Int J Med Rev 2025 September;12(3): 933-941

10.30491/IJMR.2025.500657.1306

INTERNATIONAL JOURNAL OF MEDICAL REVIEWS
Meta-Analysis

Arthroscopy Versus Open Rotator Cuff Repair in Young-age Patients (<60 Years Old): Systematic Review and Meta-Analysis

Febyan Febyan [1*], Kenny Gozal [1], I Gusti Ngurah Wien Aryana [1], Putu Agung Wirahadi Sanjaya [2]

[1] Department of Orthopaedics and Traumatology, Faculty of Medicine, Udayana University, Prof Ngoerah Hospital, Bali, Indonesia
[2] Department of Orthopaedics and Traumatology, Bali Mandara General Hospital, Bali, Indonesia

*** Corresponding Author:** Febyan Febyan, Department of Orthopaedics and Traumatology, Faculty of Medicine, Udayana University, Prof Ngoerah Hospital, Bali, Indonesia. E-mail: febyanmd@gmail.com

Received January 18, 2025; **Accepted** February 25, 2025; **Online Published** September 1, 2025

Abstract

Rotator cuff tear is a common problem that can seriously impair shoulder function and cause discomfort. Surgical repair may be required, nevertheless, if conservative therapies are unsuccessful. Open surgery and arthroscopic procedures have grown in popularity recently because of their favorable pain alleviation, little scarring, and improved functional outcomes. Until now there have not been many studies comparing these two interventions for populations under 60 years. The aim of the study is to compare the clinical and functional outcomes between arthroscopy and open surgery for rotator cuff repair according to recent publications. A comprehensive search for pertinent scientific papers was carried out for this study utilizing a mix of keywords like "arthroscopic surgery," "open surgery," and "rotator cuff repair" across several medical databases, including PubMed, Cochrane, and Wiley Online. There were 1723 studies found throughout the search from 2013 to 2024. After conducting separate screenings of the abstracts and reference lists and reaching a consensus on any differences, the reviewers included eight papers. By contrasting the clinical and functional gains made possible by each treatment option, the review attempted to provide an answer to the study issue. Eight trials totaling 716 individuals, 379 of whom underwent arthroscopic and 337 of whom underwent open rotator cuff surgeries. Comparably significant clinical and functional results, such as VAS score, Constant score, and range of motion (shoulder flexion and rotation), are present. Arthroscopic and open surgeries serve as equally balanced excellent options for rotator cuff repairs, providing pain relief, restoration of ROM, and improved functional outcomes.

Keywords: Arthroscopy, Open Surgery, Rotator Cuff, Young Age Patient

Introduction

Rotator cuff tear is a common problem that can seriously impair shoulder function and cause discomfort. Trauma is where rotator cuff injuries originate, and acute tears brought on by macro-trauma typically occur in younger patients and culminate in a full tear. Microtrauma results in degenerative tears when there is insufficient healing and tendon degradation. Younger patients typically experience acute tears, while elderly patients typically experience degenerative tears.[1] The spectrum of rotator cuff injuries includes partial tears, tendinopathy, damage, and ultimately full tears. Age is the most common factor for rotator cuff disease. Whether or not symptoms were present, the percentage of injuries increased from 9.7% in patients 20 years of age and under to 62% in patients 60 years of age and beyond.[2]

Typically, conservative measures like physical therapy and medication serve as the initial course of treatment. Surgical repair may be required, nevertheless, if conservative therapies are unsuccessful.[3] Open surgery and arthroscopic procedures have grown in popularity recently because of their favorable pain alleviation, little scarring, and improved functional outcomes. The main problem with open rotator cuff repair is the deltoid takedown, which is addressed by open surgery. A more recent minimally invasive all-arthroscopic method suggested a decreased incidence of deltoid damage, stiffness, and infection. Even still, opinions regarding the best kind of surgery remain largely divided.[4,5]

Studies have demonstrated that both open surgery and arthroscopic surgery have similar functional outcomes and complication rates.[6] On the other hand, some research indicates that arthroscopic repair might be more successful. With arthroscopic surgery, doctors can see the joint in greater detail and can make more accurate repairs that leave fewer scars and require less time to heal. However, both procedures are widely regarded as safe and successful; therefore, the best course of action should be determined case-by-case while taking the demands of the patient and the preferences of the surgeon into account.[7]

Until now there have not been many studies comparing these two interventions for populations under 60 years. Various studies show that the results are the same no matter what age, and several studies show that arthroscopic and open surgery of rotator cuff tears in patients under 60 years of age can produce good results and may be associated with better outcomes than in older patients. In light of recent publications, we perform a meta-analysis study to evaluate arthroscopy versus open rotator cuff repair in young-age patient (<60 years old).

