

The Top 50 Most-Cited Shoulder Arthroscopy Studies



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Purpose: To determine the 50 most frequently cited studies in the orthopaedic shoulder arthroscopy literature and to conduct a bibliometric analysis of these studies. **Methods:** The Clarivate Analytics Web of Knowledge database was used to gather data and metrics using Boolean queries to capture all possible iterations of shoulder arthroscopy research. The search list was sorted so that articles were organized in descending order based on the number of citations and included or excluded based on relevance to shoulder 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 13,910, with an average of 278.2 citations per paper. The most-cited article was cited 1134 times, whereas the second- and third-most cited articles were cited 920 and 745 times, respectively. All 50 articles were published in English and came from 7 different orthopaedic journals. The United States was responsible for most of the included articles (31), followed by France (9) and Japan (3). **Conclusions:** The majority of the most-cited articles in shoulder arthroscopy are case series and descriptive studies originating from the United States. In addition, more than one half of the top 50 most-cited studies were published after 2004, which suggests that article age may be less important in the accumulation of citations for a rapidly growing field like shoulder arthroscopy. **Clinical Relevance:** The top 50 most-cited studies list will provide researchers, medical students, residents, and fellows with a foundational list of the most important and influential academic contributions to shoulder arthroscopy.

Arthroscopic surgery has significantly advanced the field of orthopaedic surgery and is often regarded as one of the greatest improvements in orthopaedic care.¹ Arthroscopic procedures can be performed on nearly any joint in the human body and represent an attractive alternative to open procedures, as they are typically associated with lower pain scores and faster functional recovery.¹ The use of arthroscopic procedures of the shoulder has been on the rise and is projected to continue to increase through 2025.²

Shoulder arthroscopy was first described and performed in a diagnostic capacity by the American

surgeon Michael S. Burman as early as 1931 during his cadaveric studies.^{3,4} However, the first clinical use of shoulder arthroscopy in the literature did not appear until 1965 in the setting of treatment for adhesive capsulitis.⁵ In the 1980s, James Andrews and Harvard Ellman helped support the widespread use of shoulder arthroscopy as a method for rotator cuff debridement and subacromial decompression in orthopaedic surgery.^{6,7} Further advancements were made through the 1980s and 1990s in the treatment of shoulder instability, including arthroscopic Bankart repair.⁸⁻¹⁰ Since then, arthroscopic management for a variety of shoulder pathologies has continued to advance and the indications for shoulder arthroscopy have rapidly expanded to include management of shoulder instability, fractures of the humerus and glenoid, rotator cuff repair, and many other soft-tissue pathologies.³

The development of shoulder arthroscopy has been rapid, and it is increasingly difficult for clinicians to stay up to date with the current state of the literature and its evolution over the past 4 decades. To fully understand the current state of the shoulder arthroscopy literature, it is invaluable to be familiar with the foundational articles and studies upon which the field is built. Citation analyses are an effective and useful way to objectively determine the impact that a particular article or

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group of articles have had on a specific topic or field.¹¹⁻¹⁴ The number of citations accrued by a study is an important indicator of the influence that a particular work has had on its subject area.^{11,13,15-26} Several studies analyzing the most impactful general orthopaedic articles have previously been performed in addition to several orthopaedic subspecialties, including hip arthroscopy, hip and knee arthroplasty, pediatric orthopaedics, knee surgery, and hand surgery.²⁷⁻³² In addition, Namdari et al.³³ performed a bibliometric analysis that analyzed the top 50 citations in orthopaedic shoulder surgery; however, only 3 of the included articles had any mention of shoulder arthroscopic surgery. An analysis by Cassar et al.³⁴ examined the top 25 most-cited articles in arthroscopic surgery as a field; however, this study only included 3 shoulder arthroscopy studies when all databases were searched. Shoulder arthroscopy is a dynamic field that is rapidly evolving and expanding, as such, it is important to analyze the most influential studies in this growing area of research and clinical practice. The purpose of this study was to determine the 50 most frequently cited studies in the orthopaedic shoulder arthroscopy literature and to conduct a bibliometric analysis of these studies. The hypothesis of this study was that publication year would have a noticeable influence on the number of citations that an article was able to generate.

Methods

Given the public nature of this data, institutional review board approval was deemed unnecessary. As described in similar studies conducting bibliometric analyses of orthopaedic literature, the Clarivate Analytics Web of Knowledge database was used to gather data and metrics.²⁷⁻³⁴ The literature search took place on March 29, 2020, and used varying Boolean queries to capture all possible iterations of shoulder arthroscopy research. The Boolean search with the greatest number of results was used. The final Boolean search phrases were: [(shoulder) AND (arthroscopy OR arthroscopic) AND (shoulder arthroscopy OR arthroscopic shoulder OR shoulder arthroscopic)]. No date, language, journal, or country of origin restrictions were placed on this search. This resulted in 10,976 total articles.

