Functional Mobility Comparison in Anatomic and Reverse Total Shoulder Arthroplasty

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Abstract-This research review was conducted to determine if the reverse total shoulder arthroplasty is more superior than the anatomic total shoulder arthroplasty in a 69 year- old male with rotator cuff arthropathy. Database searches were conducted in PubMed, Cochrane, and Cumulative Index to Nursing and Allied Health Literature. Four top research articles addressing comparison of outcomes in terms of mobility and pain rating after anatomic and reverse shoulder arthroplasty were selected for critical appraisal. All four research articles were prospective case control therapeutic studies at Level III and Level II evidence based as per the Oxford Center for Evidence Based Medicine (2011). Two of the studies compared the different outcome metrics before and after surgery at an average of 2 years' follow-up post-operatively. One of the studies analyzed the effectiveness of treatment and the time required for an improvement in mobility after each procedure. The fourth study quantified the impairment rate as well as isometric strength and mobility improvements after surgery. Based on the evidence obtained, none of the procedures would be superior in providing increased functional mobility after surgery. The rTSA was typically indicated for rotator cuff pathology and standard TSA for degenerative arthritis with the similar outcome measures.

Keywords: Shoulder arthroplasty, functional mobility, outcomes.

I. INTRODUCTION

Shoulder arthroplasty is one of the well-established common joint replacement surgeries for the treatment of glenohumeral (GH) joint pathologies. The goal of the surgery is to restore the comfort and function of the pathologic shoulder joint [1]. Total shoulder arthroplasty (TSA) technique has been developed by Neer in 1970's and since then it is one of the reliable methods for treating the primary GH arthritis with good long-term results [1]. Reverse total shoulder arthroplasty (rTSA) is the recent transformation in shoulder arthroplasty surgeries introduced by Paul Grammont in 1985 and mostly indicated for patients with GH arthritis (GHA) and rotator cuff arthropathy (RCA) [2].

The patient was a 69-year-old right-hand dominant male with a 3.5-year history of progressively increased right shoulder pain and dysfunction. During the initial evaluation, thepatient described his pain as constant achy, nagging, and at time sharp with movements. He reported that it often woke him up at night. The patient rated the pain as 7-8/10 on a visual analog scale (VAS) [3]. He was unable to elevate his right upper extremity above shoulder height. He was a non-smoker and occasionally consumed alcohol. He lived with his wife in a single-story house and was independent for self-care and ambulation. Professionally, he was the senior executive of a carpet manufacturing factory and his job involved repetitive shoulder movements for operating heavy machinery. The pain was limiting his ability to perform work-related tasks. The past medical history included Type 2 diabetes and hypertension and taking the following medications: metformin for diabetes, atenolol for hypertension, and baby aspirin for coagulation prophylaxis [4].

The objective evaluation found a significant limitation of abduction to 85° (degrees), external rotation (ER) to 43° with gross right shoulder muscle weakness of 3+/5 on manual muscle testing (MMT) [5]. The supraspinatus test (full can) and Hawkins- Kennedy impingement test was positive with pain [6]. The Shoulder Pain and Disability Index score was 68.46% or 89 points [7]. The MRI was remarkable for severe GH degenerative arthritis, full thickness supraspinatus, and infraspinatus tendon tear [6].

The patient received an extensive conservative medical management included physical therapy over the past 3 years with minimal improvements. His goal was to get back to work with less pain and improved function of the right shoulder specifically mobility and strength. The orthopedic surgeon recommended shoulder replacement surgery for this patient as the treatment of choice for pain relief and to regain the GH joint functional mobility. The patient inquired as to whether the rTSA would be a better option for him to regain functional mobility and pain control, compared to the anatomic TSA.

The PICO question developed was: For a 69 year- old male with osteoarthritis of the right shoulder. would a reverse total shoulder arthroplasty provide superior functional mobility than a standard total shoulder replacement?

