

## The 50 Most Cited Articles in Shoulder Arthroplasty

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### ABSTRACT

**AIM:** Citation analyses are often used as a measurement of an article's impact in a specific field of study. Clinically, shoulder arthroplasty has been a rapidly growing field, and there has been ample research done on it in the past few decades. The purpose of this study is to determine the 50 most cited articles in shoulder arthroplasty and their characteristics.

**METHODS:** The Science Citation Index Expanded was searched for citations of articles related to shoulder arthroplasty (including total shoulder, reverse shoulder arthroplasty, and hemiarthroplasty) published in the 72 journals in the category "Orthopedics". The 50 most cited articles were determined and the following characteristics were analyzed in each article: authors, journal, year of publication, country of origin, number of citations, citation density (total number of citations/years since publication), article type (clinical or basic science), article subtype via study design and level of evidence.

**RESULTS:** The number of citations ranged from 594 to 104, with citation density ranging from 28.8 to 4.1. The 50 most cited articles in shoulder arthroplasty were published in 6 of the 72 journals, most from 1970s to 2010s and represented by 10 countries. The articles were composed of 7 study designs with the most common being case series and 7 topics within shoulder arthroplasty. The most common level of evidence was IV (35 out of 50 studies).

**CONCLUSION:** Articles with the highest citation density were those discussing reverse shoulder arthroplasty. The top 50 list provides residents, fellows and researchers with a comprehensive list of the major academic contributions to shoulder arthroplasty.

**Key words:** Total shoulder arthroplasty; Reverse shoulder arthroplasty; Shoulder Hemiarthroplasty; Shoulder replacement; High impact; Most cited

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### INTRODUCTION

Citation analyses have been widely used as a means to measure the academic impact an article instills on a medical specialty<sup>[1-15]</sup>. Lefaivre *et al*<sup>[7]</sup> has provided the 100 most substantial articles in the field of orthopaedics in terms of times cited. The publication focused on orthopedics as a whole and did not hone in on any topic specifically. Namdari *et al*<sup>[11]</sup> narrowed their approach to only evaluating the top 50 most cited articles regarding orthopedic shoulder surgery including articles discussing topics such as labral instability, rotator cuff repair, impingement, arthroplasty, and fractures.

Although Namardi *et al*<sup>[11]</sup> covered shoulder arthroplasty articles in their review, they are comprised of only four articles out of their top 50. Within the past couple of decades shoulder arthroplasty has grown in popularity<sup>[16]</sup>, mainly driven by the increased interest in

total and reverse shoulder arthroplasty. However, a detailed literature search was unable to identify a publication specifically evaluating the top cited articles regarding this procedure. The purpose of this study is identify the top 50 most influential papers in shoulder arthroplasty as defined by the number of times cited in the literature.

## MATERIALS AND METHODS

We utilized the ISI Web of Knowledge’s database to conduct this cross-sectional study. The ISI Web of Knowledge contains 72 journals which are listed under the subject category “Orthopedics”<sup>[17]</sup>. In March 2016, we utilized the Web of Science’s “basic search tool” to search its database for articles evaluating shoulder arthroplasty from 1900 to the present. We were then able to display our results by times cited with the database ranking how often each article was cited starting in the order of most cited to least. The top 500 most cited articles were reviewed and any articles that did not include shoulder arthroplasty in its content were excluded. If an article mentioned shoulder arthroplasty but this subject was not the major focus of the publication, the article was excluded. From the top 500 articles whose primary content was based upon the discussion of shoulder arthroplasty, we determined the top 50 mostcited. Resultantly, our analysis included publications discussing total shoulder arthroplasty, reverse total shoulder arthroplasty, as well as hemiarthroplasty of the shoulder.

In a similar fashion to the methods of Lefavre *et al*<sup>[7]</sup> and Namdari *et al*<sup>[11]</sup>, each of the top 50 articles was reviewed for the following criteria: authors, year of publications, source journal of the article, geographic origin of the authors, article type (basic science article, clinical research article), article subtype (basic science, biomechanics, basic science-animal research, basic science-in vitro study, clinical-randomized controlled trial, prospective cohort study, case series, review article, case report, or expert opinion), and level of evidence for clinical articles based on guidelines published by *The Journal of Bone and Joint Surgery American*<sup>[18]</sup>.