The search list was sorted so that articles were organized in descending order based on the number of citations. The title and abstract of each article were then reviewed to determine its relevance to shoulder arthroscopy. If the study did not present information on surgical indications, descriptions of procedures, surgical outcomes, or complications of arthroscopic shoulder procedures, the article was excluded. Only articles that had shoulder arthroscopy as the focus of the study were included. Studies with peripheral mention of shoulder arthroscopy were excluded. In addition, articles that only used arthroscopy to methodologically diagnose a

pathology but did not offer further discussion or research on shoulder arthroscopy techniques, indications, outcomes, management, or complications explicitly were excluded. For example, a study that described the patterns of injury that resulted in SLAP lesions of the shoulder was not included in the analysis because it only mentioned shoulder arthroscopy briefly as a tool to diagnose the SLAP lesion and did not make it a focus of the manuscript. If a study was unclear or if there was a question as to whether it should be excluded, the full article was obtained and reviewed by 2 independent authors (M.L.M. and J.R.P.) to ultimately decide on inclusion or exclusion.

A total of 126 articles were reviewed to reach the 50 most cited studies that met the inclusion criteria. These 50 studies were reviewed to obtain the following information: author name, publication year, country of origin, journal name, article type (expert opinion, review article, descriptive study, case report, case series, case-control study, cohort study, randomized controlled trial), and the level of evidence for clinical articles based on the guidelines published by *The Journal of Bone and Joint Surgery*.³⁵ The level of evidence of a study is an indicator of the relative risk of bias, not necessarily of its quality. The level of evidence was determined by a consensus opinion between the first and second authors M.L.M. and J.R.P.). If there was still a question of classification, the senior author, J.S.B., was consulted. If an article simply reviewed the literature, and no systematic approach was used, it was classified in the "expert opinion" category. However, if an article incorporated a systematic approach to reviewing the literature or if a meta-analysis was performed, the article was classified in the "review article" category. Bibliometric metrics were compiled and presented by the year of publication. The citation density, which represents the number of citations per year since publication, for each of the 50 studies also was calculated and recorded.

Results

For the 50 included studies, the earliest year of publication was 1985 and the latest was 2013. Of these studies, 36 were published after 2000 and more than one half were published after 2004. Of these studies, 2007 had the most articles published (9) followed closely by 2005 (7) (Fig 1). For these 50 studies, the total number of citations was calculated to be 13,910, with an average of 278.2 citations per paper. The most commonly cited article was cited 1134 times (Galatz et al.³⁶) at the time the search was performed. The second- and third-most cited articles were cited 920 and 745 times, respectively (Burkhart and De Beer³⁷ and Boileau et al.³⁸). There also existed a large range between the most-cited (1134) and the least-cited article (161; Andrews et al.⁶). Across the 50 most-cited studies

Number of Articles Published by Year

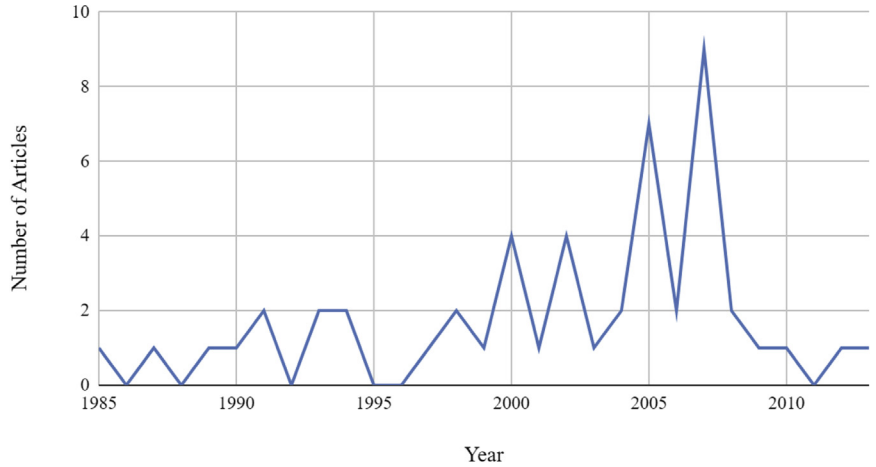


Fig 1. The total number of top 50 cited shoulder arthroscopy articles published per year.

in this analysis, the most citations in a single year occurred in 2018 (1154), followed by 2012 and 2016 (1099 and 1092 citations, respectively). There also exists tremendous growth in the number of citations that the selected articles have generated since 2000 (Fig 2).

