

The most influential studies concerning revision shoulder arthroplasty research

Alina Syros^a, Olivia F. Perez^a, Dylan Luxenburg^{a,*}, Jacob L. Cohen^b, Ronald Swonger^a, Samuel Huntley^b

^a University of Miami Miller School of Medicine, 1600 NW 10th Ave #1140, Miami, FL, 33136, USA

^b University of Miami/Jackson Health Systems Department of Orthopedic Surgery, 1611 NW 12th Ave #303, Miami, FL, 33136, USA

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ABSTRACT

Background: Bibliometric analysis is a unique tool that can be used to study the characteristics and trends of a given topic. This study aimed to report on the most influential studies concerning revision shoulder arthroplasty research.

Methods: On July 4th, 2022, the Institute of Scientific Information (ISI) Web of Knowledge Database was used to identify articles concerning revision shoulder arthroplasty research. The top 50 most cited articles were selected and analyzed.

Results: The mean number of citations was 142 (median: 97; range 599–70). Most articles were published in the 2010s (56%), followed by the 2000s (38%), and 1990s (6%). The most common level of evidence (LOE) was LOE II (42%) followed by LOE IV (38%), LOE I and III each had 10%. The greatest number of papers were published in the *Journal of Shoulder and Elbow Surgery* (46%), followed by the *Journal of Bone and Joint Surgery- American Version* (14%).

Conclusion: This review can serve as a useful tool to study the most influential articles concerning revision shoulder arthroplasty research. Most of the articles were classified as clinical outcomes (62%), followed by natural history/epidemiology (12%), and surgical technique (10%). Our findings suggest that high-quality studies (LOE I) are lacking and other areas of research besides clinical outcomes are not as well studied.

1. Introduction

Shoulder arthroplasty is an effective treatment for many pathologies of the shoulder, most commonly severe osteoarthritis, inflammatory arthritis, irreparable rotator cuff pathology, and comminuted proximal humerus fractures.^{1,2} The most predictable outcomes of successful shoulder arthroplasty are pain relief and improved range of motion compared to the pathological state of the patient. Shoulder arthroplasty has come a long way since its inception in 1893 by French surgeon Jules Emile Péan and the beginning of the evolution to modern-day implants in 1955 by Charles Neer with the first shoulder hemiarthroplasty. Well described within the literature, patients undergoing shoulder arthroplasty may receive one of three operations, including hemiarthroplasty, total shoulder arthroplasty (TSA), or reverse total shoulder arthroplasty (RTSA), guided by indications for each.

TSA remains the most commonly performed shoulder arthroplasty. TSA is indicated in patients with osteoarthritis or inflammatory arthritis

demonstrating glenoid chondral wear with adequate bone stock and the absence of rotator cuff pathology or deltoid dysfunction, presenting with significant pain affecting their activities of daily living. Procedural volume and incidence of TSA are on the rise.³ The number of TSA in the United States increased by 103.7% between 2011 and 2017 and is projected to significantly increase again between 2017 and 2025.²

Hemiarthroplasty is primarily indicated in patients with osteoarthritis with insufficient glenoid bone stock, rotator cuff arthropathy with adequate forward flexion at baseline, young and active patients where the risk of prosthetic loosening is high, and those with severe proximal humerus fractures.

Finally, RTSA is indicated in low-demand patients with adequate glenoid bone stock and intact deltoid with rotator cuff arthropathy without adequate forward flexion at baseline, severe proximal humerus fractures in the elderly, rheumatoid arthritis, or failed previous arthroplasty.

With any arthroplasty comes risk of complications, patient

* Corresponding author. 1600 NW 10th Ave. #1140, Miami, FL, 33136, USA.

E-mail address: Dil21@miami.edu (D. Luxenburg).

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dissatisfaction and the need for revision surgery.⁴ Previous meta-analyses report rates of revision arthroplasty for hemiarthroplasty and TSA to be around 11%, and approximately 10% for RTSA when looking at all causes for revision.⁵ Common reasons for revision surgery in shoulder arthroplasty include prosthetic loosening, infection, bony or soft tissue repair failure, glenohumeral instability and dislocation, periprosthetic fracture, iatrogenic rotator cuff tears, and neurologic injury.^{1,6–10} Specific to RTSA, another indication for revision is the development of scapular notching. Further, hemiarthroplasty can lead to progressive glenoid arthrosis leading to failure.^{11,12} Despite the known complications necessitating revision shoulder arthroplasty, overall limited comprehensive data exist within the literature regarding revision procedures.¹³

Bibliometric reviews use statistical analysis to gain insight into the impact of publications on a topic. This is accomplished by analyzing the number of times an article has been cited. Although the number of times an article has been cited does not necessarily equal quality, it does indicate the article has a high level of interest and influence in that space. The information gathered from bibliometric reviews can highlight advances in treatment, identify gaps in knowledge, and guide the direction of future research.^{14,15} To the authors knowledge, this is the first bibliometric review of revision shoulder arthroplasty (rTSA). The objectives of this study are to (1) comprehensively evaluate the 50 most cited, peer-reviewed articles on the topic of rTSA and (2) provide an organized framework that allows providers to easily navigate the existing literature regarding rTSA.