The level of evidence for each article was determined by consensus by two authors (J.B. and S.A.). As in the Lefavre *et al*<sup>[7]</sup> and Namdari *et al*<sup>[11]</sup> articles, we classified each article as methodologic or not based on if it introduced or tested a classification or scoring system. For each article, the citation density was calculated by dividing the number of total citations by the number of years since the article was published. Articles were then classified into one of the following subtopics of shoulder arthroplasty: total arthroplasty, reverse arthroplasty, hemiarthroplasty, revision (all), fracture, and other.

## RESULTS

There were 50 articles included in our list. The number of citations per article varied from 595 to 104 (Table 1). The articles were published from as early as 1974 up until 2011 with the 2000s contributing the most total articles (33) (Figure 1). The majority of the listed top 50 articles were published between 2000 and 2011 (34) and only 16 were published from 1970 to 1999. Only one article was published in the last decade. Evaluating each decade based on its mean number of citations displayed that the 1980s had the greatest mean number (267) followed closely by the 70s (256) (Figure 2).

The top 50 articles were also analyzed based on total number of citations per year since publication (citation density) (Table 1). Wall *et al* became the leading article (28.8 citations/year) with Sirveaux *et al* and Werner *et al* tied for second each with 28.5 citations/year. 47 of the articles were clinical and 3 discussed basic sciences (2 biomechanics, 1 incidence). Only 4 of the 47 articles were considered

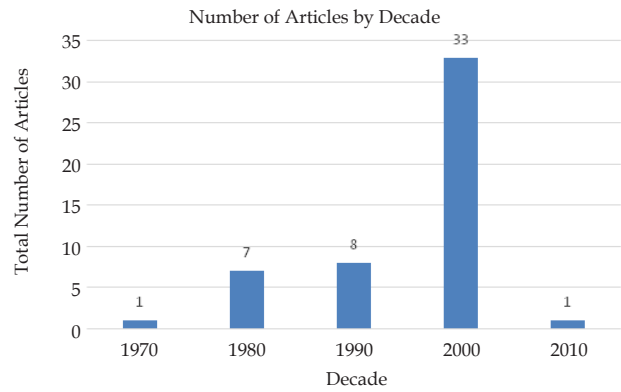


Figure 1 Total number of articles in the top 50 that were published in each decade.

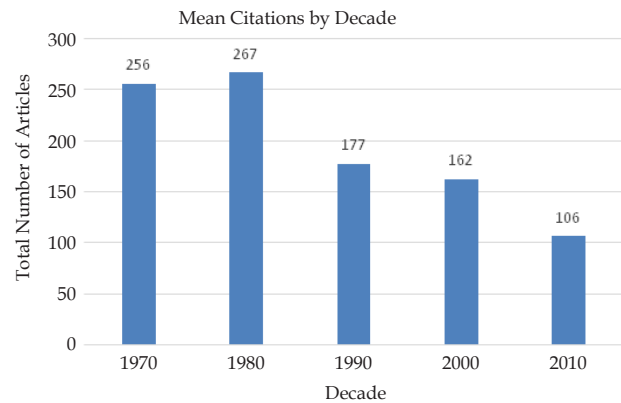


Figure 2 Mean number of citations from the top 50 articles by publication decade.

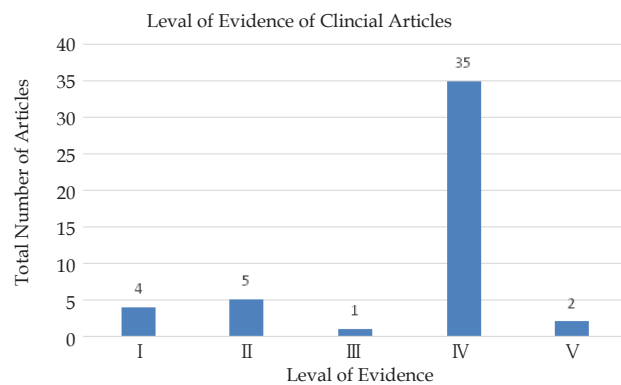


Figure 3 Number of articles per level of evidence.

methodologic. The mean number of citations per article was greater for the clinical non-methodologic articles (183.8 citations/article) than the methodologic (160.3 citations/article). Basic science articles had a relatively low average number of citations per article (154.7 citations/article). A large majority of the 47 clinical articles utilized a case series study design (34) (Table 2). Of these clinical articles, 35 had a level of evidence of IV, and there were no case reports or non-randomized control trials (Figure 3).