In addition to analyzing the articles by total number of citations, they were also analyzed by the citation density or the number of citations divided by the number of years since publication (Table 1).³⁹⁻⁸³ The top 3 articles by citation density can be attributed to Galatz et al.³⁶ (66.7 citations/year), Boileau et al.³⁸ (46.6 citations/year) and Colvin et al.⁴¹ (46.4 citations/year). The oldest article included in this study, published in 1985, by Andrews et al.⁶ placed last in both the total number of citations (161) and the citation density (4.5 citations/year). Mihata et al.⁵⁸ was the author of the most recent article published in 2013 and ranked 24th in the number of citations (212) and 7th in

citation density (26.5 citation/year). Articles published in 2004 or after had an average citation density of 22.1 while articles published before 2004 had an average citation density of 10.4.

Of the top 50 most-cited shoulder arthroscopy articles, Boileau et al. and Burkhart and De Beer were responsible for the most publications, at 5 each. They were followed closely by Gartsman, Lafosse, and Mazzocca at 3 publications each. All 50 articles were published in English and came from 7 different orthopaedic journals (Table 2). Of these journals, *Arthroscopy* was the most represented, with 21 articles, followed by the *Journal of Bone and Joint Surgery - American Volume* (15) and the *American Journal of Sports Medicine* (8). The 50 top shoulder arthroscopy articles also originated from 8 different countries (Fig 3). The United States was responsible for the majority of the included articles (31), followed by France (9) and Japan (3). The study

Number of Citations by Year

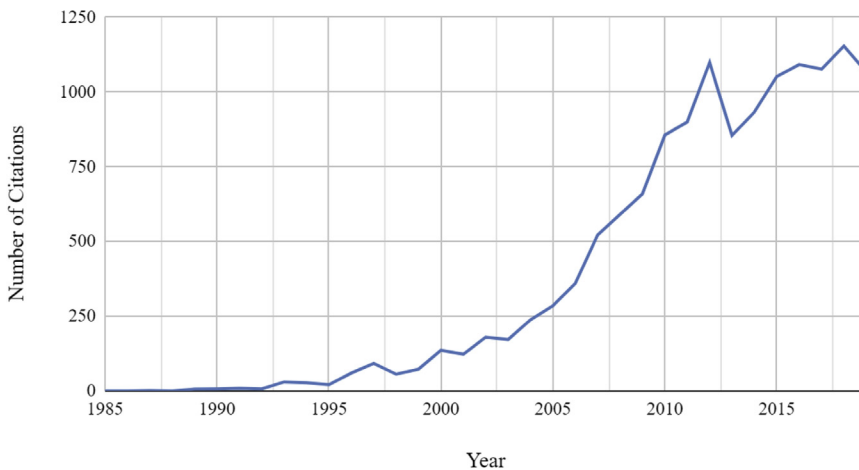


Fig 2. The total number of citations generated by the top 50 cited shoulder arthroscopy articles per year.