2. Methods

Articles analyzed for this review were queried and selected from the Institute of Scientific Information (ISI) Web of Knowledge Database. The search terms used were shoulder revision OR revision total shoulder arthroplasty OR revision TSA. The query was sorted to only include studies published in the English language. All articles related to the search terms were hierarchically ordered according to citation count. Citation count was inclusive across all databases. Article inclusion criteria included: experiments conducted at the time of rTSA, retrospective or prospective studies on outcomes relating to rTSA, epidemiologic or literature review of rTSA, and pathologic findings leading to rTSA. Exclusion criteria included: studies not directly benefiting the body of knowledge for revision shoulder arthroplasty surgery. Each article was analyzed by a trained researcher for the relation to rTSA based on article content.

Exclusion and inclusion criteria were strictly used to review articles and export a preliminary list of articles. A second trained researcher then reviewed the list of exported articles to determine relevance to the topic. The two researchers agreed on all the top 50 articles to include in this analysis. All data was exported to Microsoft Excel.

A manual review of each article was conducted to extrapolate the level of evidence and article type. Level of Evidence was determined according to the requirements listed in the *Journal of Bone and Joint Surgery*.¹⁶ Classifications for article type were defined by the authors as clinical outcomes, surgical/biomechanical technique, imaging, or natural history/epidemiology. All other variables analyzed were provided with the article results in the initial database query. These variables included: article title, source journal, language, citation count, year published, and country of origin. Microsoft Excel Statistical Package was used to complete statistical analysis.

3. Results

Initial search results yielded 3393 articles. Roughly 400 articles were reviewed, and 101 of those fit inclusion criteria and were exported. After a full-text review of the articles by both trained researchers, a list of the top 50 was compiled.

The 50 most cited articles in revision shoulder arthroplasty research

are listed in (Appendix 1). The mean number of citations was 142 (median 97; range 599–70). All the articles were published between 1993 and 2019, with most articles being published between 2010 and 2019 (n = 28) (Fig. 2). The number one most cited article was published in 2006 (599 citations), with the second top cited being published in 2005 (593 citations).

The top 50 articles came from a total of 12 different journals. The highest number of papers were published in the *Journal of Shoulder and Elbow Surgery* (n = 23), followed by the *Journal of Bone and Joint Surgery-American Version* (n = 7) (Fig. 3).

Seven countries combined published the top 50 most cited articles. Those articles came from Austria (n = 1), South Korea (n = 1), Spain (n = 2), England (n = 2), Switzerland (n = 2), France (n = 8), and USA (n = 34) (Fig. 4).

The most common level of evidence was level 2 (n = 21) with the second most common being level 4 (n = 19) (Fig. 5). No articles had a level 5 for evidence.

Lastly, most of the articles were classified as clinical outcomes (n = 36), followed by natural history/epidemiology (n = 6). The smallest category was imaging (n = 1) (Fig. 6).

4. Discussion

With the increased interest in rTSA research, it is important to analyze the literature to identify the qualities and characteristics of the publications. This analysis comprehensively evaluated the 50 most cited articles regarding rTSA research. Of note, in this study we included literature discussing rTSAs in the context of either conventional or reverse arthroplasty procedures. The recent use and adaptation of the reverse arthroplasty has been hypothesized to in part explain the greater incidence of TSA.¹⁷ Additionally, limitations in conventional TSA can be addressed with the reverse arthroplasty technique.^{18,19} In efforts to be inclusive, articles discussing either technique in the setting of a revision were included.

