research contributions.

It is thought that older articles may have an advantage in total citations. Unexpectedly, the oldest publication, published in 1972,⁹³ ranked 50th in total citations and 50th in citation density. Moreover, one of the more recent papers, published in 2013,⁴⁶ ranked third in total citations and second in citation density.

Table 3. The Study Design Represented in the Top 50 Knee Arthroscopy Papers

Type	Number of Articles
Randomized Controlled Trial	7
Nonrandomized Controlled Trial	0
Cohort Study	12
Case-control Study	1
Case Series	20
Case Report	0
Review Article	3
Descriptive Article	7

Although older articles have longer time to accrue citations than newer articles, older articles also can be outdated and eventually cited less over time. This concept is referred to as obliteration by incorporation.³² Notwithstanding, consideration of both total citations and citation density is needed to fully comprehend the influence of a scientific paper.

Nearly one half of the 50 most influential articles in knee arthroscopy were published in the 1990s. This is consistent with the rapid use of knee arthroscopy after it was accepted to be superior to open arthrotomy in the mid-1980s.⁷ Other citation analyses have similarly demonstrated that the majority of highly cited papers in orthopaedics are published between the 1970s and 1990s.^{27,32,34,39} Essentially, these earlier articles have an advantage because they can be inherently more foundational to the field. However, it is also unsurprising with the current expansion of arthroscopy procedures that nearly 40% of the publications occurred after 2000.

The United States had the majority (52%) of the highly cited publications in knee arthroscopy. This is consistent with other orthopaedic studies and can be a result of several factors.^{27,28,31,38} First of all, the United States is known to have the greatest health care expenditures per capita and is one of the most productive in biomedical research.⁹⁴⁻⁹⁶ Knee arthroscopy is also especially popular in the United States. Although the number of knee arthroscopy procedures is not regularly reported, an estimated 956,000 procedures were performed in 2006 alone.⁹⁷ It is possible that the representation of the United States in the top 50 influential knee arthroscopy papers is a reflection of the sheer volume of knee arthroscopy use and advancement originating from the United States.

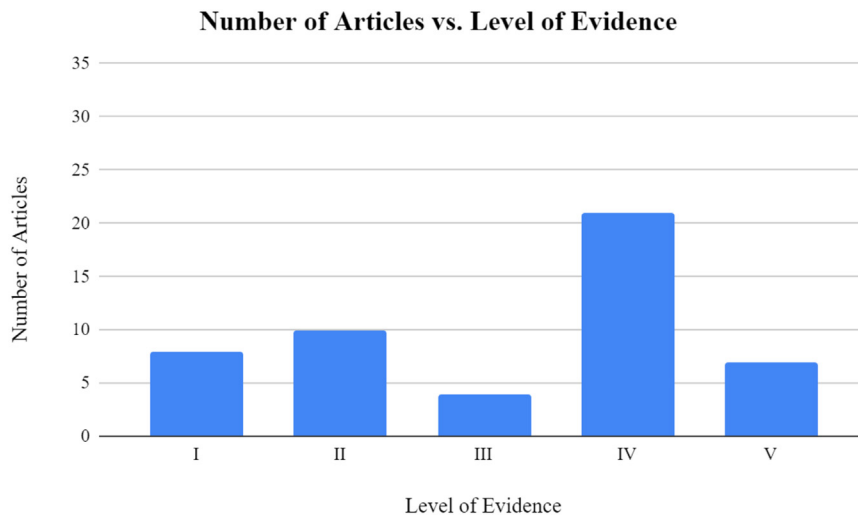


Fig 4. Categorization of the top 50 most-cited knee arthroscopy articles by level of evidence.

Another factor that might influence a study's total citations is the reputation of the journal. Together, the *American Journal of Sports Medicine* and *Arthroscopy* published more than one half of the most influential knee arthroscopy papers included here. In terms of individual contributions, the 2 journals had equal representation with 14 articles each. These journals were similarly highlighted in other orthopaedic citation analyses as well.^{31,33}

Hierarchies of evidence are quantitative representations of the quality of the study design, the legitimacy of its results and its relevance to practice. The most common level of evidence was Level IV ($n = 21$), which corresponds to the most common study designs represented: case series ($n = 20$) and cohort studies ($n = 12$). Ahmad et al.³² saw a similar distribution of levels of evidence and type of study as did several other orthopaedic studies.^{27,31} Propitiously, these data suggest that large impacts have been made by studies with small groups of patients. This may reflect the relatively young age of knee arthroscopy and would be interesting to reevaluate to determine if systematic reviews and randomized controlled trials gradually replace Level IV studies.

Limitations

A limitation of this study is the incomplete congruence between an article's impact and its total number of citations. Although the measure is generally representative and more objective than other means, influential articles can be overlooked. Some subjectivity was unavoidable in making final inclusion or exclusion decisions. Despite this limitation, we reduced this subjectivity through consensus of multiple authors. Though the Web of Knowledge database does perform quality control, we recognize that bias may be introduced at the data level by authors who cite their own

works or preferentially cite from certain journals. However, citations resulting from these actions probably serve as a small fraction of the total citations, considering these 50 articles were cited more than the multitude of other articles in knee arthroscopy. With the limitations discussed, citation analysis remains a widely accepted tool to measure a publication's impact on the field.

Conclusions

The 50 most influential articles in knee arthroscopy were cited a total of 12,168 times. The study designs most commonly used were case series and cohort studies. This article serves as a reference to direct orthopaedic practitioners to the 50 most influential studies in knee arthroscopy. We hope that these 50 studies and the analysis we provide help healthcare professionals efficiently assess consensus, trends and needs within the field.

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