Materials and Methods

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 was used as a guideline when compiling this meta-analysis. These guidelines were followed to guarantee the appropriate reporting about a randomized controlled trial (RCT) meta-analysis. This study was registered in the PROSPERO on October 9th, 2024. The registration number is CRD42020214413. Available from: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42024595526

Search Strategy

The Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guideline statement was followed when doing the research. From 2013 to 2024, a thorough search was conducted to find studies that might be included in this analysis. PubMed, Cochrane, and Wiley Online are the databases that are used. Researchers using a combination of keywords such as "arthroscopic surgery," "open surgery", and "rotator cuff. "

The reference lists and abstracts were checked separately by reviewers. Conflicts amongst reviewers about whether to include or not include a study will be settled by consensus and, if necessary, discussion with an outside reviewer. This research will include studies that employ full text, are in English, and compare all-arthroscopic and open rotator cuff repairs. This meta-analysis compares the functional and clinical results of rotator cuff restoration with open surgery against all-arthroscopic surgery.

Table 1. PICO Criteria for Inclusion Study

	Inclusion	Exclusion
Patient	Patient with rotator cuff injury (<60 years old)	Patient with rotator cuff injury (≥60 years old), patient with associated adhesive capsulitis, degenerative arthritis of the glenohumeral joint, and previous history of surgery
Intervention	Patients treated with all-arthroscopic rotator cuff repair	Patients treated with conservative measures and surgery or other technique other than all-arthroscopic or open rotator cuff repair
Control	Patients treated with open rotator cuff repair	Patients treated with conservative measures and surgery of other technique other than all-arthroscopic or open rotator cuff repair
Outcome	VAS score, Constant score, ROM flexion, and ROM rotation at months of follow-up	Outcomes not clearly mentioned Outcome with other parameters than our inclusion criteria
Design	Randomized controlled trials (RCT), cohort	Case report, case series, cross-sectional, systematic review, or meta-analysis

Inclusion Criteria

The criteria for including studies were as follows: (1) Studies that compare arthroscopic vs. open rotator cuff repair in patients with rotator cuff injury through prospective or retrospective comparative and RCT studies; (2) English language studies; (3) Studies published within 2013-2024 which this timeframe was utilized to compare the most recent and cutting-edge arthroscopic and open surgery techniques; (4) Studies that report outcome measurements using tools like the Visual Analog Scale (VAS), Constant-Murley score, and range of motion (ROM) flexion and external rotation at

months' follow-up. Excluded from consideration were studies including individuals who had already had surgery, adhesive capsulitis, or degenerative arthritis of the glenohumeral joint (Table 1).

Quality Evaluation

Every manuscript was subjected to an impartial review by reviewers. Any disparities found were settled by thorough debate and consensus. The seven Cochrane criteria for assessing risk of bias in the "Risk of bias" assessment tool—which include selection, performance, detection, attrition, reporting, and other bias—will be used by the same independent reviewers to evaluate the quality of the included studies (Figure 1 and Figure 2).

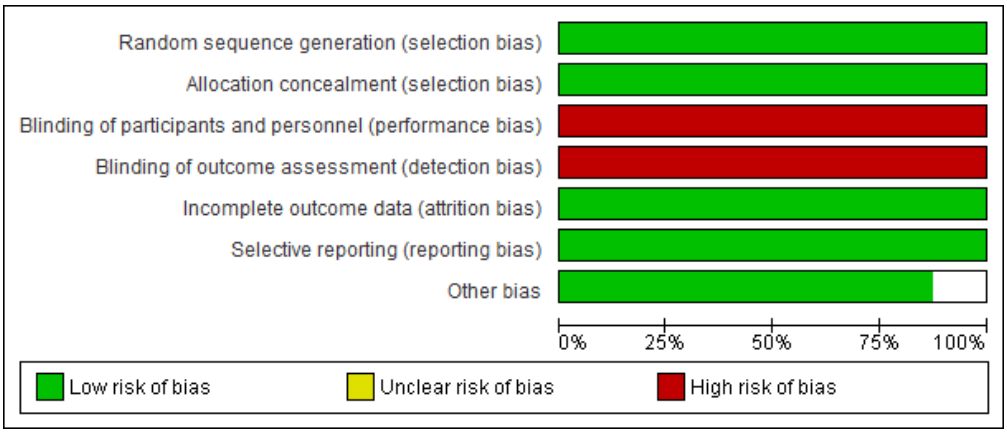

Figure 1. Risk of Bias Graph.

