

Comparison of single versus double-row techniques in arthroscopic rotator cuff repair of full-thickness tears

Comparison of single versus double row techniques in arthroscopic rotator cuff repair

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Abstract

Aim: This study aimed to evaluate the effect of suture techniques on clinical outcomes and re-tear rate following arthroscopic rotator cuff repair (aRCR) in full-thickness rotator cuff tears.

Material and Methods: The study included 115 consecutive aRCRs with a minimum 1-year follow-up. Patients were divided into two groups according to the repair technique used (Group 1: single-row technique; Group 2: double-row technique). Pre- and postoperative clinical and functional outcomes were measured using the Visual Analog Scale (VAS), the American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form (ASES), the Constant-Murley Score (CMS) and range of motion (ROM) (abduction degrees). Magnetic Resonance Imaging (MRI) was used for radiological evaluation pre- and postoperatively. Patte' classification was used to determine the retraction amount of the tear. Failure was determined by MRI imaging together with clinical and functional evaluation. A comparative analysis of clinical and functional outcomes and failure rates were performed between groups.

Results: The mean follow-up period was 25.3 ± 9.7 months. The mean age at the time of surgery was 58.6 ± 8.3 years. While no statistical difference was observed between preoperative patient and tear characteristics, the number of anchors used in Group 2 was significantly higher than the Group 1, $p=0.001$). A significant improvement was found in clinical and functional scores in both groups ($p < 0.001$ for both). However, pre- and postoperative clinical and functional outcomes and failure rates did not differ between groups ($p>0.05$). Eight patients (7%) had a re-tear at the last follow-up (4 in Group 1; 4 in Group 2, $p=0.571$). Patients with no re-tear could return to their preoperative activities at the last follow-up.

Discussion: Satisfactory results can be obtained in the early postoperative period, regardless of the suture technique in aRCR of full-thickness rotator cuff tears. We suggest that the single-row method is at least as effective as the double-row and cost-effective procedure in aRCR.

Keywords

Rotator cuff; Repair technique; Arthroscopic; Single row; Double row

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Introduction

Rotator cuff tear (RCT)s are among the most common shoulder pathologies, the incidence of which increases with age and requires surgical intervention [1]. Arthroscopic rotator cuff repair a(RCR) procedures have gradually improved with the use of suture anchors with several advantages over open surgery [2]. Fixation methods based on the use of anchors have become popular with their convenient use, better biomechanics of the repair structure, and the ease of creating a variety of suture configurations [3]. Single-row (SR) and double-row (DR) fixation techniques are the most commonly used techniques with good clinical short-and long-term results [4-6]. However, early repair failures are still common, and re-tear rates ranging from 9% to 29% have been reported [5]. Although various studies report that the DR repair technique has several biomechanical advantages (footprint re-creation [7], wider contact area [8], superior resistance to gap formation under static loading [9], fixation strength [10], resistance to cyclic displacement [11]) over SR, studies comparing functional outcomes and healing rates after SR and DR of RCTs published in the last decade have reported conflicting results [6]. Furthermore, in several meta-analyzes, variable conflicting clinical outcomes and re-tear rates have been reported in terms of suture repairing technique (SR vs DR) in partial and full-thickness RCT subgroups [12–14]. Therefore, the present study aimed to evaluate the effect of surgical technique on clinical and functional outcomes and re-tear rate in the repair of full-thickness RCTs. We hypothesized that a double-row aRCR would provide a better clinical and functional outcome and also lower re-tear rate in full-thickness RCTs.

Material and Methods

Between 2015 and 2019, we performed 186 aRCRs, of which, we retrospectively reviewed 115 aRCRs with a minimum 1-year follow-up. We included patients with total aRCRs who did not respond to conservative treatment and attended regular follow-ups. The exclusion criteria were as follows: non-attendance of regular follow-ups (25 patients), history of previous surgery on the affected shoulder (subacromial pathologies: 18 patients; trauma: 2 patients; glenohumeral pathologies: 8 patients), isolated subscapularis tendon tear (2 patients), or non-attendance of the postoperative rehabilitation program regularly (16 patients).

All surgical procedures were performed in the beach-chair position. For aRCRs, the SR (Figure 1 a-d) or DR (Figure 2 a-d) repair techniques were used. Repairs were performed using a suture anchor (Twinfix® or Footprint PK®, Smith & Nephew, London, UK). Subacromial decompression and release of the anterior aspect of the coracoacromial ligament were performed following aRCR.