Table 1. The Top-50 Cited Shoulder Arthroscopy Articles

Rank	Article	No. of Citations (Citation Density*)
1	Galatz LM, Ball CM, Teefey SA, Middleton WD, Yamaguchi K. The outcome and repair integrity of completely arthroscopically repaired large and massive rotator cuff tears. <i>J Bone Joint Surg</i> 2004;86:219-224 ³⁶	1134 (66.7)
2	Burkhart SS, De Beer JF. Traumatic glenohumeral bone defects and their relationship to failure of arthroscopic Bankart repairs: Significance of the inverted-pear glenoid and the humeral engaging Hill-Sachs lesion. <i>Arthroscopy</i> 2000;16:677-694 ³⁷	920 (43.8)
3	Boileau P, Brassart N, Watkinson DJ, Carles M, Hatzidakis AM, Krishnan SG. arthroscopic repair of full-thickness tears of the supraspinatus: Does the tendon really heal? <i>J Bone Joint Surg</i> 2005;87:1229-1240 ³⁸	745 (46.6)
4	Boileau P, Villalba M, Héry J-Y, Balg F, Ahrens P, Neyton L. Risk factors for recurrence of shoulder instability after arthroscopic Bankart repair. <i>J Bone Joint Surg</i> 2006;88:1755-1763 ³⁹	503 (33.5)
5	Sugaya H, Maeda K, Matsuki K, Moriishi J. Repair integrity and functional outcome after arthroscopic double-row rotator cuff repair: A prospective outcome study. <i>J Bone Joint Surg</i> 2007;89:953-960 ⁴⁰	446 (31.9)
6	Colvin AC, Egorova N, Harrison AK, Moskowitz A, Flatow EL. National trends in rotator cuff repair. <i>J Bone Joint Surg</i> 2012;94:227-233 ⁴¹	418 (46.4)
7	Sugaya H, Maeda K, Matsuki K, Moriishi J. Functional and structural outcome after arthroscopic full-thickness rotator cuff repair: Single-row versus dual-row fixation. <i>Arthroscopy</i> 2005;21:1307-1316. ⁴²	399 (24.9)
8	Bishop J, Klepps S, Lo IK, Bird J, Gladstone JN, Flatow EL. Cuff integrity after arthroscopic versus open rotator cuff repair: A prospective study. <i>J Shoulder Elbow Surg</i> 2006;15:290-299 ⁴³	352 (23.5)
9	Balg F, Boileau P. The instability severity index score. <i>J Bone Joint Surg Br</i> 2007;89-B:1470-1477 ⁴⁴	343 (24.5)
10	Ellman H. Arthroscopic subacromial decompression: Analysis of one- to three-year results. <i>Arthroscopy</i> 1987;3:173-181. ⁷	343 (10.1)
11	Teefey SA, Hasan SA, Middleton WD, Patel M, Wright RW, Yamaguchi K. Ultrasonography of the rotator cuff: A comparison of ultrasonographic and arthroscopic findings in one hundred consecutive cases*. <i>J Bone Joint Surg</i> 2000;82:498 ⁴⁵	292 (13.9)
12	Boileau P, Baqué F, Valerio L, Ahrens P, Chuinard C, Trojani C. Isolated arthroscopic biceps tenotomy or tenodesis improves symptoms in patients with massive irreparable rotator cuff tears. <i>J Bone Joint Surg</i> 2007;89:747-757 ⁴⁶	287 (20.5)
13	Walch G, Edwards TB, Boulahia A, Nové-Josserand L, Neyton L, Szabo I. Arthroscopic tenotomy of the long head of the biceps in the treatment of rotator cuff tears: Clinical and radiographic results of 307 cases. <i>J Shoulder Elbow Surg</i> 2005;14:238-246 ⁴⁷	286 (17.9)
14	Franceschi F, Ruzzini L, Longo UG, et al. Equivalent clinical results of arthroscopic single-row and double-row suture anchor repair for rotator cuff tears: A randomized controlled trial. <i>Am J Sports Med</i> 2007;35:1254-1260 ⁴⁸	279 (19.9)
15	Gartsman GM, Khan M, Hammerman SM. Arthroscopic repair of full-thickness tears of the rotator cuff*. <i>J Bone Joint Surg</i> 1998;80:832-840 ⁴⁹	277 (12.0)
16	Lafosse L, Brozka R, Toussaint B, Gobezie R. The outcome and structural integrity of arthroscopic rotator cuff repair with use of the double-row suture anchor technique. <i>J Bone Joint Surg</i> 2007;89:1533-1541 ⁵⁰	276 (19.7)
17	Arciero RA, Wheeler JH, Ryan JB, McBride JT. Arthroscopic Bankart repair versus nonoperative treatment for acute, initial anterior shoulder dislocations. <i>Am J Sports Med</i> 1994;22:589-594 ⁵¹	260 (9.6)
18	Burkhart SS, DeBeer JF, Tehrany AM, Parten PM. Quantifying glenoid bone loss arthroscopically in shoulder instability. <i>Arthroscopy</i> 2002;18:488-491 ⁵²	242 (12.7)
19	Mazzocca AD, Millett PJ, Guanche CA, Santangelo SA, Arciero RA. Arthroscopic single-row versus double-row suture anchor rotator cuff repair. <i>Am J Sports Med</i> 2005;33:1861-1868 ⁵³	240 (15.0)
20	Gartsman GM, Roddey TS, Hammerman SM. Arthroscopic treatment of anterior-inferior glenohumeral instability: Two to five-year follow-up*. <i>J Bone Joint Surg</i> 2000;82:991 ⁵⁴	233 (11.1)
21	Burkhart SS, Danaceau SM, Pearce CE. Arthroscopic rotator cuff repair: Analysis of results by tear size and by repair technique—margin convergence versus direct tendon-to-bone repair. <i>Arthroscopy</i> 2001;17:905-912 ⁵⁵	227 (11.4)

(continued)