The most influential articles came from research groups in the United States and focused on clinical outcomes. After clinical outcomes (72%), natural history/epidemiology (12%) and surgical/biomechanical techniques (10%) were the leading article types (Fig. 5). This is likely because clinical outcomes provide insight into the risks and benefits of rTSA. This data is an important tool for both physicians and patients to engage in shared decision-making regarding rTSA. Analysis of clinical

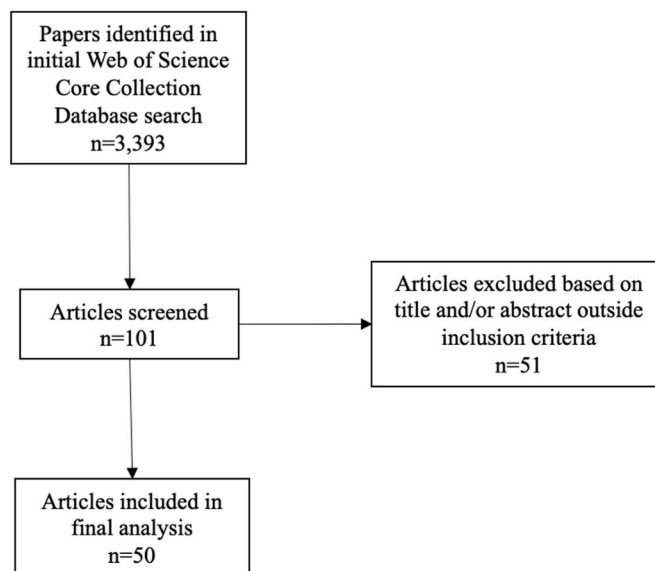


Fig. 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flowchart.

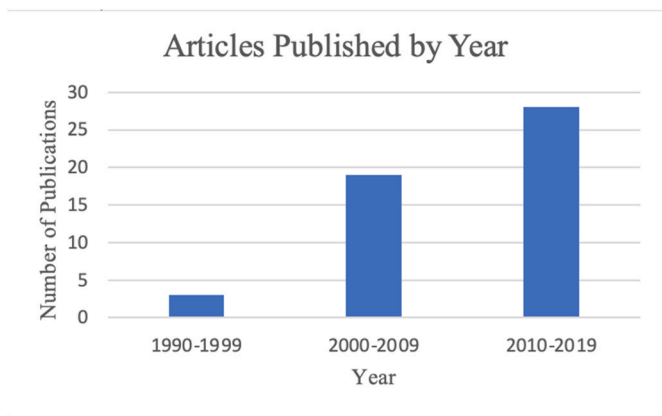


Fig. 2. Date of publication for the top 50 highest cited articles.

outcomes is critical as TSA has gained popularity in the United States over the past two decades, with an expected additional increase of 235.2% by the year 2025.^{2,13} As such, the need for revision procedures is also increasing.¹³ Knowles et al.²⁰ conducted a recent meta-analysis on revision shoulder arthroplasty. They found that the most common indication for revision was rotator cuff tear, deficiency or arthropathy, and the most common implant used was reverse shoulder arthroplasty (56%).²⁰ Analysis of these clinical outcomes provides physicians with a framework to learn from to achieve the best outcomes for their patients. Furthermore, when clinical outcomes are measured and reported, it fosters the adoption of best clinical practices and improves future outcomes.²¹ Assessing clinical outcomes is one strategy to identify the causes of implant failure and reduce the need for rTSA in the future. Thus, it is imperative that continued research be done assessing factors that contribute to positive and negative outcomes.

Understanding natural history/epidemiology is also relevant for advancements in surgical and biomechanical techniques, as illustrated



Fig. 3. Frequency of articles published by journals.

Contribution of the Top 50 Articles by Country

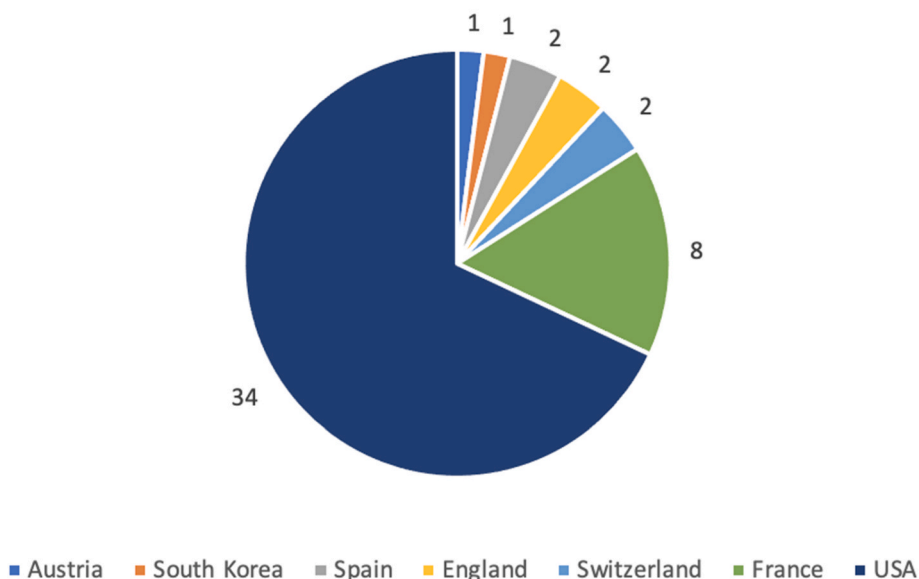


Fig. 4. Country of origin for top 50 articles.