Postoperative in-hospital analgesics included 50 mg of tramadol and 500 mg of acetaminophen three times a day. After discharge, the same drugs were prescribed with the order of one or two pills a day. An immobilizer was used postoperatively for six weeks. Pendulum exercises were started immediately at day 1 postoperatively. Pendulum exercises with active elbow, wrist, and hand exercises were allowed for the first six weeks. Passive range of motion (ROM) was allowed

in weeks 6-8, active-assisted ROM between weeks 8 and 10, and active ROM between weeks 10 and 12. A strengthening program was started on the 12th week.

Patient characteristics and demographic data were recorded. Operative reports were evaluated and pre- and postoperative clinical and preoperative radiological examinations were performed. While preoperative magnetic resonance imaging (MRI) was used routinely, postoperative MRI was evaluated only in patients with ongoing or new-onset symptoms. Pre- and postoperative clinical and functional outcome scores were measured preoperatively and at the last follow-up visit using the Visual Analog Scale (VAS; ranging from 0 to 10; 0 = no pain, 10 = worst pain ever), the American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form (ASES) [15], the Constant-Murley-Score (CMS) [16] and range of motion (ROM) (abduction degrees). Patte classification was used to determine the retraction amount of the tear [17]. Postoperative rotator cuff re-tear was evaluated by physical examination (persistent pain, loss of strength) correlating with MRI (assessing the structural integrity of the repaired rotator cuff) [18]. Informed consent was obtained from all participants and the study was approved by the Local Ethics Committee.

Statistical Analysis

Mean, standard deviation, median, lowest, and highest values, and frequency ratio were used in descriptive statistics of the data. The Kolmogorov-Smirnov test was used to measure the distribution of the variables. For the analysis of independent quantitative data, the independent sample t-test and the Mann-Whitney U tests were used. The Wilcoxon test was used for the analysis of dependent quantitative data. The Chi-square test was used to analyze independent qualitative data, and Fischer's exact test was used when the chi-square test requirements were not met. A p-value of < 0.05 was considered significant. All statistical analyses were performed using SPSS v22.0 for Windows (SPSS Inc., IL, USA).

Results

The mean age of the 115 patients was 58.6 ± 8.3 years. There were 83 right-sided and 32 left-sided tears. The mean follow-up duration was 25.3 ± 9.7 months (range: 12 to 52 months). No statistical difference was observed between pre- and postoperative patient characteristics and demographics of patients of the groups. Patient characteristics and demographic data of all patients and two groups are summarized in Table 1. The tear pattern, torn tendon, tear size (cm) and retraction amount were similar between groups, however, the number of anchors used in Group 2 was significantly higher than the Group 1 ($p=0.001$). Tear and surgical characteristics of all patients and two groups are summarized in Table 2.

Good to excellent outcomes with significant improvements in clinical and functional scores were obtained at the last follow-up. Pre- and postoperative VAS, ASES, CMS, and abduction degrees of ROM were significantly improved compared to the baseline ($p < 0.001$ for all). However, no statistical difference was observed in terms of clinical and functional outcomes between the groups ($p>0.05$ for all). In addition, there was no significant difference in failure rates between groups. The pre- and postoperative clinical outcome scores and failure rates of

all patients and two groups are summarized in Table 3. Eight patients had re-tear and underwent revision surgery during the follow-up period. The mean re-tear time was 12.7 ± 5.1 months (range: 8 to 24 months; 12.0 ± 2.9 for group 1 vs 13.5 ± 5.7 for group 2, p=0.713). In the re-tear group, all the patients underwent revision aRCR. No patients developed a superficial or deep infection. No major complications were observed perioperatively or at the last follow-up.

Discussion

The most important finding of this study was that good and satisfactory outcomes can be obtained in aRCR of full thickness RCTs in the early postoperative period, regardless of the suture technique. Moreover, the repair technique (SR or DR) did not

affect re-tear development in the early period after aRCR.