Table 1. Continued

Rank	Article	No. of Citations (Citation Density*)
22	Cole BJ, L'Insalata J, Irrgang J, Warner JJP. Comparison of arthroscopic and open anterior shoulder stabilization: A two to six-year follow-up study*. <i>J Bone Joint Surg</i> 2000;82:1108 ⁵⁶	226 (10.8)
23	Mazzocca AD, Bicos J, Santangelo S, Romeo AA, Arciero RA. The biomechanical evaluation of four fixation techniques for proximal biceps tenodesis. <i>Arthroscopy</i> 2005;21:1296-1306 ⁵⁷	226 (14.1)
24	Mihata T, Lee TQ, Watanabe C, et al. Clinical results of arthroscopic superior capsule reconstruction for irreparable rotator cuff tears. <i>Arthroscopy</i> 2013;29:459-470 ⁵⁸	212 (26.5)
25	Liu SH, Baker CL. Arthroscopically assisted rotator cuff repair: Correlation of functional results with integrity of the cuff. <i>Arthroscopy</i> 1994;10:54-60 ⁵⁹	212 (7.8)
26	Bottoni CR, Wilckens JH, DeBerardino TM, et al. A prospective, randomized evaluation of arthroscopic stabilization versus nonoperative treatment in patients with acute, traumatic, first-time shoulder dislocations*. <i>Am J Sports Med</i> 2002;30:576-580 ⁶⁰	210 (11.0)
27	Kim S-H, Ha K-I, Cho Y-B, Ryu B-D, Oh I. Arthroscopic anterior stabilization of the shoulder: Two to six-year follow-up. <i>J Bone Joint Surg Am</i> 2003;85:1511-1518. ⁶¹	207 (11.5)
28	Neviaser TJ. The GLAD lesion: Another cause of anterior shoulder pain. <i>Arthroscopy</i> 1993;9:22-23 ⁶²	203 (7.2)
29	Lafosse L, Lejeune E, Bouchard A, Kakuda C, Gobeze R, Kochhar T. The arthroscopic Latarjet procedure for the treatment of anterior shoulder instability. <i>Arthroscopy</i> 2007;23:1242.e1-1242.e5 ⁶³	195 (13.9)
30	Fabbriciani C, Milano G, Demontis A, Fadda S, Ziranu F, Mulas PD. Arthroscopic versus open treatment of Bankart lesion of the shoulder: A prospective randomized study. <i>Arthroscopy</i> 2004;20:456-462 ⁶⁴	194 (11.4)
31	Huijsmans PE, Pritchard MP, Berghs BM, van Rooyen KS, Wallace AL, de Beer JF. Arthroscopic rotator cuff repair with double-row fixation. <i>J Bone Joint Surg</i> 2007;89:1248-1257 ⁶⁵	193 (13.8)
32	Boileau P, Krishnan SG, Coste J-S, Walch G. Arthroscopic biceps tenodesis: A new technique using bioabsorbable interference screw fixation. <i>Arthroscopy</i> 2002;18:1002-1012 ⁶⁶	192 (10.1)
33	Bond JL, Dopirak RM, Higgins J, Burns J, Snyder SJ. Arthroscopic replacement of massive, irreparable rotator cuff tears using a GraftJacket allograft: Technique and preliminary results. <i>Arthroscopy</i> 2008;24:403-409.e1 ⁶⁷	190 (14.6)
34	Mazzocca AD, Brown FM, Carreira DS, Hayden J, Romeo AA. Arthroscopic anterior shoulder stabilization of collision and contact athletes. <i>Am J Sports Med</i> 2005;33:52-60 ⁶⁸	186 (11.6)
35	Purchase RJ, Wolf EM, Hobgood ER, Pollock ME, Smalley CC. Hill-Sachs "remplissage": An arthroscopic solution for the engaging Hill-Sachs lesion. <i>Arthroscopy</i> 2008;24:723-726 ⁶⁹	186 (14.3)
36	Wheeler JH, Ryan JB, Arciero RA, Molinari RN. Arthroscopic versus nonoperative treatment of acute shoulder dislocations in young athletes. <i>Arthroscopy</i> 1989;5:213-217 ⁷⁰	184 (5.8)
37	Burkhart SS, Tehrany AM. Arthroscopic subscapularis tendon repair: Technique and preliminary results. <i>Arthroscopy</i> 2002;18:454-463 ⁷¹	182 (9.6)
38	Snyder SJ, Pachelli AF, Del Pizzo W, Friedman MJ, Ferkel RD, Pattee G. Partial thickness rotator cuff tears: Results of arthroscopic treatment. <i>Arthroscopy</i> 1991;7:1-7 ⁷²	179 (6.0)
39	Gartsman GM. Arthroscopic acromioplasty for lesions of the rotator cuff. <i>J Bone Joint Surg</i> 1990;72:169-180 ⁷³	176 (5.7)
40	Tauro J. Arthroscopic rotator cuff repair: Analysis of technique and results at 2- and 3-year follow-up. <i>Arthroscopy</i> 1998;14:45-51 ⁷⁴	176 (7.6)
41	Kirkley A, Griffin S, Richards C, Miniaci A, Mohtadi N. prospective randomized clinical trial comparing the effectiveness of immediate arthroscopic stabilization versus immobilization and rehabilitation in first traumatic anterior dislocations of the shoulder. <i>Arthroscopy</i> 1999;15:507-514 ⁷⁵	172 (7.8)
42	Boileau P, Parratte S, Chuinard C, Roussanne Y, Shia D, Bicknell R. Arthroscopic treatment of isolated type II SLAP lesions: Biceps tenodesis as an alternative to reinsertion. <i>Am J Sports Med</i> 2009;37:929-936 ⁷⁶	172 (14.3)
43	Burkhart SS. Arthroscopic treatment of massive rotator cuff tears. Clinical results and biomechanical rationale. <i>Clin Orthop Relat Res</i> 1991;(267):45-56 ⁷⁷	170 (5.7)