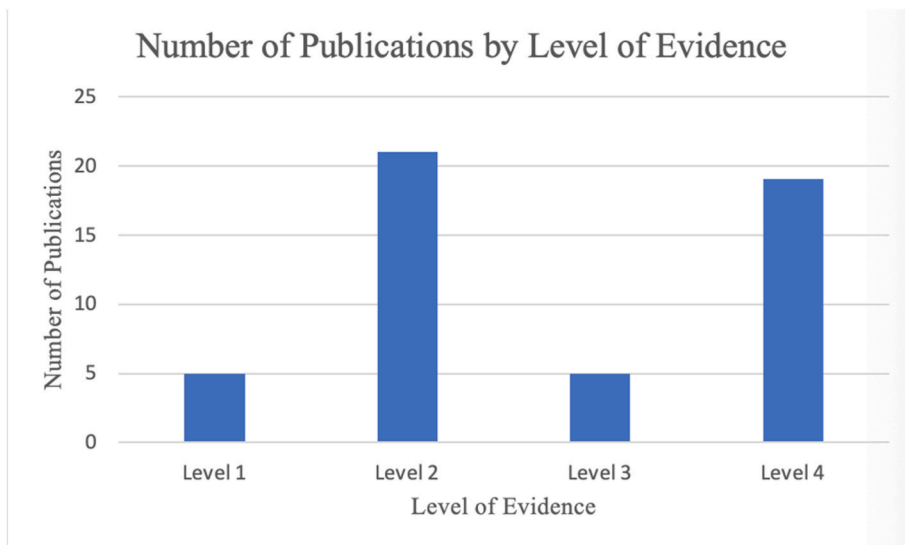


Fig. 5. Number of publications and their level of evidence.

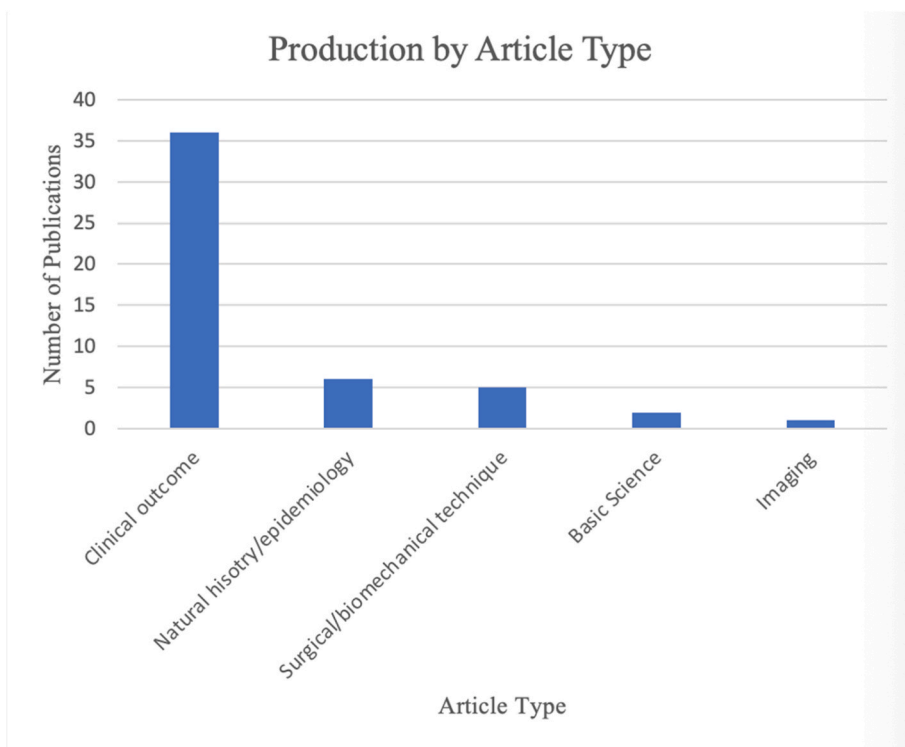


Fig. 6. Number of publications and their article type.

with the introduction of the reverse prosthesis. The introduction of the reverse prosthesis increased indications, and approval of the reverse shoulder arthroplasty (RSA) for use in the USA in 2004 served as an inflection point for the global rise of TSA.^{2,22} Additionally, due to broadened implications, TSA is becoming more common in younger cohorts, further increasing the population living with implants. A thorough understanding of the epidemiologic trends resulting from surgical advancements allows us to best predict and prepare for future trends.