The most appropriate technique for aRCR is controversial. An ideal surgical technique involved in the repair of rotator cuff tears should have the potential to withstand physiological loads and at the same time provide healing and prevent re-rupture [19]. There are several surgical techniques described for the repair of RCTs including SR and DR suture anchor techniques, knotless anchors, transosseous tunnels [19]. These techniques, especially SR and DR repairs and their effectiveness were evaluated in various studies [3–11,18,19]. Different results have been reported with the efficiency of SR or DR repairs in aRCR repair, and even between partial and full thickness tears these methods have been reported to produce different results [12-14]. This difference in existing studies was thought to be

Table 1. Patient characteristics and demographic data of all patients and two groups

	Total n (%) =115 (100)		Single row n (%) = 61 (53.0)		Double row n (%) = 54 (47.0)		p value
	Mean ± SD/n-%	Median (min-max)	Mean ± SD/n-%	Median (min-max)	Mean ± SD/n-%	Median (min-max)	
Age	58.6 ± 8.3	58.0 (35-78)	58.7 ± 9.0	57.0 (35-78)	58.5 ± 7.4	58.0 (44-78)	0.892
Follow-up period (Month)	25.3 ± 9.7	24.0 (12-52)	24.9 ± 8.3	24.0 (12-48)	26.3 ± 7.8	24.0 (12-52)	0.144
BMI	26.3 ± 2.5	26.7 (21.2-33.3)	26.2 ± 2.2	26.4 (21.2-31.2)	26.4 ± 2.8	26.8 (21.2-33.3)	0.611
Sex	Female	75 65.2%	40 65.6%		35 35.2%		0.932
	Male	40 35.8%	21 34.4%		19 64.8%		
Side	Right	83 72.2 %	41 67.2%		42 77.8%		0.207
	Left	32 27.8 %	20 32.8%		12 22.2%		
Smoking Habit	(-)	93 80.9 %	50 82.0%		43 79.6%		0.750
	(+)	22 19.1 %	11 18.0%		11 20.4%		
Comorbidity*	(-)	64 55.7 %	30 49.2%		32 59.3%		0.279
	(+)	51 44.3 %	31 50.8%		22 40.7%		
Time period between symptom onset and surgery (months)	9.5 ± 6.9	8.0 (2-36)	9.2 ± 5.7	8.0 (2-24)	9.9 ± 8.1	6.5 (2-36)	0.587
Postoperative analgesic use in hospital (hours)	34.8 ± 14.5	30.0 (24-72)	36.0 ± 15.1	30.0 (24-72)	33.5 ± 13.9	24.0 (24-72)	0.284
Postoperative analgesic use at discharge (day)	11.0 ± 4.1	10.0 (7-30)	11.5 ± 4.6	10.0 (7-30)	10.3 ± 3.4	10.0 (7-71)	0.150
Biceps tenotomy	(-)	69 60.0 %	38 62.3%		31 57.4%		0.593
	(+)	46 40.0 %	23 37.7%		23 42.6%		

Abbreviations: BMI: Body Mass Index, ACJ: Acromioclavicular joint, *: Hypertension, Diabetes, Renal failure, Thyroiditis.

Table 2. Tear and surgical characteristics of all patients and two groups

	Total n (%) =115 (100)		Single row n (%) = 61 (53.0)		Double row n (%) = 54 (47.0)		p value
	Mean ± SD/n-%	Median (min-max)	Mean ± SD/n-%	Median (min-max)	Mean ± SD/n-%	Median (min-max)	
Tear pattern	Crescent	94 81.7%	47 77.0%		47 87.0%		0.321
	U type	13 11.3%	8 13.1%		5 9.3%		
	L type	8 7.0%	6 9.8%		2 3.7%		
Torn tendon	SS	87 75.7%	47 77.0%		40 74.1%		0.774
	SS+IS	25 21.7%	13 21.3%		12 22.2%		
	SS+IS+SSC	3 2.6%	1 1.7%		2 3.37		
Patte Classification	I	31 27.2%	16 26.2%		15 27.8%		0.377
	II	62 53.9%	36 59.0%		26 48.1%		
	III	22 19.1%	9 14.8%		13 24.1%		
Number of anchors used	2.2 ± 0.6	2.0 (1-4)	2.0 ± 0.4	2.0 (1-3)	2.4 ± 0.7	2.0 (2-4)	0.001
Tear size (cm)	2.13 ± 0.9	2.0 (1-5)	2.16 ± 0.9	2.0 (1-5)	2.11 ± 0.9	2.0 (1-5)	0.730

Abbreviations: SS: supraspinatus, IS: infraspinatus, SSC: subscapularis. Bold-italic values indicate statistical significance.