II. METHODS

The search was conducted on February 3rd, 2017. Three databases were used for an unbiased search to effectively answer the PICO question, PubMed, Cumulative Index to

Nursing and Allied Health Literature (CINAHL), and Cochrane. The population of interest was patients aged 65 to 80 underwent either TSA or rTSA for the diagnosis of RCA and/or GHA. The following type of publication studies were included in the search: systematic review, meta-analysis, cohort study, case control studies, and randomized control trials. The exclusion criterion set for the search was patients who underwent TSA or rTSA for proximal humerus fracture, any other pathology, and revision surgery. The simple search was initiated in the PubMed with the keywords- anatomic shoulder arthroplastyandreverse shoulder arthroplasty. This yielded 137 results without any filters. The search was further narrowed down by activating several filters like full text, 10 years' publication date, English language, and journal categories: core clinical journals and MEDLINE. After the filters were activated, the results were narrowed down to 81 full text articles. The 13 were considered for abstract review and five met the inclusion criterion and considered for final review. A second simple search were conducted with the alternate key terms- comparison of shoulder arthroplastyandrotator cuff tear. This retrieved 26 full text articles without filters activated and there were several duplicates from the first search. The three articles that met the inclusion criteria were selected for review.

The initial simple search in CINAHL resulted in 196 articles with the keywords- 'rotator cuff arthropathy and shoulder replacement and functional mobility. The search was narrowed down to 67 articles with the filters full text, English language, age 65 and over, and dates 2005 to 2017. There were several articles duplicated from the PubMed. There were 12 articles were relevant, of which 3 met the inclusion criteria for review. A second search using the keywords rotator cuff tear and shoulder arthroplastyyielded 33 articles. However, the application of the same search filters limited the number to 11. Only one article was relevant and selected for review. There were no duplicates found from the previous searches.

The initial simple search in Cochrane were performed with the keywords shoulder arthroplasty resulted in 50 articles. The keyword functional outcomes were added with a reduction to 42 articles. Many of the articles were not related to shoulder arthroplasty and were not considered. Two articles were relevant to the PICO question,of which one met the inclusion criteria. The search was repeated with the key words shoulder replacement and rotator cuff arthropathy. This retrieved three articles and one of which was duplicated from the previous search. No articles were considered for review.

The search strategy for each databaseis presented in Figure 1.

III. RESULTS

Each relevant article was appraised critically and summarized. The reliability and validity concerns were identified and referenced appropriately. Table 2 provides further details regarding study design, population of interest, and outcomes of each study with the level of evidence based on the Oxford Center for Evidence- Based Medicine (OCEBM).

Article one: Flurin et al. (2015) [8]

This study was selected because the population matched the PICO patient and it involved subjects that underwent TSA for GHA and rTSA for RCT with or without GHA. Flurin et al. (2015) [8] investigated the clinical correlation and comparison of functional outcome metrics and pain levels in standard TSA and rTSA. The study met the PICO inclusion criteria for age, population, and outcomes. The retrospective cohort therapeutic study design by Flurin et al. (2015) met the OCEBM (2011) [9] criteria for Level III evidence.

Flurin et al. (2015) recruited 1145 subjects mean age 69.2 years (528 for TSA and 617 for rTSA for RCT and/ or GHA). The average follow-up period was 40 months post-operatively and each patient scored pre-operatively and post operatively. The outcome measures used for the study were Simple Shoulder Test (SST), UCLA, Constant, American Shoulder and Elbow Surgeons Score (ASES), SPADI, and active range of motion. A p-value < 0.05 was considered significant. Flurin et al. (2015) used student's two tailed unpaired t-test to determine the differences in the pre-operative, post-operative, and pre-to-post-operative improvements. Flurin et al. (2015) found statistically significant ($P<0.001$) improvement in the post-operative strength in the rTSA patients. However, rTSA cohort had significantly lower active abduction, internal rotation, and external rotation than the standard TSA patients. The rTSA patients also demonstrated significant improvements in the active forward flexion and strength. The TSA patients noted significant ($P<0.0001$) improvements in the external and internal rotation compared to rTSA patients.

Flurin et al (2015) did not specify the use of blind assessors for dataassessment or use Confidence Intervals (CI) for sample size or precision. Selection bias was identified as the study failed to specify the demographics of patients. The data were collected by 12 different orthopedic surgeons that might have caused threat to the inter and intra-rater reliability due to the variations in different patient population, rehabilitation protocol, data collection methods, and experience of surgeon. Flurin et al. (2015) concluded that each technique provided significant improvements with similar mean results. This study on a large sample size demonstrated that the mean clinical outcome metrics obtained from the rTSA technique were

considered as gold standard for their respective indications.