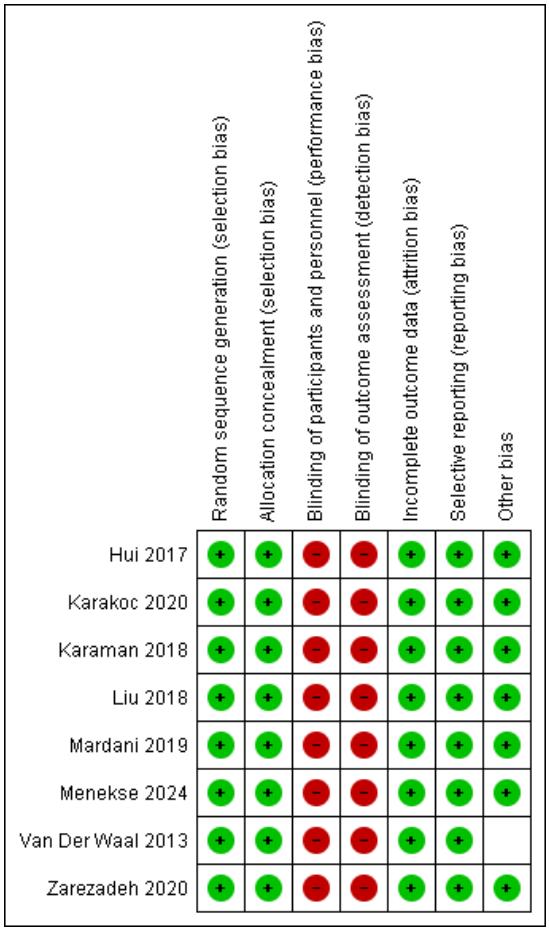

Figure 2. Risk of Bias Summary.

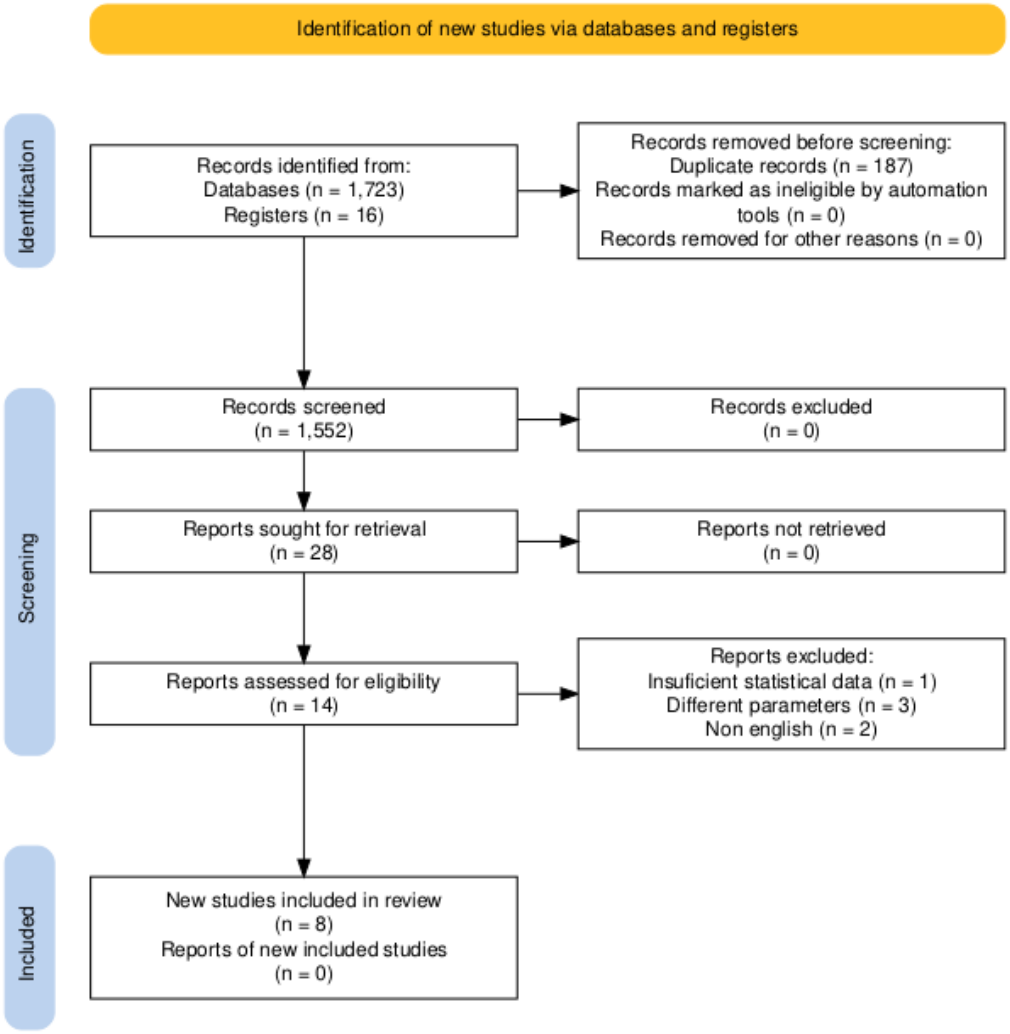

Figure 3. PRISMA Flowchart for the Included Study.

Data Synthesis

For every study that was found and included, data extraction was gathered using specified tables under the headings of fundamental characteristics and results. Review Manager was used to carry out quantitative analysis once the data were available. Forest plots were used to display the results. In each study, the mean difference for continuous outcome and odds ratio for dichotomous outcome with a 95% confidence interval (CI) was calculated. When the heterogeneity (I^2) was less than 10%, a fixed-effects model was employed; when the heterogeneity was greater than 10%, a random-effects model was utilized.