All 50 articles were published in English and in 7 different journals (Table 3). Of those, 6 were journals in the orthopaedicspeciality and 1 was published in Instructional Course Lectures. *The Journal of Bone and Joint Surgery - American Volume* published 20 of the top 50 cited articles, the most of all the journals, and the *Journal of Shoulder and Elbow Surgery* trailed closely with 18. The authors originated

from 10 different countries (Figure 4). The US (30) and France (11) contributed the majority of these publications while the other 8 countries combined for only 15 publications. Some articles had authors from multiple countries and were recorded as such. Dividing the articles by topic exhibited that total shoulder arthroplasty and hemiarthroplasty were the most common topics discussed (Figure 5). Some articles discussed multiple topics and were recorded in multiple topic categories. The “Other” category covered an article about infection and 2 articles that generally discussed arthroplasty, not focusing on any topic in particular. Articles were further evaluated in terms of subtype of arthroplasty (Figure 6). It is worth noting that publications assessing reverse shoulder arthroplasty had the greatest mean citation density (19.0) and maximum citation density (28.8). Many articles discussed hemiarthroplasty and total arthroplasty together resulting in similar mean citation densities and maximum citation densities in each category.

## DISCUSSION

The number of times an article is cited has been shown to correlate with its relevance and consequently how impactful an article is on its field of publication<sup>[7,11]</sup>. The aim of this paper was to determine the most influential publications regarding the orthopaedic topic of shoulder arthroplasty including hemiarthroplasty, total shoulder arthroplasty, and reverse shoulder arthroplasty. Lefaivre *et al*<sup>[7]</sup> and Namdari *et al*<sup>[11]</sup> provided similar reviews of the top 100 articles in the orthopaedic field and the top 50 articles in shoulder surgery, respectively. Both articles covered only a few articles regarding shoulder arthroplasty. The intent of this study was to focus on shoulder arthroplasty given the explosive interest and recent technology that have developed in the past 30 years Table 1.

Determining which publications on shoulder arthroplasty are highly cited allowed us to analyze what factors make an article important. The Namdari *et al*<sup>[11]</sup> and Lefaivre *et al*<sup>[7]</sup> papers only referenced a few articles that included clinical long-term outcome studies in their top 50 article. Namdari *et al*<sup>[11]</sup> and Lefaivre *et al*<sup>[7]</sup> reviewed broader topics which allowed for inclusion of older studies since the majority of their citations were published in the 1980s and earlier. Contrarily, the majority of papers in this study were more recent which provides the reader with more relevant, up-to-date information.

Similar to many other reviews and as demonstrated by Figure 4, the United States was responsible for predominant portion of publications<sup>[3,12,14,16,17,10]</sup> likely due to the level of interest in shoulder arthroplasty and a larger volume of this procedure performed annually in the United States compared to other countries. Time also plays an important role in an article’s accumulation of citations, and despite categorizing the articles by citation density, only one article from this decade was included. Therefore, the authors hypothesize that, in general, there might be less interest in shoulder arthroplasty in this decade so far. The majority of articles were published in the 2000s; however, the 1970s and 1980s were responsible for the highest mean citations per decade. Recent changes in the indications of reverse shoulder arthroplasty, leading to the increase in the amount of reverse shoulder arthroplasty procedures performed, has spiked a great interest in this relatively new technology. This interest has lead to the publication of many articles discussing reverse shoulder arthroplasty in the 2000s compared to earlier decades. As a result, articles with the highest citation density were those discussing reverse shoulder arthroplasty. Additionally, the majority of articles were clinical and the most common level of evidence was level IV,