The top three most cited articles were all published by the Journal of Shoulder and Elbow Surgery (Fig. 2). The most cited article on rTSA is “*Neer Award 2005: The Grammont reverse shoulder prosthesis: Results in cuff tear arthritis, fracture sequelae, and revision arthroplasty*” by Boileau

et al.²³ The innovative design of the *Grammont* prosthesis stabilizes the center of rotation, minimizes torque on the glenoid component and aids in recruiting additional fibers.²⁴ These advances in biomechanics make the *Grammont* prosthesis a viable option for rTSA, especially in the cuff-deficient shoulder. This prospective cohort article was published in 2006 and analyzed the midterm results and complications of the *Grammont* reverse prosthesis in three different cohorts. The cohorts were based on indications for surgery and consisted of massive and irreparable cuff tear arthropathy, proximal humeral fracture sequela, and revision after failed primary arthroplasty. All patients were followed up clinically and radiographically at 3, 6, and 12 months and then yearly after the procedure. Boileau et al. demonstrated that the revision cohort had the highest rates of complications as well as the unpredictability of

outcomes when compared to the other cohorts (complication rates of 47% and 5%, respectively). These complications included dislocations, humeral fractures, loosening, and infections. This article was influential in raising awareness about rTSA and the increased risk of postoperative infections and complications regardless of new surgical advances, including the *Grammont* reverse shoulder prosthesis.^{23,25}

The second most cited article is “*Grammont reverse prosthesis: design, rationale, and biomechanics*” by Boileau et al. Published in 2005, the authors present the *Grammont* reverse prosthesis as a viable alternative for patients requiring a prosthetic revision in a cuff-deficient shoulder.²⁴ More recent studies have further explored complications in patients undergoing TSA and found that revision to reverse TSA is associated with better outcomes and lower complication rates when compared to revision to anatomical shoulder arthroplasty.²⁶ This study highlights the need for future surgical advances to further decrease the risk of post-operative complications in rTSA.²⁷

The third most cited article, “*Prevalence and projections of total shoulder and elbow arthroplasty in the United States to 2015*” utilized the United States National Inpatient Sample from 1993 to 2007 to examine trends regarding procedure volumes and prevalence rates of TSA, including revision procedures.²⁸ This study found that rates of TSA were increasing at similar rates to hip and knee arthroplasty procedures. For example, rTSA procedure volumes increased from 6% to 13% from 1993 to 2007 and were predicted to increase between 192% and 322% by 2015 alone. Perhaps most notably, revision rates increased from 4.5% to 7% during this study period. As TSA continues to gain popularity, indications for revision procedures will continue to rise. Since revision procedures are often deemed more complex than primaries, the increase in rTSA threatens to place a financial burden on the health care system. Using this comprehensive study as a model, current studies need to be done to predict the future volume of rTSA. Results of such studies could guide future management of rTSA and allow relevant healthcare sectors to prepare for an influx of revision procedures with the goal of minimizing the strain on the healthcare system.

Level of evidence (LOE) is a hierarchical tool used to stratify publications from level I to level V and provides the basic framework for evidence-based medicine. LOE grading has become widely adopted in the field of orthopedics, and studies depict that higher levels of evidence (I, II) were associated with significantly higher rates of citation.²⁹ Among the articles studied, the most common level of evidence was II, accounting for 21 studies (Fig. 4). This is consistent with the literature showing that most articles in the USA medical journals come from levels I and II.³⁰ The second leading LOE in this review was level IV; this may be explained by the fact that publications are often used as a metric for physician career advancement. Based on the complexity of the study designs, level III and IV studies are easier to accomplish to increase publication volume, thus making them more popular options.³¹

This review outlines the trends regarding the most influential publications regarding rTSA published in the past three decades, with most articles being published between 2010 and 2019 (Fig. 1). The increase in publications over the last decade is likely secondary to an increase in upper extremity arthroplasty training programs and advancements in the field.²⁸ The USA produced the highest number of articles and made up 68% of the most influential articles included in this review (Fig. 3).