Results

Literature Search, Study Selection, and Study Characteristics

1739 records were found using the electronic search across several databases. Following the steps of removing duplicates, screening, and excluding research, the final eight studies were incorporated into the qualitative synthesis. The remaining papers were eliminated because they weren't in English, had different criteria, or didn't have enough statistical evidence. There were 716 patients in all in this meta-analysis, 379 of whom had all arthroscopic procedures and 337 of whom had open rotator cuff repairs. The age range of the patient was 46-58 years old (Table 2).

VAS Score

In 4 studies, including a total of 177 patients in the arthroscopic group and 177 patients in the open surgery group, VAS scores were analyzed. Figure 4 demonstrates there were no significant differences between the arthroscopic and open repair on VAS score (MD = 0.03 95% CI -0.16, 0.22, P = 0.79). A

Table 2. Main Characteristics of the Included Studies (2013-2024)

No	Author (Year)	Study Design	Mean Age	Population	Interventions	Control	Outcome	Results
1	Menekse et al. (2024)[8]	Cohort Retrospective	Arthroscopy group: 56.2 Open surgery group: 54.8	100 patients	50 arthroscopic surgery group; in addition, an acromioplasty was performed on 12 patients in the open surgery group	50 open surgery group; in addition, an acromioplasty was performed in 43 patients in the arthroscopic surgery group	Functional outcome: VAS, Constant Murley Objective outcome: -	Both methods resulted in similar recovery times and functional capacity scores, but patients treated with the open method reported slightly lower pain levels compared to those treated with the arthroscopic method
2	Karakoc & Atalay (2020)[9]	Cohort Retrospective	Arthroscopy group: 46.9 Open surgery group: 52.5	40 patients	20 patients enrolled in all-arthroscopic surgery	20 patients enrolled in open surgery groups	Functional outcome: Quick Dash Objective outcome: Shoulder flexion	Arthroscopically operated patients with rotator cuff tear had less pain after surgery and better shoulder flexion in long-term follow-up with no postoperative complication
3	Zarezadeh et al. (2020)[10]	Nonrandomized clinical trial	Arthroscopy group: 47.8 Open surgery group: 47.7	51 patients	25 patients had undergone arthroscopic repair	26 cases had undergone open repair surgery	Functional outcome: UCLA scores Objective outcome: Shoulder flexion, shoulder abduction	There are no significant differences in terms of pain relief and range of motion between the two groups. Nevertheless, the function of the patients who underwent open surgery, improved more than the arthroscopic group
4	Mardani-Kivi et al. (2019)[11]	Randomized clinical trial	Arthroscopy group: 56.1 Open surgery group: 55.2	60 patients	30 patients had undergone arthroscopic repair	30 cases had undergone open repair surgery	Functional outcome: VAS, Constant Murley Objective outcome: -	The functional status of both groups was improved, but not significantly differently so between the two groups
5	Karaman et al. (2018)[12]	Cohort Retrospective	Arthroscopy group: 48.7 Open surgery group: 48.7	45 patients	21 patients where a full arthroscopic operation was performed.	24 patients where the open technique was applied	Functional outcome: Constant Murley Objective outcome: Shoulder flexion, shoulder rotation	There was no difference between the groups in respect of muscle strength, Constant Murley score, wound healing, or physical examination
6	Liu et al (2018)[13]	Randomized clinical trial	Arthroscopy group: 53.5 Open surgery group: 52.5	99 patients	50 patients had undergone arthroscopic repair	49 cases had undergone open repair surgery	Functional outcome: DASH, VAS, Constant Murley	The arthroscopy approach was associated with less pain, lower DASH score, and

							Objective outcome: Shoulder flexion, shoulder rotation	higher CMS in the early recovery period
7	Hui et al. (2017)[14]	Cohort Retrospective	Arthroscopy group: 57 Open surgery group: 56	226 patients	136 patients where the arthroscopic-assisted mini-open technique was applied	90 patients where an open repair surgery was applied	Functional outcome: Constant Murley Objective outcome: -	There was also no difference in Constant scores both preoperatively and at 1 year postoperatively
8	Van Der Waal et al. (2013)[15]	Randomized clinical trial	Arthroscopy group: 57.2 Open surgery group: 57.8	95 patients	47 patients had undergone arthroscopic repair	48 cases had undergone open repair surgery	Functional outcome: DASH, VAS, Constant Murley Objective outcome: Shoulder flexion, shoulder rotation	There was a significant improvement in postoperative range of motion in the arthroscopy treatment group: both postoperative forward flexion and postoperative external rotation were higher in this group.