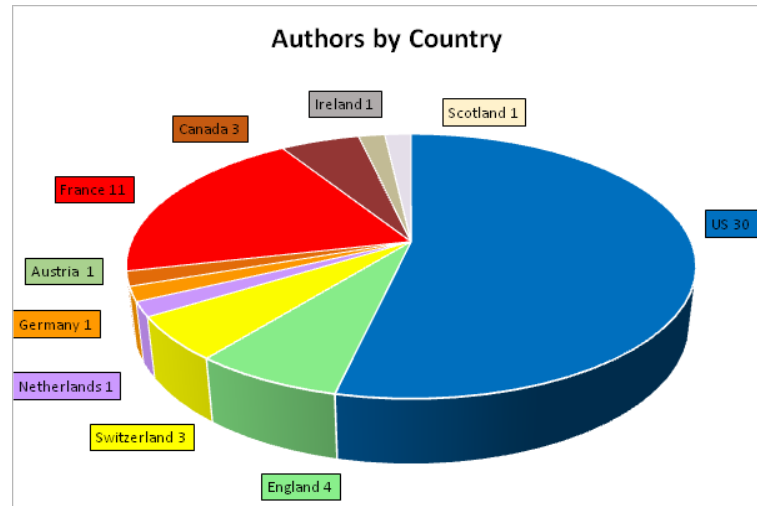


Figure 4 Country of origin of authors from the top 50 articles.

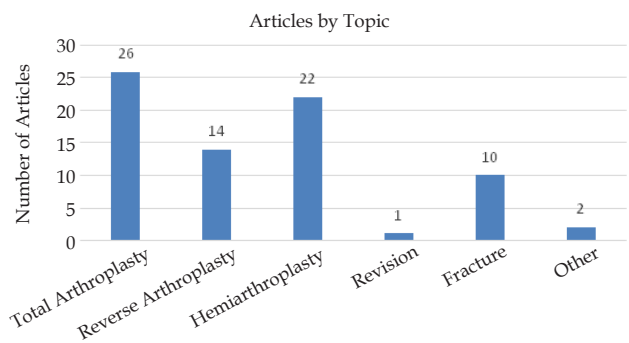


Figure 5 Classification of top 50 articles based on topic discussed. Various articles covered multiple topics and thus were recorded in multiple categories.

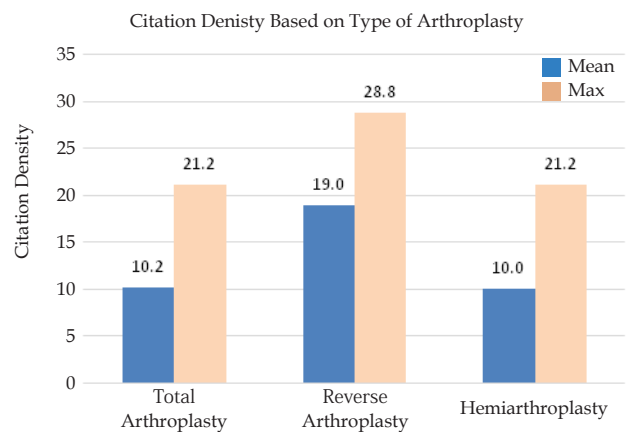


Figure 6 Mean and maximum citation densities of articles based on type of shoulder arthroplasty discussed. Some articles assessed more than one subtype of arthroplasty.

which is also similar to other reviews<sup>[2,6-8,11-12]</sup>. These findings raise the concern that most of our clinical practice guidelines in this field are derived from weak to moderate studies, and therefore highlight the need for strong level I (randomized control trials) or level II (prospective cohort) studies.