Article two: Kiet et al. (2015) [1]

The prospective case-control study by Kiet et al. (2015) was selected for review because it directly addressed the PICO question by measuring functional mobility among shoulder arthroplasty patients. The purpose of the study was to compare the outcomes and complications after TSA and rTSA[1]. The level of evidence was III based on the OCEBM 2011 scale. The study design was retrospective cohort therapeutic study.

Kiet et al. (2015) recruited 153 subjects underwent either TSA (N=77) for GHA or rTSA (N=75) for RCP. Exclusion criteria was other shoulder pathologies like humeral fracture and revision TSA. The follow-up (F/U) period was 2 years. By the end of 2 years, follow-up data was available for n=53 for rTSA and n=47 for TSA. The outcome measures included in the study were VAS, ASES, and goniometer for the range of motion. An independent assessor examined the patient's clinical outcomes during the follow-up visits at 1 and 2 years respectively. The P value was set at P< .05. The comparison of outcome measures was done with the paired sample t-test and the qualitative measures were assessed with Fisher exact test.

At 2- year follow up, no statistically significant differences were noted between the TSA and rTSA group [1]. The outcomes measured assessed through ASES and VAS were similar among both the groups. Regarding ROM, patients after TSA experienced greater improvement (P= 0.001) in external rotation at 2-year follow-up. However, forward flexion, abduction, and internal rotation did not show any statistically significant differences between the two groups. External rotation was limited in the rTSA group.

The limitations included small sample size that may have affected the internal validity of the study design. Patient reported outcome measures of the study may have resulted through chance due to a small sample size [10]. The study also failed to explain the baseline characteristics of the patients, uniformity of the underlying pathology, and randomization of the subjects thus affect the external validity [11]. The study measured comparison between two different operative procedures for two different operative indications. The follow-up rate of the patients at the end of 2 years was 60%. Loss of adequate follow up was a problem in most of the cohort studies and can lead to bias [12]. Kiet et al. (2015) concluded that the standard TSA for shoulder arthritis and rTSA for RCP can be successful surgical procedures with similar post-operative outcomes and complication rates based on a 2 years of follow-up period.

Article three: Levy et al. (2014) [13]

The retrospective study by Levy et al. (2014) was selected because this study investigated the patient's expectations after shoulder arthroplasty in terms of regaining functional mobility, and the time necessary to reach these goals. The inclusion and exclusion criteria matched the PICO question. The purpose of the study was to investigate the speed of recovery and to compare the efficacy at each time point for TSA and rTSA[13]. The study design consisted of retrospective OCEBM (2011) Level III cohort design with the analysis of prospectively collected data from patients treated with anatomic TSA for GHA and rTSA for RCA and/or GHA. The inclusion criteria were patients undergoing primary TSA or rTSA with a minimum of 12 months' post-operative follow-up period. Exclusion criteria was revision surgery, acute fractures, and follow-up period less than 12 months. The sample included patient treated with TSA N=166, average age of 69.3 years, 81 females and 85 males. rTSA N=122, average age 75.7 years, 84 females and 38 males.

Clinical outcome scores included in the study were the ASES, VAS, Single Assessment Numeric Evaluation (SANE), SST, and 12-Item Short Form Health Survey (SF-12) scores. Range of motion was tested by goniometer. Scores were collected preoperatively and postoperatively at 3 months, 6 months, 1 year, and 2 years, respectively. The statistical analysis was performed by using SPSS software. Independent sample t-test and Mann-Whitney U test were utilized to assess the differences between the two groups. Repeated measures analyses of variance along with post hoc-t test were conducted for the analysis of differences within the group over time. Levy et al. (2014) noted significant improvements for both TSA and rTSA at all intervals (P< .001), except with internal rotation (IR) for rTSA. The rTSA patients noted significant improvement in IR 1 year after surgery (P<0.023). TSA patients achieved a steady plateau for pain and functional mobility by 6 months and shoulder elevation by 1 year. By 6 months, TSA patients had achieved 90% to 100% of functional improvement, whereas RSA patients reached 72% to 91%. The limitation identified in the study include: there was a short follow-up period of 2 years to determine the long-term functional improvements. Patients may have experienced improvement after 2 years. A longer follow-up period may facilitate to determine the steadier plateau point for rTSA patients. Selection bias were identified in the study because all the patients were recruited from the same facility [10]. Levy et al. (2014) concluded that the significant improvements in pain, function, and range of motion can be expected after both anatomic TSA and RSA. However, TSA was more effective than the rTSA for all clinical measures except elevation and abduction.