Table 3. Clinical outcome scores of all patients and two groups

	Total n (%) =115 (100)		Single row n (%) = 61 (53.0)		Double row n (%) = 54 (47.0)		p value
	Mean ± SD/n-%	Median (min-max)	Mean ± SD/n-%	Median (min-max)	Mean ± SD/n-%	Median (min-max)	
VAS score							
Preoperative	8.6 ± 1.0	9.0 (6-10)	8.7 ± 0.9	9.0 (6-10)	8.4 ± 1.0	9.0 (6- 10)	0.372
Postoperative	2.6 ± 1.9	2.0 (1-9)	2.7 ± 2.2	2.0 (1-9)	2.4 ± 1.7	2.0 (1- 9)	0.879
Pre-post difference			-5.9 ± 2.3	-6.0((-9)-0)	-6.0 ± 1.8	-7.0((-9)- 1)	0.954
Pre-post difference p	<0.001		<0.001		<0.001		
ASES score							
Preoperative	38.8 ± 14.7	40.0 (10-65)	37.5 ± 13.0	40.0 (15-60)	40.3 ± 16.3	44.5(10-65)	0.265
Postoperative	87.0 ± 15.3	90.0 (23-100)	86.3 ± 14.1	90.0(25-100)	87.8 ± 16.7	95.0(23-100)	0.110
Pre-post difference			48.8 ± 15.8	50.0((-10)-80)	47.4 ± 17.5	45.0(8-85)	0.475
Pre-post difference p	<0.001		<0.001		<0.001		
Constant Murley score							
Preoperative	32.5 ± 6.4	32.0 (11-47)	31.4 ± 5.0	32.0(22-42)	33.7 ± 7.6	34.0(11-47)	0.058
Postoperative	79.4 ± 16.1	82.0 (26-100)	78.4 ± 15.1	82.0(26-94)	80.5 ± 17.3	81.5(31-100)	0.178
Pre-post difference			47.0 ± 15.2	52.0((-10)-66)	46.7 ± 19.2	50.0((-5)-76)	0.897
Pre-post difference p	<0.001		<0.001		<0.001		
Abduction degree							
Preoperative	57.2 ± 8.0	55.0 (45-80)	57.6 ± 8.6	55.0 (45-80)	56.8 ± 7.4	55.0 (45-80)	0.535
Postoperative	112.1 ± 20.4	115.0(50-160)	110.4 ± 21.2	110.0(50-160)	114.1 ± 19.3	115.0(55-145)	0.167
Pre-post difference			52.7 ± 20.2	55.0((-5)-95)	57.3 ± 19.7	60.0((-5)-85)	0.130
Pre-post difference p	<0.001		<0.001		<0.001		
Failure							
(-)	107 93%		57 93.4%		50 92.6%		0.571
(+)	8 7%		4 6.6%		4 7.4%		

Abbreviations: VAS: Visual Analog Scale; ASES: American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form. Bold-italic values indicate statistical significance.