**Table 1** Top Fifty Most-cited Articles in Shoulder Arthroplasty.

Rank	Article	No. of Citations (Citation Density‡)
1	Neer CS, Watson KC, Stanton FJ. Recent experience in total shoulder replacement. <i>J Bone Joint Surg Am.</i> 1982; <b>64(3)</b> : 319-37.*	595 (17.5)
2	Sirveaux F, Favard L, Oudet D, Huquet D, Walch G, Mole D. Grammont inverted total shoulder arthroplasty in the treatment of glenohumeral osteoarthritis with massive rupture of the cuff. <i>Bone &amp; Joint Journal</i> 2005; <b>86-B(3)</b> : 388-395.*	342 (28.5)
3	Cofield RH. Total shoulder arthroplasty with the Neer prosthesis. <i>J Bone Joint Surg Am.</i> 1984; <b>66(6)</b> : 899-906.	337 (10.5)
4	Werner CM, Steinmann PA, Gilbert M, Gerber C. Treatment of painful pseudoparesis due to irreparable rotator cuff dysfunction with the Delta III reverse-ball-and-socket total shoulder prosthesis. <i>J Bone Joint Surg Am.</i> 2005; <b>87(7)</b> : 1476-86.*	314 (28.5)
5	Torchia ME, Cofield RH, Settergren CR. Total shoulder arthroplasty with the Neer prosthesis: long-term results. <i>J Shoulder Elbow Surg.</i> 1997; <b>6(6)</b> : 495-505.	288 (15.2)
6	Franklin JL, Barrett WP, Jackins SE, Matsen FA. Glenoid loosening in total shoulder arthroplasty. Association with rotator cuff deficiency. <i>J Arthroplasty.</i> 1988; <b>3(1)</b> : 39-46.*	273 (9.8)
7	Wall B, Nové-josserand L, O'connor DP, Edwards TB, Walch G. Reverse total shoulder arthroplasty: a review of results according to etiology. <i>J Bone Joint Surg Am.</i> 2007; <b>89(7)</b> : 1476-1485.	259 (28.8)
8	Neer CS. Replacement arthroplasty for glenohumeral osteoarthritis. <i>J Bone Joint Surg Am.</i> 1974; <b>56(1)</b> : 1-13.	256 (6.1)
9	Boileau P, Watkinson D, Hatzidakis AM, Hovorka I. Neer Award 2005: The Grammont reverse shoulder prosthesis: results in cuff tear arthritis, fracture sequelae, and revision arthroplasty. <i>J Shoulder Elbow Surg.</i> 2006; <b>15(5)</b> : 527-540.*	254 (25.4)
10	Barrett WP, Franklin JL, Jackins SE, Wyss CR, Matsen FA. Total shoulder arthroplasty. <i>J Bone Joint Surg Am.</i> 1987; <b>69(6)</b> : 865-872.*	251 (8.7)
11	Frankle M, Siegal S, Pupello D, Saleem A, Mighell M, Vasey M. The Reverse Shoulder Prosthesis for glenohumeral arthritis associated with severe rotator cuff deficiency. A minimum two-year follow-up study of sixty patients. <i>J Bone Joint Surg Am.</i> 2005; <b>87(8)</b> : 1697-1705.	245 (22.3)
12	Wirth MA, Rockwood CA. Complications of total shoulder-replacement arthroplasty. <i>J Bone Joint Surg Am.</i> 1996; <b>78(4)</b> : 603-616.	244 (12.2)
13	Boileau P, Watkinson DJ, Hatzidakis AM, Balg F. Grammont reverse prosthesis: design, rationale, and biomechanics. <i>J Shoulder Elbow Surg.</i> 2005; <b>14(1 Suppl 5)</b> : 1475-1615.	235 (21.4)
14	Boileau P, Krishnan SG, Tinsi L, Walch G, Coste JS, Molé D. Tuberosity malposition and migration: reasons for poor outcomes after hemiarthroplasty for displaced fractures of the proximal humerus. <i>J Shoulder Elbow Surg.</i> 2002; <b>11(5)</b> : 401-412.*	214 (15.3)
15	Sperling JW, Cofield RH, Rowland CM. Neer hemiarthroplasty and Neer total shoulder arthroplasty in patients fifty years old or less. Long-term results. <i>J Bone Joint Surg Am.</i> 1998; <b>80(4)</b> : 464-473.	212 (11.8)
16	Guery J, Favard L, Sirveaux F, Oudet D, Mole D, Walch G. Reverse total shoulder arthroplasty. Survivorship analysis of eighty replacements followed for five to ten years. <i>J Bone Joint Surg Am.</i> 2006; <b>88(8)</b> : 1742-7.*	210 (21.0)
17	Bohsali KI, Wirth MA, Rockwood CA. Complications of total shoulder arthroplasty.. <i>J Bone Joint Surg Am.</i> 2006; <b>88(10)</b> : 2279-2292.*	208 (20.8)
18	Robinson CM, Page RS, Hill RM, Sanders DL, Court-brown CM, Wakefield AE. Primary hemiarthroplasty for treatment of proximal humeral fractures. <i>J Bone Joint Surg Am.</i> 2003; <b>85-A(7)</b> : 1215-1223.	171 (13.2)
19	Gartsman GM, Roddey TS, Hammerman SM. Shoulder arthroplasty with or without resurfacing of the glenoid in patients who have osteoarthritis. <i>J Bone Joint Surg Am.</i> 2000; <b>82(1)</b> : 26-34.*	166 (10.4)
20	Amstutz HC, Sew hoy AL, Clarke IC. UCLA anatomic total shoulder arthroplasty. <i>ClinOrthopRelat Res.</i> 1981; <b>(155)</b> : 7-20.	156 (4.5)