Article four: Puskas et al. (2013) [14]

This study by Puskas et al. (2013) was selected because it was directly related to the PICO question in that it sought to determine the isometric strength and impairment after TSA and rTSA. The patient population recruited in the study was like the PICO patient and the inclusion-exclusion criteria for the patients undergoing either TSA or rTSA were also like the PICO question. The purpose of the study was to assess the severity of disease and improvements in terms of isometric strength and mobility from standard TSA and rTSA. The study design was prospective cohort treatment study Level II based on the OCEBM (2011). Puskas et al. (2013) recruited 174 patients underwent TSA (n= 87) for GHA or rTSA (n=55) for RCT and/or GHA. The average follow-up period was 49 months. The objective outcome measures were isometric strength and range of motion. The data were collected by independent assessor blinded to the study at 1 week before the surgery and at a minimum of 2-years period post-operatively. The impairment was objectively measured by Florida Impairment Guideline rating. The p-value < 0.05 was considered statistically significant.

The Kolmogorov-Smirnov test was used to assess the normality of continuous variables whereas the Wilcoxon signed rank test was utilized to evaluate the statistical significance for paired data. Mann-Whitney U and t test was used for unpaired data. The independent predictors of postoperative impairment were carried out by regression analysis. Puskas et al. (2013) in TSA cohort found significant ($P<0.001$) strength improvements in the ER & IR as well as mobility improvements in the forward flexion, abduction, IR, & ER. The rTSA group demonstrated statistically significant ($P<0.001$) improvements in strength for FF and ER as well as mobility for FF, abduction, and IR [14]. The impairment rating was significantly ($P<0.001$) decreased for both TSA and rTSA patients. The study was conducted at one specific surgical center by single surgeon's experience. The results may lack generalizability to all patients undergoing shoulder arthroplasty. The study involved testing of multiple comparisons by using objective strength and motion testing and the several comparisons demonstrated large differences and failed to reach statistical significance thus increased the chances of Type-I errors. Puskas et al. (2013) concluded that both groups were expected to achieve significant improvements in strength and mobility and will maintain these improvements for 4 years post-operatively.

IV. DISCUSSION

Patients treated with TSA and rTSA are often pre-occupied with the debilitating pathological factors that result in pain, loss of functional mobility, and inability to use the shoulder for ADL [13]. Patients managed with shoulder arthroplasty often share the common goals of less pain, improved functional mobility, ability to perform activities of daily living (ADL), and better quality of life. The short and long-term outcome of shoulder arthroplasty surgery depends upon various factors like preserved function of the rotator cuff and glenohumeral joint, experience of the surgeon, age, and activity level of the patient [1]. Several clinical trials had shown reliable improvements in shoulder outcome measures in terms of pain scores, mobility, and functional scores [13]. The prospective OCEBM Level III clinical trial by Kiet et al. (2015) on a cohort of 100 patients who underwent standard TSA and rTSA, reported a similarity in the patient-reported outcome measures like pain and functional mobility scores except for external rotation [1]. External rotation was typically limited with the rTSA because of the implant design and deficient teres minor muscle [15].

Levy et al. (2014) on a cohort of about 280 patients who underwent TSA and rTSA also reported the lack of significant improvement in the external and internal rotation with improved mobility in the forward flexion and abduction plane after rTSA. The possible explanation related to the non-anatomic nature of the rTSA that required longer adaptation period ($\geq$ 2 years) for restoration of shoulder mechanics, strength, and motion compared to the anatomic TSA (Levy et al., 2014). The time required to attain a plateau in maximal benefit was faster for patients underwent TSA (Levy et al., 2014). TSA cohort attained consistent plateau by 6 months after surgery for pain scores, functional mobility scores, and abduction; however, forward flexion and internal rotation attained plateaus by 1 year [13]. The prospective clinical trials by Levy et al. (2014) and Kiet et al. (2015) had selection bias issues in terms of heterogeneity in the patients [10]. There were differences in the patient's age, sex, pre-operative outcome scores that may have influenced the outcome of the study. However, Kiet et al. (2015) had controlled the heterogeneity issue by limiting the sample size in his study. Similarly, the Levy et al. (2014) had limited the variability in the selection bias by adhering to the strict inclusion and exclusion criterion for their study.