This is consistent with other bibliometric analyses, where the USA has the highest number of cited articles.³² This is likely secondary to the increased incidence of rTSA in the USA, with 10,290 revision procedures performed in 2017 alone.¹³

There are many limitations inherent to this type of review, mainly bias towards older publications that have had more time to accrue higher citation counts. Additionally, specific to this study, only a single database was used (Web of Science), and all non-English articles were excluded.

5. Conclusion

This review can serve as a useful tool to study the most influential articles concerning revision shoulder arthroplasty research. Most of the articles were classified as clinical outcomes (62%), followed by natural history/epidemiology (12%), and surgical technique (10%). Our findings suggest that high-quality studies (LOE I) are lacking and other areas of research besides clinical outcomes are not as well studied.

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Institutional ethical committee approval

Not required as this is a bibliometric review.

CRediT authorship contribution statement

Alina Syros: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization, Supervision, Project administration. **Olivia F. Perez:** Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization, Supervision, Project administration. **Dylan Luxemburg:** Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization, Supervision, Project administration. **Jacob L. Cohen:** Conceptualization, Methodology, Writing – original draft, Writing – review & editing, Visualization, Supervision, Project administration. **Ronald Swonger:** Investigation, Writing – original draft. **Samuel Huntley:** Supervision, Project administration, Writing – original draft, Writing – review & editing.

Declaration of competing interest

None.

Acknowledgements

None.

Appendix 1. Fifty Most Cited Articles Regarding revision total shoulder arthroplasty

Rank	Article Title	First Author	Year	Citations	Journal	Country	Category	LOE
1	Neer Award 2005: The Grammont reverse shoulder prosthesis: Results in cuff tear arthritis, fracture sequelae, and revision arthroplasty	Boileau, Pascal	2006	599	<i>Journal of Shoulder and Elbow Surgery</i>	France	Clinical outcome	2
2		Boileau, P	2005	593		France	Clinical outcome	2