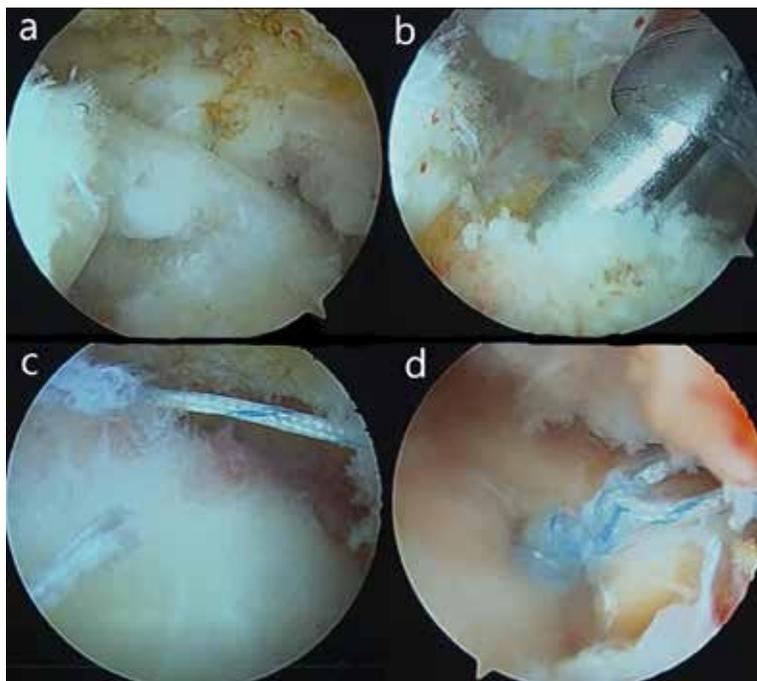


Figure 1a, b, c, d . Images of the arthroscopic repair of rotator cuff tears with single-row technique.

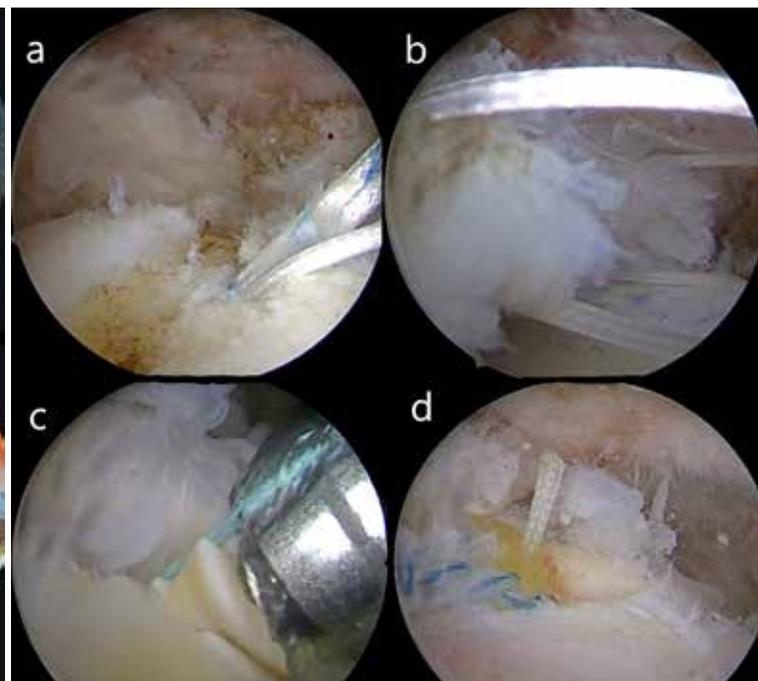


Figure 2a, b, c, d . Images of the arthroscopic repair of rotator cuff tears with double-row technique.

due to the comparison of SR and DR repair techniques with different configurations in more heterogeneous patient groups [19]. There is also a recent study that suggests comparing the methods in which both are the most robust to show which method is the most effective, and that the current literature

does not respond to this [20]. The present study evaluated the effectiveness of these two methods in a relatively homogeneous patient group in full-thickness RCT, and whether there was a difference between the techniques. Several studies reported that the DR repair technique has

several biomechanical advantages (footprint re-creation [7], wider contact area [8], superior resistance to gap formation under static loading [9], fixation strength [10], resistance to cyclic displacement [11]) over SR. Zhang et al. [13] in their meta-analysis performing a subgroup analysis of RCT size, revealed that the DR technique increased postoperative cuff integrity and improved the clinical outcomes for full-thickness RCTs (>3cm). In line with this study, Xu et al. [21] reported significantly better clinical outcomes (ASES, UCLA scores) with the DR technique than SR for full-thickness tears (>3 cm). Although biomechanical advantages of DR repair techniques in favor of biological healing have been shown, a comparative study by Gerhardt et al. [22] reported similar results between the fixation methods 2 years after surgery. In concordance with this study, Perser et al. [23] revealed that the DR repair technique did not show a statistically significant improvement in clinical outcomes in the short-term. A long-term comparative study by Plachel et al. [5] stated that there was no difference in clinical outcomes between DR and SR repair. Findings in our study were in line with the latter studies with no significant difference between groups.