The retrospective OCEBM Level III analysis by Flurin et al. (2015) on a large sample size of 1145 patients underwent TSA and rTSA surgical procedures reported greater overall improvements in the post-operative mobility scores in all planes. However, the rTSA cohort had demonstrated significant improvements in the outcome scores of strength and mobility in the active forward flexion plane. In contrast, the prospective OCEBM Level II single blinded clinical trial by Puskas et el. (2013) on a sample size of 174 patients underwent either TSA or rTSA for their respective indications demonstrated increased

post-operative isometric strength and mobility in the TSA patients.

The outcome measures that reported a significant improvement in terms of patient satisfaction and speed of recovery were pain severity and improvements in the functional mobility. For both TSA and rTSA, there was a significant improvement (85%) in pain scores by the third post-operative month [1]; [8]; [13]. Patient satisfaction was one of the most essential factors in determining the efficacy of the treatment outcomes after TSA and rTSA[13].

V. CONCLUSION

The literature reviewed answered the proposed PICO question with adequate clinical evidence to educate the patient about the expectations after surgery. The articles demonstrated that both TSA and rTSA had similar complication rates and patient-reported outcome measures in terms of mobility and pain at an average of 2-year follow-up period [1]; [8]; [13]. The patient's goal to get back to work with less pain and improved function of the shoulder specifically in terms of mobility and strength was sufficiently addressed by Flurin et al. (2015); Kiet et al. (2015); Levy et al. (2014); and Puskas et al. (2103). The patient's self-rated improvement in the functional measures would be measured by SPADI outcome metric scale after the surgery. Additionally, the research trial by Levy et al. (2014) also determined the time needed to regain the post-operative strength and mobility after each procedure. From the review, it is conclusive that none of the procedures would be superior in providing increased functional mobility after surgery. The rTSA was typically indicated for rotator cuff pathology and standard TSA for glenohumeral degenerative arthritis with the similar outcome measures.

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TABLE 1. Summary of Reviewed Articles

Authors	Date of Publication	Disposition	Rationale
Roren, Lefevre-Colau, Roby-Brami, Nguyen, &Poiraudeau [21]	Sep-16	Rejected	This was the oral communication article presented in the 31st annual French conference of physical medicine. This study described the movement analysis of scapula after rTSA& TSA. This article may be use for reference.
Kiet et al. [1]	February, 2015	Accepted	Prospective case control study compared the outcomes after TSA &rTSA in patients with diagnosis of RCT & GHA.
Flurin et al. [8]	December, 2015	Accepted	Retrospective analysis study. This trial was performed in France and USA and had a 3.5 year follow up. Large sample size (n= 1145).
Levy et al. [13]	December, 2014	Accepted	Retrospective analysis of prospectively collected data from patients underwent TSA &rTSA for RCT & GHA.
Young, Zhu, Walker, & Poon [23]	May, 2013	Rejected	Matched pair analysis study compared functional outcomes of rTSA and hemiarthroplasty for the treatment of RCT.
Puskas et al. [14]	Jul-13	Accepted	Prospective comparative study compared the isometric strength, range of motion, and impairment after TSA and rTSA.
Flurin et al. [17]	December, 2013	Rejected	This study compared the outcomes following TSA &rTSA in patients with humerus fracture as well. Not applicable to PICO question.
Ramirez, Ramirez, &Murthi [20]	October, 2012	Rejected	Literature review compared the complications following rTSA& hemiarthroplasty. This article may be use for reference.

Nolan, Ankerson, &Wiater[19]	November, 2011	Rejected	Retrospective review of patients underwent rTSA for RCT. The age of the patients in the study was 54 to 92. The age range was the exclusion criteria.
Singh, Sperling, Buchbinder, &McMaken [22]	Oct-10	Rejected	This study compared TSA and hemiarthroplasty implants versus placebo in patients with GHA.
Mulieri et al. [18]			This study evaluated the indications for, and outcomes, of rTSA in patients with RCT without GHA.
Cuff, Pupello, Virani, Levy, &Frankle [16]	Nov-10	Rejected	This was the prospective outcome study of specific 5.0mm peripheral locking screw for rTSA surgery in patients with rotator cuff tear (RCT). Also, the study did not specify the age of the patients in the methods section.
Boudreau, Boudreau, Higgins, & Wilcox III [15]	Jun-08	Rejected	This study reviewed the indications and outlines of the rehabilitation protocol following rTSA. This article may be use for reference.
	December, 2007	Rejected	