21	Simovitch RW, Zumstein MA, Lohri E, Helmy N, Gerber C. Predictors of scapular notching in patients managed with the Delta III reverse total shoulder replacement. <i>J Bone Joint Surg Am.</i> 2007; <b>89(3)</b> : 588-600.*	152 (16.9)
22	Nagels J, Stokdijk M, Rozing PM. Stress shielding and bone resorption in shoulder arthroplasty. <i>J Shoulder Elbow Surg.</i> 2003; <b>12(1)</b> : 35-39	152 (11.7)
23	Rittmeister M, Kerschbaumer F. Grammontreverse total shoulder arthroplasty in patients with rheumatoid arthritis and nonreconstructible rotator cuff lesions. <i>J Shoulder Elbow Surg.</i> 2001; <b>10(1)</b> : 17-22.*	148 (9.9)
24	Wirth MA, Rockwood CA. Complications of shoulder arthroplasty. <i>Clin Orthop Relat Res.</i> 1994; <b>(307)</b> : 47-69.	148 (6.7)
25	Sperling JW, Cofield RH, Rowland CM. Minimum fifteen-year follow-up of Neer hemiarthroplasty and total shoulder arthroplasty in patients aged fifty years or younger. <i>J Shoulder Elbow Surg.</i> 2004; <b>13(6)</b> : 604-613.*	141 (11.8)
26	Cuff D, Pupello D, Virani N, Levy J, Frankle M. Reverse shoulder arthroplasty for the treatment of rotator cuff deficiency. <i>J Bone Joint Surg Am.</i> 2008; <b>90(6)</b> : 1244-1251.	140 (17.5)
27	Goldman RT, Koval KJ, Cuomo F, Gallagher MA, Zuckerman JD. Functional outcome after humeral head replacement for acute three- and four-part proximal humeral fractures. <i>J Shoulder Elbow Surg.</i> 1995; <b>4(2)</b> : 81-86.	140 (6.7)
28	Cofield RH, Edgerton BC. Total shoulder arthroplasty: complications and revision surgery. <i>Instr Course Lect.</i> 1990; <b>39</b> : 449-462.	139 (5.3)
29	Bufoquin T, Hersan A, Hubert L, Massin P. Reverse shoulder arthroplasty for the treatment of three- and four-part fractures of the proximal humerus in the elderly: a prospective review of 43 cases with a short-term follow-up. <i>J Bone Joint Surg Br.</i> 2007; <b>89(4)</b> : 516-520.	134 (14.9)
30	Kralinger F, Schwaiger R, Wambacher M, Farrell E, Menthi-Chiari W, Lajtai G, Hubner C, Resch H. Outcome after primary hemiarthroplasty for fracture of the head of the humerus. A retrospective multicentre study of 167 patients. <i>J Bone Joint Surg Br.</i> 2004; <b>86(2)</b> : 217-9.	134 (11.2)
31	Norris TR, Iannotti JP. Functional outcome after shoulder arthroplasty for primary osteoarthritis: a multicenter study. <i>J Shoulder Elbow Surg.</i> 2002; <b>11(2)</b> : 130-135.	134 (9.6)
32	Tanner MW, Cofield RH. Prosthetic arthroplasty for fractures and fracture-dislocations of the proximal humerus. <i>Clin Orthop Relat Res.</i> 1983; <b>(179)</b> : 116-128.	134 (4.1)
33	Boyd AD, Thomas WH, Scott RD, Sledge CB, Thornhill TS. Total shoulder arthroplasty versus hemiarthroplasty. Indications for glenoid resurfacing. <i>J Arthroplasty.</i> 1990; <b>5(4)</b> : 329-336.	133 (5.1)
34	Edwards TB, Kadakia NR, Boulahia A, et al. A comparison of hemiarthroplasty and total shoulder arthroplasty in the treatment of primary glenohumeral osteoarthritis: results of a multicenter study. <i>J Shoulder Elbow Surg.</i> 2003; <b>12(3)</b> : 207-213.	131 (10.1)
35	Hasan SS, Leith JM, Campbell B, Kapil R, Smith KL, Matsen FA. Characteristics of unsatisfactory shoulder arthroplasties. <i>J Shoulder Elbow Surg.</i> 2002; <b>11(5)</b> : 431-441.	126 (9.0)
36	Iannotti JP, Norris TR. Influence of preoperative factors on outcome of shoulder arthroplasty for glenohumeral osteoarthritis. <i>J Bone Joint Surg Am.</i> 2003; <b>85-A(2)</b> : 251-258.	125 (9.6)
37	Hawkins RJ, Bell RH, Jallay B. Total shoulder arthroplasty. <i>Clin Orthop Relat Res.</i> 1989; <b>(242)</b> : 188-194.	125 (4.6)
38	Nyffeler RW, Werner CM, Gerber C. Biomechanical relevance of glenoid component positioning in the reverse Delta III total shoulder prosthesis. <i>J Shoulder Elbow Surg.</i> 2005; <b>14(5)</b> : 524-528.	123 (11.2)
39	Mighell MA, Kolm GP, Collinge CA, Frankle MA. Outcomes of hemiarthroplasty for fractures of the proximal humerus. <i>J Shoulder Elbow Surg.</i> 2003; <b>12(6)</b> : 569-577.	122 (9.4)
40	Lazarus MD, Jensen KL, Southworth C, Matsen FA. The radiographic evaluation of keeled and pegged glenoid component insertion. <i>J Bone Joint Surg Am.</i> 2002; <b>84-A(7)</b> : 1174-1182.	119 (8.5)
41	Levy J, Frankle M, Mighell M, Pupello D. The use of the reverse shoulder prosthesis for the treatment of failed hemiarthroplasty for proximal humeral fracture. <i>J Bone Joint Surg Am.</i> 2007; <b>89(2)</b> : 292-300.	115 (12.8)