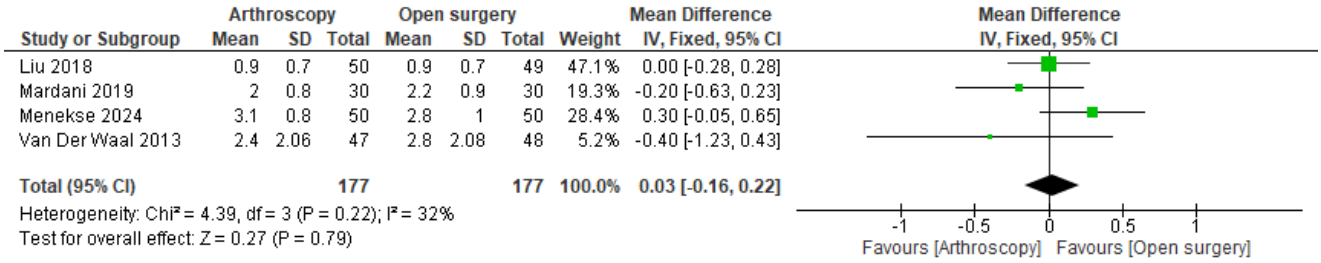

Figure 4. Forest Plot Analysis of VAS Pain Scores.

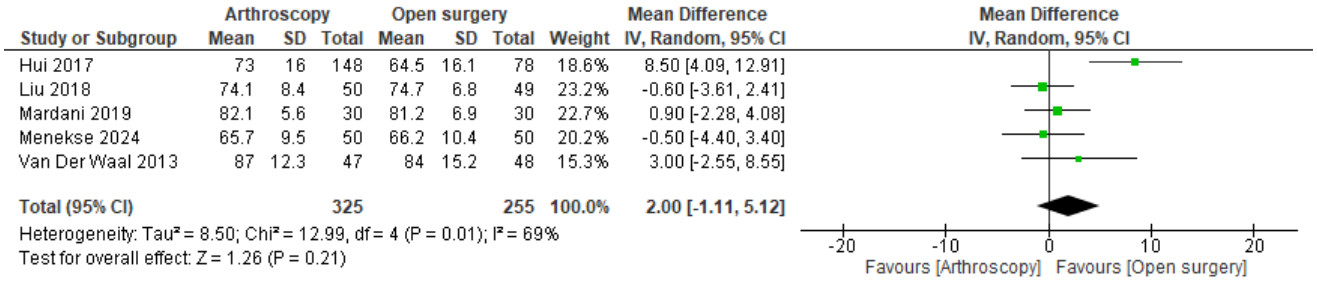

Figure 5. Forest Plot Analysis of Constant Scores.

heterogeneity (P<0.10) wasn't found in VAS analysis.

Constant Score

Constant score was analyzed in 5 investigations, with 255 patients in the open group and 325 patients in the arthroscopic group overall. Figure 5 (MD = 2.00 95%CI -1.11, 5.12 P = 0.21) shows that there were no statistically significant differences between the open and arthroscopic repairs on the Constant score. A heterogeneity (P<0.10) was discovered in the examination of Constant scores. These studies showed low heterogeneity (I2= 69%; P = <0.01).

Shoulder Flexion

Shoulder flexion was analyzed in 5 investigations, with 167 patients in the open group and 163 patients in the arthroscopic group overall. Figure 6 (MD = 8.85

95%CI -1.38, 19.08, P = 0.09) shows that there were no statistically significant differences between the open and arthroscopic repairs on shoulder flexion. A heterogeneity (P<0.10) was discovered in the examination of shoulder flexion. These studies showed low heterogeneity (I^2= 85%; P = <0.0001).

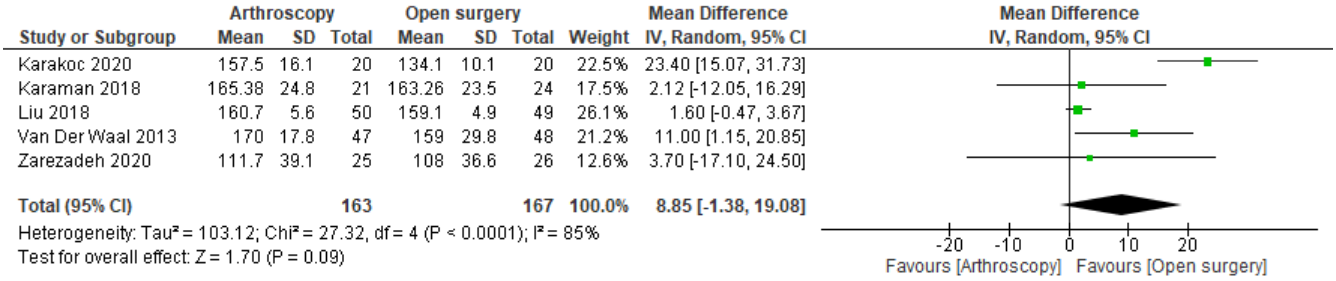

Figure 6. Forest Plot Analysis of Shoulder Flexion.