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Rank	Article Title	First Author	Year	Citations	Journal	Country	Category	LOE
3	Grammont reverse prosthesis: Design, rationale, and biomechanics				<i>Journal of Shoulder and Elbow Surgery</i>			
3	Prevalence and projections of total shoulder and elbow arthroplasty in the United States to 2015	Day, Judd S.	2010	385	<i>Journal of Shoulder and Elbow Surgery</i>	USA	Natural history/epidemiology	2
4	Microbiologic Diagnosis of Prosthetic Shoulder Infection by Use of Implant Sonication	Piper, Kerryl E.	2009	282	<i>Journal of Clinical Microbiology</i>	USA	Clinical outcome	2
5	Infection after shoulder arthroplasty	Sperling, JW	2001	253	<i>Clinical Orthopaedics and Related Research</i>	USA	Clinical outcome	2
6	Optimization of Periprosthetic Culture for Diagnosis of Propionibacterium acnes Prosthetic Joint Infection	Butler-Wu, Susan M.	2011	205	<i>Journal of Clinical Microbiology</i>	USA	Clinical outcome	2
7	Characteristics of unsatisfactory shoulder arthroplasties	Hasan, SS	2002	194	<i>Journal of Shoulder and Elbow Surgery</i>	USA	Clinical outcome	4
8	Reasons for failure after surgical repair of anterior shoulder instability	Tauber, M	2004	195	<i>Journal of Shoulder and Elbow Surgery</i>	Austria	Clinical outcome	2
9	Prognostic Factors for Bacterial Cultures Positive for Propionibacterium acnes and Other Organisms in a Large Series of Revision Shoulder Arthroplasties Performed for Stiffness, Pain, or Loosening	Pottinger, Paul	2012	189	<i>Journal of Bone and Joint Surgery- American Volume</i>	USA	Clinical outcome	2
10	Glenoid revision surgery after total shoulder arthroplasty	Antuna, SA	2001	178	<i>Journal of Shoulder and Elbow Surgery</i>	USA	Clinical outcome	2
11	Propionibacterium acnes: An agent of prosthetic joint infection and colonization	Zeller, Valerie	2007	179	<i>Journal of Infection</i>	France	Clinical outcome	2
12	Use of the reverse shoulder prosthesis for the treatment of failed hemiarthroplasty in patients with glenohumeral arthritis and rotator cuff deficiency	Levy, J. C.	2007	161	<i>Journal of Bone and Joint Surgery- British Volume</i>	USA	Clinical outcome	2
13	Reverse shoulder arthroplasty versus hemiarthroplasty for acute proximal humeral fractures. A blinded, randomized, controlled, prospective study	Sebastia-Forcada, Emilio	2014	163	<i>Journal of Shoulder and Elbow Surgery</i>	Spain	Clinical outcome	1
Rank	Article Title	First Author	Year	Citations	Journal	Country	Category	LOE
14	Instability of the Shoulder After Arthroplasty	Moeckel, BH	1993	153	<i>Journal of Bone and Joint Surgery- American Volume</i>	USA	Natural history/epidemiology	1
15	Revision shoulder arthroplasty with positive intraoperative cultures: The value of preoperative studies and intraoperative histology	Topolski, Mark S.	2006	148	<i>Journal of Shoulder and Elbow Surgery</i>	USA	Clinical outcome	4
16	Locking plate fixation of fractures of the proximal humerus: analysis of complications, revision strategies and outcome	Jost, Bernhard	2013	154	<i>Journal of Shoulder and Elbow Surgery</i>	Switzerland	Clinical outcome	4
17	Future Patient Demand for Shoulder Arthroplasty by Younger Patients: National Projections	Padegimas, Eric M.	2015	135	<i>Clinical Orthopaedics and Related Research</i>	USA	Natural history/epidemiology	3
18	Complications and revision of reverse total shoulder arthroplasty	Boileau, P.	2016	131	<i>Orthopaedics & Traumatology-Surgery & Research</i>	France	surgical/biomechanical technique	3
19	An evaluation of the radiological changes around the Grammont reverse geometry shoulder arthroplasty after eight to 12 years	Melis, B.	2011	122	<i>Journal of Bone and Joint Surgery- British Volume</i>	France	imaging	2
20	Cementless surface replacement arthroplasty (Copeland CSRA) for osteoarthritis of the shoulder	Levy, O	2004	124	<i>Journal of Shoulder and Elbow Surgery</i>	England	Clinical outcome	4
21	C-Reactive Protein, Erythrocyte Sedimentation Rate and Orthopedic Implant Infection	Piper, Kerryl E.	2010	127	<i>PLOS One</i>	USA	Basic science	2
22	Revision total shoulder arthroplasty for the treatment of glenoid arthrosis	Sperling, JW	1998	112	<i>Journal of Bone and Joint Surgery- American Volume</i>	USA	Clinical outcome	4
23	Glenoid loosening and failure in anatomical total shoulder arthroplasty: is revision with a reverse shoulder arthroplasty a reliable option?	Melis, Barbara	2012	104	<i>Journal of Shoulder and Elbow Surgery</i>	France	surgical/biomechanical technique	4
24	Revision surgery of reverse shoulder arthroplasty	Boileau, Pascal	2013	104	<i>Journal of Shoulder and Elbow Surgery</i>	France	Clinical outcome	4
25	Positive Culture Rate in Revision Shoulder Arthroplasty	Kelly, James D., II	2009	98	<i>Clinical Orthopaedics and Related Research</i>	USA	Clinical outcome	4
26	Conversion of painful hemiarthroplasty to total shoulder arthroplasty: Long-term results	Carroll, RM	2004	96	<i>Journal of Shoulder and Elbow Surgery</i>	USA	Clinical outcome	2
27	The Incidence of Propionibacterium acnes in Open Shoulder Surgery A Controlled Diagnostic Study	Mook, William R.	2015	94	<i>Journal of Bone and Joint Surgery- American Volume</i>	USA	Clinical outcome	1
Rank	Article Title	First Author	Year	Citations	Journal	Country	Category	LOE
28		Dines, Joshua S.	2006	90		USA	Clinical outcome	2