(continued)

Table 1. Continued

Rank	Article	No. of Citations (Citation Density*)
44	Lafosse L, Jost B, Reiland Y, Audebert S, Toussaint B, Gobezie R. Structural integrity and clinical outcomes after arthroscopic repair of isolated subscapularis tears. <i>J Bone Joint Surg</i> 2007;89:1184-1193 ⁷⁸	169 (12.1)
45	Brox JI, Staff PH, Ljunggren AE, Brevik JI. Arthroscopic surgery compared with supervised exercises in patients with rotator cuff disease (stage II impingement syndrome). <i>BMJ</i> 1993;307:899-903 ⁷⁹	169 (6.0)
46	Bacilla P, Field LD, Savoie FH. Arthroscopic Bankart repair in a high demand patient population. <i>Arthroscopy</i> 1997;13:51-60 ⁸⁰	169 (7.0)
47	Tashjian RZ, Hollins AM, Kim H-M, et al. Factors affecting healing rates after arthroscopic double-row rotator cuff repair. <i>Am J Sports Med</i> 2010;38:2435-2442 ⁸¹	167 (15.2)
48	Kelly AM, Drakos MC, Fealy S, Taylor SA, O'Brien SJ. Arthroscopic release of the long head of the biceps tendon: Functional outcome and clinical results. <i>Am J Sports Med</i> 2005;33:208-213 ⁸²	166 (10.4)
49	Cole BJ, McCarty LP, Kang RW, Alford W, Lewis PB, Hayden JK. Arthroscopic rotator cuff repair: Prospective functional outcome and repair integrity at minimum 2-year follow-up. <i>J Shoulder Elbow Surg</i> 2007;16:579-585 ⁸³	164 (11.7)
50	Andrews JR, Broussard TS, Carson WG. Arthroscopy of the shoulder in the management of partial tears of the rotator cuff: A preliminary report. <i>Arthroscopy</i> 1985;1:117-122 ⁶	161 (4.5)

*Number of citations per year since publication.

design most prevalent in this analysis were case series (28) followed by randomized controlled trials (7) and cohort studies (6) (Table 3). This is closely correlated to the level of evidence, with Level IV being the most common (29) followed by Level I (7) and Level II and V (5 each) (Fig 4).

Discussion

The top 50 articles in shoulder arthroscopy are case series studies (28) and studies with Level IV evidence (29).^{27-29,32,33} Arthroscopic shoulder surgery is a relatively young field, which explains the abundance of case series and descriptive studies. This conclusion is similar to the findings by Barbera et al. in the top 50 cited hip arthroscopy procedures.³² However, it was interesting to note that the second most common study design and level of evidence represented among the top 50 shoulder arthroscopy papers were randomized controlled trials (7) with Level I evidence (7). This differed from similar analyses performed for hip arthroscopy literature (0) and shoulder surgery literature (0).^{32,33} The reasoning for this is unclear, but it

may be attributed to the rapid adoption and use of arthroscopic shoulder procedures over the past 3 decades.⁴⁰ For these types of procedures to be used at such a large scale, robust evidence in the form of randomized controlled trials were necessary.

In addition, as the state of the shoulder arthroscopy literature progresses, it is likely that more randomized controlled studies will displace case series and expert opinion articles in the top 50 most-cited studies. Case series and expert opinion articles are useful pieces of the literature; however, randomized controlled trials provide even stronger and more influential findings that have a much better likelihood of significantly impacting the clinical practice of shoulder arthroscopy.