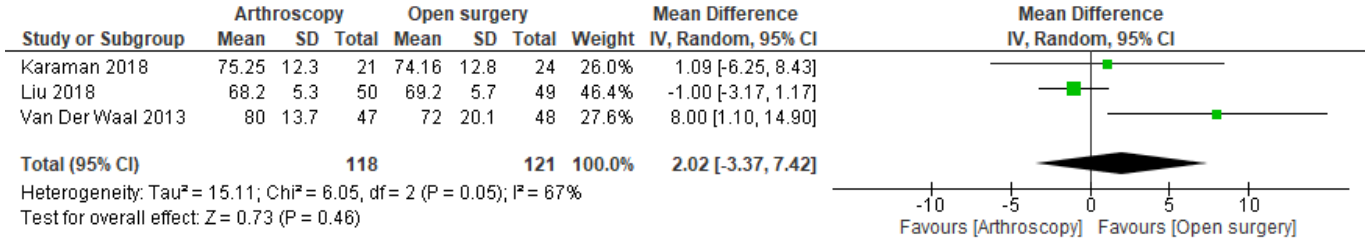

Figure 7. Meta-analysis of Shoulder Rotation.

Shoulder Rotation

Shoulder rotation was analyzed in 3 investigations, with 121 patients in the open group and 118 patients in the arthroscopic group overall. Figure 7 (MD = 2.02 95% CI -3.37, 7.42, P = 0.46) shows that there were no statistically significant differences between the open and arthroscopic repairs on shoulder rotation. A heterogeneity (P<0.10) was discovered in the examination of shoulder rotation. These studies showed low heterogeneity (I^2 = 67%; P = <0.05).

Discussion

The most prevalent upper extremity ailment addressed by orthopaedic and primary care physicians is rotator cuff tears, which can range in severity from tendinopathy to full-thickness rips with arthritic change. Rotator cuff tears are exceedingly prevalent, impacting 6.8% to 22.4% of adults over 40.[16] While there are some acute tears, degenerative issues with the rotator cuff predominate. Not every patient experiences a worsening of their symptoms when their tears get longer, and not every patient experiences symptoms at all. Thus, it is difficult to develop a consistent algorithm for patient management.[17]

Rotator cuff tears have a complicated pathophysio logy that involves interactions between the tendon, bone, and muscle. Degenerative alterations in the tendon, along with matrix disarray and inflammatory changes, are the first signs of rotator cuff tears. Tears subsequently develop into partially thick and then fully thick tears. The total size of the muscle and intramuscular fatty infiltration are indicators of muscle quality, which also affects symptoms, the course of tears, and surgical results.[17]

Treatment for rotator cuff issues is mostly based on symptoms, with nonoperative care being adequate for the majority of patients. However, failing conservative treatment necessitates using alternative forms of care, ideally surgical surgery. In a recent meta-analysis, Brindisino et al. (2021) compared nonoperative treatment with rotator cuff surgery and found that surgical rotator cuff repair leads to improved pain alleviation and functional improvement across a 24-month follow-up period.[18] Acromioplasty and debridement would be sufficient treatments for a lesion with less than 50% cuff thickness. On the other hand, more cuff excision and repair are necessary for a lesion that is thicker and longer than 50%. Patients under 60 years old seem to

have better results. Diabetes, moderate to severe muscular atrophy, larger and significant tears (>3 cm) in the lesion morphology, and more than 2.5 mm of tear retraction are all linked to poorer outcomes in patients older than 60.[19,20]

There are conflicting data regarding which of the two methods is better. Because rotator cuff tears are so common, a lot of researchers are focusing their attention on this subject. From the perspective of both the patient and the surgeon, an all-arthroscopic treatment is more convenient than an open repair. Unfortunately, numerous studies revealed the opposite. Similar research was conducted in 2015 by Ji et al., who found no differences in the duration of surgery, functional outcome, pain score, or range of motion between the two treatments.[21] However, a more recent, bigger assessment by Migliorini et al. (2021) compared the results of 1644 arthroscopic and mini-open rotator cuff repairs and found comparable outcomes between the two techniques, which is in line with our findings.[22]

VAS score analysis shows no difference between two groups. Patients treated with the arthroscopic method (average VAS score: 2.1) reported slightly lower pain levels compared to those treated with the open method (average VAS score: 2.2). The visual analog scale (VAS) is a validated, subjective measure for acute and chronic pain. Scores are recorded by making a handwritten mark on a 10-cm line that represents a continuum between “no pain” and “worst pain.”[23] After open or rotator cuff arthroscopic surgery, pain is frequently experienced, particularly in the first 48 hours following the procedure. The shoulder joint may take weeks or months to fully recover, and the discomfort and swelling may persist for several weeks. Basically, these two procedures are highly standardized, and as technology develops, patient comfort is taken into account so as to minimize pain.[24]