TABLE 2. Summary of Results

Study	Level of evidence CEBM PEDro	Subject characteristics of interest	Specifics for intervention	Outcome measures with results	Other relevant information to PICO
Flurin et al (2015) [8]	III 9/10	N=1145, TSA for GHA n=528 (283 females & 245 males) mean age- 66.2. rTSA for GHA &/or RCT n=617 (392 females & 225 males), mean age= 71.8. Average F/U period was 40 months.	Patients underwent TSA for diagnosis of GHA and rTSA for diagnosis of GHA and/or RCT. Each patient scored pre-operatively and post-operatively during the f/u period using the SST, UCLA, ASES, Constant, & SPADI, & active ROM was measured.	Improvements in each metric was correlated and compared by normalized on a 100point scale. A student's two tailed, unpaired t-test were used. Statistical significance was set at $P<0.05$. $P<0.001$ for post-op strength in the rTSA patients. rTSA = lower active abd, IR, & ER than TSA patients. No significant ($P= 0.6309$) difference in the active FF. rTSA patients demonstrated significant improvements in the active FF and strength. The TSA patients noted significant ($P<0.0001$) improvements in the IR & ER compared to rTSA patients.	The target population and outcome metrics measured was similar to the PICO patient and address the PICO patient's goals and preferences. rTSA patients demonstrated significant improvements in the active FF and strength. The results will assist to effectively answer the PICO patient's questions.
Kiet et al (2015) [1]	Level III	TSA n=47 mean age- 66.2. rTSA for GHA &/or RCT n=53 mean age= 77.8.	Patients underwent TSA for diagnosis of GHA and rTSA for diagnosis of GHA and/or RCT. Blind	Data collected at 2 year's f/u period by independent blind assessor. $P<0.05$. outcome	Population matched the PICO patient and the results assisted to determine the rationale for selecting the

Study	Level of evidence CEBM PEDro	Subject characteristics of interest	Specifics for intervention	Outcome measures with results	Other relevant information to PICO
		Average F/U period was 2 years.	independent assessor scored each patient during the f/u period using the VAS, ASES, & active ROM by goniometry. Blind independent rater evaluated the scapular notching by radiological evaluation. Both cohort immobilized in a sling for 6 weeks after surgery and started AROM at 6 weeks and strengthening at 12 weeks.	measures comparison was done with the paired sample t-test and the qualitative measures were assessed with Fisher exact test. No statistical significant differences were noted between the TSA and rTSA group at 2 year's f/u period. O/come measures- ASES, VAS, and ROM were also similar between the two groups. TSA patients demonstrated greater improvements in ER (P<0.001). FF, abd, & IR were in comparable ROM in both groups.	appropriate surgical technique for PICO patient based on patient's goals and preferences. Study. The study also outlined the specific indications for each surgical procedure based on the severity of pre-operative diagnosis.
Levy et al (2014) [13]	Level III	TSA N=166 (81 females & 85 males), average age 69.3 years. rTSA N=122, (84 females & 38 males), average age 75.7 years.	All subjects were analyzed for pain scores, functional scores, & ROM pre-op, and at 3 & 6 months, 1 & 2 years post-operatively. Comparison were made to determine the treatment effectiveness and to study the time required to reach functional mobility improvements at 3 and 6 months.	The outcome measures were ASES, VAS, SANE, SST, and SF-12 scores. ROM was tested by goniometer. Independent sample t-test and MW U test were utilized to assess the differences between the two groups. Repeated measures ANOVA along with post hoc-t test were conducted for the analysis of differences. Significant improvements (P<0.001) were noted for both cohorts at all measures except IR for rTSA. Pain relief was rapid post-operatively. By 6 months, TSA achieved 90 to 100% functional improvements whereas rTSA noted 72 to 91%. TSA was more effective in all measures than the rTSA except abd& elevation.	Patient population were relevant to the PICO patient. The purpose of the study was to evaluate the speed of recovery in terms of pain and functional mobility after either TSA or rTSA procedure. This study facilitated to answer the patient's question regarding the length of recovery and the time frame to reach functional mobility after each procedure.