Another interesting finding presented in our study was the spike of publications in 2007 (9) and 2005 (7) and the majority of the most cited articles being published after 2000. Barbera et al.³² found a similar trend among the most-cited articles in hip arthroscopy. There was a trend in hip arthroscopy toward most studies being published after 2007 with the largest spike in publications occurring in 2009.³² This is in congruence with the majority of shoulder arthroscopy papers being published since 2000 and the large spikes in 2007 and 2005. This finding was surprising, as articles published earlier typically have an advantage in terms of the total number of citations generated because they provide a scientific foundation for which subsequent studies in the field are based upon. For example, similar orthopaedic bibliometric analyses have demonstrated the majority of the top-cited articles occurred between the 1970s and 1990s as one would expect.^{13,27,29,30,33}

The difference seen between our study and many other orthopaedic bibliometric analyses can likely be

Table 2. The Top 50 Cited Shoulder Arthroscopy Journals of Origin

Journal of Origin	Number of Articles
Arthroscopy	21
Journal of Bone and Joint Surgery	
American Volume	15
British Volume	1
American Journal of Sports Medicine	8
Journal of Shoulder and Elbow Surgery	3
BMJ-British Medical Journal	1
Clinical Orthopaedics and Related Research	1

Number of Articles by Country of Origin

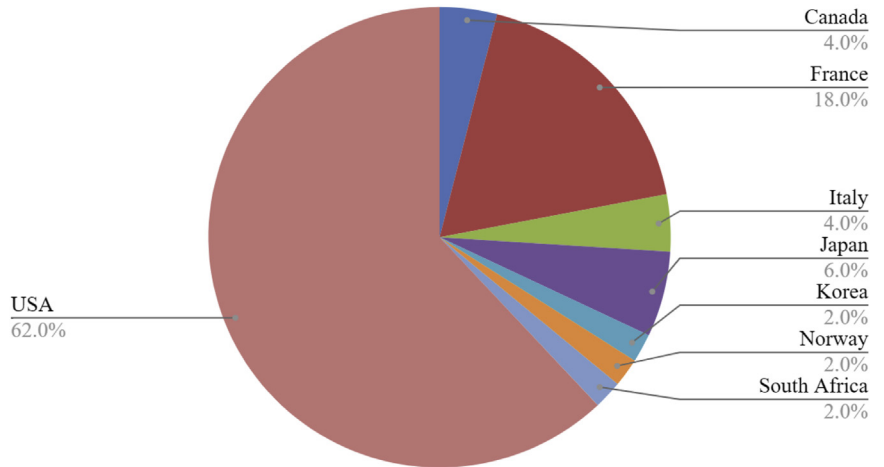


Fig 3. The number of top 50 cited shoulder arthroscopy articles by the country of origin.

attributed to the rapid development, use, and expansion of arthroscopic technologies over the past 2 decades with projected development and expansion continuing well into the 2020s.^{2,41,84-86} Arthroscopy is a relatively newer technique in the practice of orthopaedics, with its usage constantly being expanded and advanced.

In addition to the time of publication, we found the publishing language, country of origin, and publishing journal are factors that may affect an article’s total number of citations. All 50 of the most-cited shoulder arthroscopy articles were published in English, which suggests that articles written in other languages such as French or Mandarin may be at a disadvantage in the number of citations able to be generated. The included articles had countries of origin that are all highly industrialized and rank near the top in health care expenditures. Most of the articles in this analysis originated from the United States (31). This is consistent with similar studies performed in orthopaedics, where the United States had the greatest number of most cited articles.^{27-29,32,33} This finding may suggest that authors publishing outside of the United States may be at a disadvantage; however, it is possible that this trend also may reflect either the sheer number of publications coming from authors in the United States.

Most of the articles were published in *Arthroscopy* (21) and the *Journal of Bone and Joint Surgery - American Volume* (15) and *The American Journal of Sports Medicine* (8). Barbera et al.³² found similar results, with *Arthroscopy* (24) and the *Journal of Bone and Joint Surgery - American Volume* (3) and *The American Journal of Sports Medicine* (9). This is reflective of the high reputation and large impact that these journals occupy within the field of shoulder arthroscopy and orthopaedics in general.