Constant score analysis also shows no difference between the two groups. Patients treated with the arthroscopic method (average Constant score: 76.4) reported slightly higher overall shoulder function compared to those treated with the open method (average Constant score: 74.1). Four components of shoulder pathology are evaluated by the Constant score: two objective (range of motion and strength) and two subjective (pain and activities of daily living, or ADL). A maximum of 100 points (best function) might be obtained by adding the objective's 65 points and the subjective components' 35 points. The patient responds to pain and ADLs; the orthopaedic surgeon or physiotherapist responds to ROM and strength, which need a physical examination.[25] The majority of rotator cuff repairs are made arthroscopically, while certain major tears may need to be repaired "open." It has been demonstrated that both standard methods enhance patients' ADLs.[24]

Both open and arthroscopic rotator cuff surgeries enhance range of motion in terms of flexion and rotation. A tiny incision with less scarring has a positive postoperative correlation with the functional pain score. Thus, a patient's discernibly quicker recovery greatly encourages early rehabilitation. Pain alleviation, functional improvement, and a gain in shoulder strength and range of motion are all realized as a result of rotator cuff repair. During the rehabilitation phase, optimal stability is felt, which enhances glenohumeral mobility and rotator cuff muscle strength. The overall result of our investigation is an increase in glenohumeral range of motion at flexion and external rotation.[26]

Although much research shows arthroscopic repairs are less intrusive, require less recovery time, and have a lower risk of problems, this does not rule out the fact that open surgery is a treatment that is often performed because the tears that occur are usually large. Selecting between the two techniques for rotator cuff repairs is safe because they have comparable long-term results at the follow-up when compared to another treatment.[27] Between the two operations, the risk of complications is minimal and is restricted to local infection, stiffness, and re-tear. The clinical judgment consisted of the surgeon's preference, trained abilities, and the appropriate indication, taking into account the patient's desire based on their activity.[28]

This study has some limitations; different types of repair techniques were also noted in the included studies. However, we opted not to perform subgroup analysis due to the lack of detailed data in each study. We also did not subcategorize the patients based on types of rotator cuff pathologies. Not all the included studies in our research discuss repair conditions. Since the degree of repair integrity is a predictor of shoulder functions after arthroscopic rotator cuff repair, future studies on this issue should also document the status of cuff repair.

Conclusion

For rotator cuff repairs, arthroscopic and open surgery are equally good options. Both arthroscopic and open repairs offer pain reduction, range of motion restoration, and enhanced functional results for day-to-day activities at the follow-up. Therefore, selecting the right surgical treatments still requires careful consideration of each patient's needs as well as the surgeon's preferences.

Conflict of Interest

The authors declare no conflicts of interest.