**Table 1** Top Fifty Most-cited Articles in Shoulder Arthroplasty.

Rank	Article	No. of Citations (Citation Density‡)
42	Zyto K, Wallace WA, Frostick SP, Preston BJ. Outcome after hemiarthroplasty for three- and four-part fractures of the proximal humerus. <i>J Shoulder Elbow Surg.</i> 1998; <b>7(2)</b> : 85-89.	114 (6.3)
43	Boileau P, Trojani C, Walch G, Krishnan SG, Romeo A, Sinnerton R. Shoulder arthroplasty for the treatment of the sequelae of fractures of the proximal humerus. <i>J Shoulder Elbow Surg.</i> 2001; <b>10(4)</b> : 299-308.	110 (7.3)
44	Levy O, Copeland SA. Cementless surface replacement arthroplasty of the shoulder. 5- to 10-year results with the Copeland mark-2 prosthesis. <i>J Bone Joint Surg Br.</i> 2001; <b>83(2)</b> : 213-21.	108 (7.2)
45	Bryant D, Litchfield R, Sandow M, Gartsman GM, Guyatt G, Kirkley A. A comparison of pain, strength, range of motion, and functional outcomes after hemiarthroplasty and total shoulder arthroplasty in patients with osteoarthritis of the shoulder. A systematic review and meta-analysis. <i>J Bone Joint Surg Am.</i> 2005; <b>87(9)</b> : 1947-56.	107 (9.7)
46	Boileau P, Avidor C, Krishnan SG, Walch G, Kempf JF, Molé D. Cemented polyethylene versus uncemented metal-backed glenoid components in total shoulder arthroplasty: a prospective, double-blind, randomized study. <i>J Shoulder Elbow Surg.</i> 2002; <b>11(4)</b> : 351-359.	107 (7.6)
47	Kim SH, Wise BL, Zhang Y, Szabo RM. Increasing incidence of shoulder arthroplasty in the United States. <i>J Bone Joint Surg Am.</i> 2011; <b>93(24)</b> : 2249-2254.	106 (21.2)
48	Boualhia A, Edwards TB, Walch G, Baratta RV. Early results of a reverse design prosthesis in the treatment of arthritis of the shoulder in elderly patients with a large rotator cuff tear. <i>Orthopedics.</i> 2002; <b>25(2)</b> : 129-33.	104 (7.4)
49	Sperling JW, Kozak TK, Hanssen AD, Cofield RH. Infection after shoulder arthroplasty. <i>Clin Orthop Relat Res.</i> 2001; <b>(382)</b> : 206-216.	104 (6.9)
50	Sperling JW, Cofield RH, O'driscoll SW, Torchia ME, Rowland CM. Radiographic assessment of ingrowth total shoulder arthroplasty. <i>J Shoulder Elbow Surg.</i> 2000; <b>9(6)</b> : 507-513.	104 (6.5)