Lastly, regarding the content of the 10 most-cited pieces of literature in shoulder arthroscopy, rotator

cuff repair and outcome is the most common (60%), followed by Bankart repair (20%), shoulder instability (10%), and subacromial decompression (10%). The 6 rotator cuff articles were published between 2004 and 2012 which coincided with the rapid increase in use of arthroscopic rotator cuff repair versus open repair in the United States.^{85,87} These key rotator cuff publications discussed topics such as the outcome and repair integrity of arthroscopically repaired large and massive rotator cuff repairs and single versus dual-row fixation, which are still topics of research and publication more than a decade later. In addition, one of the earliest mentions of arthroscopic subacromial decompression in the literature was the 10th most cited article. This article by Ellman found that although “technically challenging,” arthroscopic subacromial decompression is a valid alternative to open anterior acromioplasty in stage II or III.⁷ Currently, subacromial decompression is a common orthopaedic procedure, but a recent study by Beard et al.⁸⁸ has suggested that this procedure may not have as much benefit as previously thought. This is all to show that even though many of the impactful articles included in this analysis are over 10 or 20 years old, they still hold substantial clinical relevance to students and new physicians becoming familiar with the

Table 3. The Top 50 Cited Shoulder Arthroscopy Articles by Study Type

Study Type	Number of Articles
Randomized controlled trial	7
Nonrandomized controlled trial	1
Cohort study	6
Case-control Study	3
Case series	28
Case report	0
Review article	0
Descriptive article	5

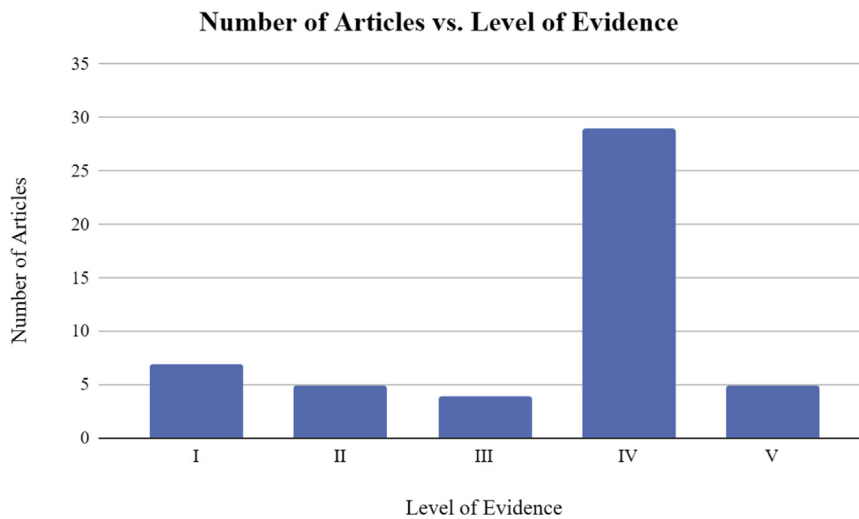


Fig 4. The number of top 50 shoulder arthroscopy articles by level of evidence.

literature and building a foundation from which future publications can be interpreted.

Limitations

A limitation of this study included the selection criteria for the identification of the top 50 most-cited shoulder arthroscopy articles. The selection criteria for relevant shoulder arthroscopy articles were well defined, but a partially subjective decision of inclusion or exclusion still had to be made. However, the authors attempted to be as objective as possible by incorporating multiple authors in the review process if ambiguity was noted. The number of citations an article has is an important metric, but it is not a perfect method for measuring an article's impact. Articles that had fewer citations but have had significant impacts on the field of shoulder arthroscopy may have been overlooked. However, by filtering articles by number of citations, the authors were able to be as objective as possible in developing a list of the 50 most influential articles. Second, the number of citations that a particular article accumulates can be influenced and impacted by many factors.³³ For example, we did not take into account self-citations; therefore, high-volume authors who self-cite many times may be at a slight advantage when it comes to total number of citations and citation density. In addition, authors may cite authors and articles who have published in journals that they too wish to publish in which is a source of bias that cannot be controlled for. Also, more recent articles may have a high citation density but overall lower number of citations. Likewise, older articles have more time to accumulate citations, which may exclude the most recent articles and favor older articles. However, this study showed that the majority of articles in this bibliometric analysis were published relatively recently, which suggests that number of years since publication may be less

important in a rapidly growing field like shoulder arthroscopy. Finally, the Web of Knowledge Database was used in this analysis. This database is comprehensive, but it is possible that influential articles were excluded by the search criteria or the categorization of articles by citation number.

Conclusions

The majority of the most-cited articles in shoulder arthroscopy are case series and descriptive studies originating from the United States. In addition, more than one half of the top 50 most-cited studies have been published after 2004, which suggests that article age may be less important in the accumulation of citations for a rapidly growing field like shoulder arthroscopy.

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