Study	Level of evidence CEBM PEDro	Subject characteristics of interest	Specifics for intervention	Outcome measures with results	Other relevant information to PICO
Puskas et al (2013) [14]	Level II	TSA (n= 87) for GHA, mean age- 66. rTSA (n=55), mean age- 71. Average f/u period was 49 months.	Patient with GHA underwent TSA and patients with RCT with GHA underwent rTSA. outcome measures collected by blind assessor were isometric strength by biodex and ROM. The data was collected at one-week pre-op and at a minimum of 2-years post-op. The impairment was objectively measured by Florida Impairment Guideline rating (FIGR).	Outcome measures were isometric strength and ROM by video goniometer. The p-value < 0.05 was considered statistically significant. Wilcoxon signed rank test was used for paired data. MWU and t test was used for unpaired data. A Bonferroni test performed for multiple comparison correction. Regression analysis for independent predictors of postop impairments. TSA cohort found significant (P<0.001) strength improvements in the ER & IR as well as mobility improvements in the FF, abd, IR, &ER. The rTSA group demonstrated statistically significant (P<0.001) improvements in strength for FF and ER as well as mobility for FF, abd, and IR. The impairment rating was significantly (P<0.001) decreased for both TSA and rTSA patients.	The target population was relevant to the PICO question. The study assisted to determine the post-op improvements after each procedure in terms of isometric strength and mobility along with impairment. The study also answered the length of time the improvements can be maintained post-op. This facilitated to answer the PICO patient's goals and preferences after surgery.

Key*Studies in the results section and in the table were organized by reverse chronological order. MWU= Mann Whitney U test; GHA= Glenohumeral arthritis; RCT= Rotator cuff tear; IR= internal rotation; ER= external rotation; Abd= abduction; FF= forward flexion; f/u= follow-up; ROM= range of motion; post-op= post-operative; pre-op= pre-operative

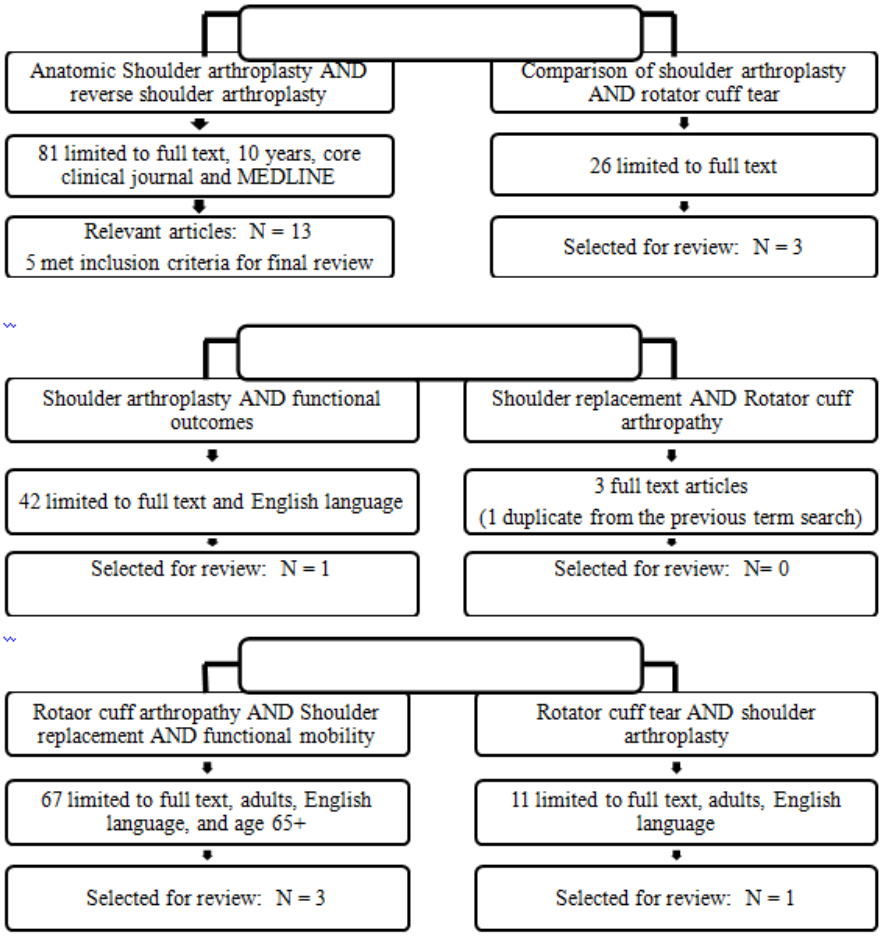

Fig. 1. Summary of Data Collection.