‡Citation density: Number of citations/Years since publication; \* Included in ASES curriculum guide bibliography.

**Table 2** Study design of clinical articles.

Journal	No. of Articles
Randomized control trial	2
Nonrandomized control trial	0
Cohort study	6
Case-control study	1
Case series	34
Case report	0
Review article	2
Expert	2

**Table 3** Number of articles on top 50 list by journal.

Journal	No. of Articles
<i>Journal of Bone and Joint Surgery - American Volume</i>	20
<i>Journal of Shoulder and Elbow Surgery</i>	17
<i>Clinical Orthopaedics and Related Research</i>	5
<i>Journal of Bone and Joint Surgery - British Volume</i>	4
<i>The Journal of Arthroplasty</i>	2
<i>Orthopaedics</i>	1
<i>Instructional Course Lectures</i>	1

As Namdari *et al*<sup>[11]</sup> similarly noted, this data may indicate that the more recent influential papers were not accounted for in our review due to lack of time to accumulate citations. However, the methodologies used likely captured the impactful articles in the history of shoulder arthroplasty. Citation density was thus used to help account for the influence of time on the rank list.

Analyzing an article's influence with this method comes with some weaknesses. The first being that only choosing the top 50 articles could have not accounted for other influential papers. Second, self-citation and citations in lectures and textbooks were unaccounted for, all factors that could influence an article's total citations. Additionally, there may be some bias generated by authors who preferentially cite articles from the journals which they are trying to publish in, as this helps drive the impact factor of a journal<sup>[7]</sup>. Namdari *et al*<sup>[11]</sup> and Lefavre *et al*<sup>[7]</sup> limited their search to only journals categorized as "orthopaedics" on the Web of Science. To avoid this limitation, we searched all journals on the Web of Science. Thirdly, as mentioned in Namdari *et al*<sup>[11]</sup> and Lefavre *et al*<sup>[7]</sup>, instead of citing articles based off of their content there is a tendency for authors to cite articles as a result of previous citations. This is known as the snowball effect<sup>[19]</sup>. Finally, the cross-sectional design of the study limits us from

observing the constantly changing number of times each article is cited.

## CONCLUSION

Our review of the top 50 cited articles (Table 1) sums up the major academic contribution to shoulder arthroplasty and may be beneficial for a variety of reasons. Not only is it a comprehensive list of the most influential articles discussing shoulder arthroplasty, but also these articles offer a background of important aspects that can be utilized to guide research and clinical practice in this field. Furthermore, this list can be used to supplement the American Shoulder and Elbow Surgeons (ASES) Curriculum Guide for Treatment of Shoulder Injury<sup>[20]</sup>. Lastly, the top 50 most cited list can provide orthopaedic surgery residents, fellows, orthopaedic surgeons, and healthcare professionals with valuable information regarding arthroplasty as an option for treatment of shoulder pathology.

## CONFLICT OF INTEREST

None of the authors or any member of his or her immediate family has funding or commercial associations (eg, consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted article.

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