References

1. May T, Garmel GM. Rotator cuff injury. [Updated 2023 Jun 26]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024.
2. Codding JL, Keener JD. Natural history of degenerative rotator cuff tears. Curr Rev Musculoskelet Med. 2018;11(1):77-85. doi:10.1007/s12178-018-9461-8
3. Ryösä A, Laimi K, Äärimaa V, Lehtimäki K, Kukkonen J, Saltychev M. Surgery or conservative treatment for rotator cuff tear: a meta-analysis. Disabil Rehabil. 2017;39(14):1357-63. doi:10.1080/09638288.2016.1198431
4. Deprés-Tremblay G, Chevrier A, Snow M, Hurtig MB, Rodeo S, Buschmann MD. Rotator cuff repair: a review of surgical techniques, animal models, and new technologies under development. J Shoulder Elbow Surg. 2016;25(12):2078-85. doi:10.1016/j.jse.2016.06.009
5. Karjalainen TV, Jain NB, Heikkinen J, Johnston RV, Page CM, Buchbinder R, et al. Surgery for rotator cuff tears. Cochrane Database Syst Rev. 1996;2019(12). doi:10.1002/14651858.CD013502
6. Longo UG, Carnevale A, Piergentili I, Berton A, Candela V, Schena E, et al. Retear rates after rotator cuff surgery: a systematic review and meta-analysis. BMC Musculoskelet Disord. 2021;22(1):749. doi:10.1186/s12891-021-04634-6
7. Kasten P, Keil C, Grieser T, Raiss P, Streich N, Loew M. Prospective randomised comparison of arthroscopic versus mini-open rotator cuff repair of the supraspinatus tendon. Int Orthop. 2011;35(11):1663-70. doi:10.1007/s00264-011-1262-2
8. Menekse S. Comparison of outcomes between open and arthroscopic rotator cuff repair. Adv Orthop. 2024;2024(1):5575404. doi:10.1155/2024/5575404
9. Potts HW, Benson T. A short generic patient experience questionnaire: howRwe development and validation. BMC Health Serv Res. 2014;14:1-10 doi:10.1186/s12913-014-0499-z
10. Bolderston A. Patient experience in medical imaging and radiation therapy. J Med Imaging Radiat Sci. 2016;47(4):356-61. doi:10.1016/j.jmir.2016.09.002
11. Mardani-Kivi M, Keyhani S, Ebrahim-Zadeh MH, Hashemi-Motlagh K, Saheb-Ekhtiari K. Rotator cuff tear with concomitant long head of biceps tendon (LHBT) degeneration: what is the preferred choice? Open subpectoral versus arthroscopic intraarticular tenodesis. J Orthop Traumatol. 2019;20(1):26. doi:10.1186/s10195-019-0531-5
12. Karaman O, Karakus O, Saygi B. A comparison of full arthroscopic and arthroscopic-assisted mini-open repair methods in rotator cuff tears 1–3 cm in size. J Orthop. 2018;15(3):894-8. doi:10.1016/j.jor.2018.08.011
13. Liu J, Fan L, Zhu Y, Yu H, Xu T, Li G. Comparison of clinical outcomes in all-arthroscopic versus mini-open repair of rotator cuff tears: A randomized clinical trial. Medicine. 2017;96(11):e6322. doi:10.1097/MD.0000000000006322
14. Hui YJ, Teo AQ, Sharma S, Tan BH, Kumar VP. Immediate costs of mini-open versus arthroscopic rotator cuff repair in an Asian population. J Orthop Surg. 2017;25(1):2309499016684496. doi:10.1177/2309499016684496
15. van der Zwaal P, Thomassen BJ, Nieuwenhuijse MJ, Lindenburg R, Swen JW, van Arkel ER. Clinical outcome in all-arthroscopic versus mini-open rotator cuff repair in small to medium-sized tears: a randomized controlled trial in 100 patients with 1-year follow-up. Arthroscopy: Arthroscopy. 2013;29(2):266-73. doi:10.1016/j.arthro.2012.08.022
16. Kuhn JE. Prevalence, natural history, and nonoperative treatment of rotator cuff disease. Oper Tech Sports Med. 2023;31(1):150978. doi:10.1016/j.otsm.2023.150978
17. Bedi A, Bishop J, Keener J, Lansdown DA, Levy O, MacDonald P, et al. Rotator cuff tears. Nat Rev Dis Primers. 2024;10(1):8. doi:10.1038/s41572-024-00492-3
18. Brindisino F, Salomon M, Giagio S, Pastore C, Innocenti T. Rotator cuff repair vs. nonoperative treatment: a systematic review with meta-analysis. J Shoulder Elbow Surg. 2021;30(11):2648-59. doi:10.1016/j.jse.2021.04.040
19. Green A, Loyd K, Molino J, Evangelista P, Gallacher S, Adkins J. Long-term functional and structural outcome of rotator cuff repair in patients 60 years old or less. JSES Int. 2023;7(1):58-66. doi:10.1016/j.jseint.2022.10.002
20. Shah NS, Suriel Peguero E, Umeda Y, Crawford ZT, Grawe BM. Long-term outcomes of massive rotator cuff tear repair: A systematic review. HSS J. 2022;18(1):130-7. doi:10.1177/15563316211008137
21. Ji X, Bi C, Wang F, Wang Q. Arthroscopic versus mini-open rotator cuff repair: an up-to-date meta-analysis of randomized controlled trials. Arthroscopy. 2015;31(1):118-24. doi:10.1016/j.arthro.2014.08.017
22. Migliorini F, Maffulli N, Eschweiler J, Schenker H, Tingart M, Betsch M. Arthroscopic versus mini-open rotator cuff repair: A meta-analysis. Surgeon. 2023;21(1):e1-2. doi:10.1016/j.surge.2021.11.005
23. Delgado DA, Lambert BS, Boutris N, McCulloch PC, Robbins AB, Moreno MR, et al. Validation of digital visual analog scale pain scoring with a traditional paper-based visual analog scale in adults. J Am Acad Orthop Surg Glob Res Rev. 2018;2(3):e088. doi:10.5435/JAAOSGlobal-D-17-00088
24. Huang R, Wang S, Wang Y, Qin X, Sun Y. Systematic review of all-arthroscopic versus mini-open repair of rotator cuff tears: a meta-analysis. Sci Rep. 2016;6(1):22857. doi:10.1038/srep22857
25. Vrotsou K, Ávila M, Machyn M, Mateo-Abad M, Pardo Y, Garin O, et al. Constant–Murley Score: systematic review and standardized evaluation in different shoulder pathologies. Quality of life research. 2018;27(9):2217-26. doi:10.1007/s11136-018-1875-7
26. Ghodadra NS, Provencher MT, Verma NN, Wilk KE, Romeo AA. Open, mini-open, and all-arthroscopic rotator cuff repair surgery: indications and implications for rehabilitation. J Orthop Sports Phys Ther. 2009;39(2):81-A6. doi:10.2519/jospt.2009.2918
27. MacDermid JC, Bryant D, Holtby R, Razmjou H, Faber K, JOINTS Canada, et al. Arthroscopic versus mini-open rotator cuff repair: a randomized trial and meta-analysis. Am J Sports Med. 2021;49(12):3184-95. doi:10.1177/0363546521103 8233
28. Randelli P, Spennacchio P, Ragone V, Arrigoni P, Casella A, Cabitza P. Complications associated with arthroscopic rotator cuff repair: a literature review. Musculoskelet Surg. 2012;96(1):9-16. doi:10.1007/s12306-011-0175-y