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Rank	Article Title	First Author	Year	Citations	Journal	Country	Category	LOE
29	Outcomes analysis of revision total shoulder replacement Arthroscopic revision Bankart repair: A prospective outcome study	Kim, SH	2002	89	<i>Journal of Bone and Joint Surgery- American Volume Arthroscopy- The Journal of Arthroscopic and Related Surgery</i>	South Korea	Clinical outcome	2
30	Glenoid bone grafting with a reverse design prosthesis	Neyton, Lionel	2007	90	<i>Journal of Shoulder and Elbow Surgery</i>	USA	surgical/ biomechanical technique	4
31	Reverse shoulder arthroplasty as a salvage procedure for failed conventional shoulder replacement due to cuff failure-midterm results	Flury, Matthias P.	2011	88	<i>International Orthopedics</i>	Switzerland	Clinical outcome	2
32	The use of the reverse shoulder arthroplasty for treatment of failed total shoulder arthroplasty	Walker, Matthew	2012	85	<i>Journal of Shoulder and Elbow Surgery</i>	USA	Clinical outcome	4
33	Revision surgery following total shoulder arthroplasty ANALYSIS OF 2588 SHOULDERS OVER THREE DECADES (1976 TO 2008)	Singh, J. A.	2011	83	<i>Journal of Bone and Joint Surgery- British Volume</i>	USA	Natural history/ epidemiology	4
34	A multicentre study of the long-term results of using a flat-back polyethylene glenoid component in shoulder replacement for primary osteoarthritis	Young, A.	2011	83	<i>Journal of Bone and Joint Surgery- British Volume</i>	France	surgical/ biomechanical technique	4
35	Reinfection rates after 1-stage revision shoulder arthroplasty for patients with unexpected positive intraoperative cultures	Grosso, Matthew J.	2012	81	<i>Journal of Shoulder and Elbow Surgery</i>	USA	Clinical outcome	4
36	alpha-Defensin as a predictor of periprosthetic shoulder infection	Frangiamore, Salvatore J.	2015	81	<i>Journal of Shoulder and Elbow Surgery</i>	USA	Basic science	3
37	A Complication-based Learning Curve From 200 Reverse Shoulder Arthroplasties	Kempton, Laurence B.	2011	82	<i>Clinical Orthopaedics and Related Research</i>	USA	Clinical outcome	4
37	Rapid prototyping for orthopaedic surgery	Potamianos, P	1998	84	<i>Proceedings of the Institution of Mechanical Engineers Part H- Journal and Engineers Part H- Journal of Engineering in Medicine</i>	England	surgical/ biomechanical technique	4
39	Outcomes in the treatment of periprosthetic joint infection after shoulder arthroplasty: a systematic review	Nelson, Gregory N.	2016	79	<i>Journal of Shoulder and Elbow Surgery</i>	USA	Clinical outcome	4
40	Clinical results of revision shoulder arthroplasty using the reverse prosthesis	Kelly, James D., II	2012	78	<i>Journal of Shoulder and Elbow Surgery</i>	USA	Clinical outcome	4
Rank	Article Title	First Author	Year	Citations	Journal	Country	Category	LOE
41	Complications rates, reoperation rates, and the learning curve in reverse shoulder arthroplasty	Groh, Gordon I.	2014	78	<i>Journal of Shoulder and Elbow Surgery</i>	USA	Clinical outcome	4
42	Clinical meaning of unexpected positive cultures (UPC) in revision shoulder arthroplasty	Foruria, Antonio M.	2013	75	<i>Journal of Shoulder and Elbow Surgery</i>	USA	Clinical outcome	4
43	Early Versus Late Culture Growth of Propionibacterium acnes in Revision Shoulder Arthroplasty	Frangiamore, Salvatore J.	2015	72	<i>Journal of Bone and Joint Surgery- American Volume</i>	USA	Clinical outcome	3
44	Prosthesis Failure Within 2 Years of Implantation Is Highly Predictive of Infection	Eugenia Portillo, Maria	2013	75	<i>Clinical Orthopaedics and Related Research</i>	Spain	Clinical outcome	2
45	Reverse total shoulder arthroplasty for failed shoulder arthroplasty	Patel, Deepan N.	2012	74	<i>Journal of Shoulder and Elbow Surgery</i>	USA	Clinical outcome	2
46	Revision shoulder arthroplasty for glenoid component loosening	Cheung, Emilie V.	2008	73	<i>Journal of Shoulder and Elbow Surgery</i>	USA	Clinical outcome	2
47	Arthroscopic revision of failed rotator cuff repairs: Technique and results	Lo, IKY	2004	78	<i>Arthroscopy- The Journal of Arthroscopic and Related Surgery</i>	USA	Clinical outcome	1
48	Revision Arthroplasty with Use of a Reverse Shoulder Prosthesis-Allograft Composite	Chacon, Ariel	2009	71	<i>Journal of Bone and Joint Surgery- American Volume</i>	USA	Clinical outcome	1
49	What Are the Instability and Infection Rates After Reverse Shoulder Arthroplasty?	Trappey, George J.	2011	70	<i>Clinical Orthopaedics and Related Research</i>	USA	Natural history/ epidemiology	2
50	Infection After Shoulder Surgery	Saltzman, Matthew D.	2011	70	<i>Journal of the American Academy of Orthopaedic Surgeons</i>	USA	Natural history/ epidemiology	3

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