An important outcome measure that evaluates success after RCR is the re-tear rate. The relationship between clinical results and retears is controversial [6]. Overall, although there was a significant increase in retear rates with imaging after SR repair, this difference did not always correlate with lower outcome scores. Plachel et al. [5] stated that more re-tears occurred in the SR repair group (33% vs 55%). They observed that re-tear rates increased over time (27% occurred at a mean 2-year, while 45% occurred at a mean 12-year follow-up) and revealed that rotator cuff integrity deteriorated over time. In contrast, Heuberger et al. [24] reported that the majority of retears occurred in the short-term period. In contrast to the findings of Plachel et al.'s study, we found similar re-tear rates as eight patients (7%) (4 in Group 1; 4 in Group 2). The short follow-up time may be the reason for the similar and relatively low re-tear rates in both groups in our study.

There are several limitations to be mentioned. First, this study was retrospective in nature, although we used prospectively collected patients' data without loss of follow-up to reach more accurate results. Secondly, a mean follow-up time of 2 years may not be sufficient to evaluate re-tear rates, long-term outcomes may differ, and more accurate results may be obtained. Thirdly, our study population was relatively small in number. Finally, since we did not have a postoperative MRG in all patients, asymptomatic re-tears may have been overlooked. Despite these limitations, conducting the study in a homogeneous patient population with similar patient characteristics and full-thickness tears was the strength of the present study. The results of the current study might be useful for showing that a SR technique can be as effective as DR technique on clinical results in the short term in full-thickness RCTs. Moreover, SR technique can also reduce the cost by reducing the number of anchors used and possible morbidity rates shortening the surgical time.

Conclusions

As a result, good and satisfactory clinical outcomes can be obtained using arthroscopic DR or SR repair techniques for full-

thickness RCTs in the short-term. The present study suggests that the SR technique is at least as effective as the DR and cost-effective procedure in arthroscopic repair of full-thickness RCTs.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest

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References

- Nicholson JA, Searle HKC, MacDonald D, McBirnie J. Cost-effectiveness and satisfaction following arthroscopic rotator cuff repair: does age matter? *Bone Joint J.* 2019;101-B(7):860-6.
- Micic I, Kholinne E, Kwak J-M, Koh K-H, Jeon I-H. Osteolysis is observed around both bioabsorbable and nonabsorbable anchors on serial magnetic resonance images of patients undergoing arthroscopic rotator cuff repair. *Acta Orthop Traumatol Turc.* 2019;53(6):414-9.
- Pauly S, Fiebig D, Kieser B, Albrecht B, Schill A, Scheibel M. Biomechanical comparison of four double-row speed-bridging rotator cuff repair techniques with or without medial or lateral row enhancement. *Knee Surg Sports Traumatol Arthrosc.* 2011; 9(12):2090-7.
- McElvany MD, McGoldrick E, Gee AO, Neradilek MB, Matsen FA 3rd. Rotator cuff repair: published evidence on factors associated with repair integrity and clinical outcome. *Am J Sports Med.* 2015;43(2):491-500.
- Plachel F, Siegert P, Rüttershoff K, Thiele K, Akgün D, Moroder P, et al. Long-term Results of Arthroscopic Rotator Cuff Repair: A Follow-up Study Comparing Single-Row Versus Double-Row Fixation Techniques. *Am J Sports Med.* 2020;48(7):1568-74.
- Rossi LA, Rodeo SA, Chahla J, Ranalletta M. Current Concepts in Rotator Cuff Repair Techniques: Biomechanical, Functional, and Structural Outcomes. *Orthop J Sport Med.* 2019;7(9):2325967119868674.
- Meier SW, Meier JD. Rotator cuff repair: the effect of double-row fixation on three-dimensional repair site. *J Shoulder Elb Surg.* 2006;15(6):691-6.
- Kim KC, Shin HD, Lee WY, Han SC. Repair integrity and functional outcome after arthroscopic rotator cuff repair: double-row versus suture-bridge technique. *Am J Sports Med.* 2012;40(2):294-9.
- Smith CD, Alexander S, Hill AM, Huijsmans PE, Bull AMJ, Amis AA, et al. A biomechanical comparison of single and double-row fixation in arthroscopic rotator cuff repair. *J Bone Joint Surg Am.* 2006;88(11):2425-31.
- Meier SW, Meier JD. The effect of double-row fixation on initial repair strength in rotator cuff repair: a biomechanical study. *Arthrosc J Arthrosc Relat Surg Off Publ Arthrosc Assoc North Am Int Arthrosc Assoc.* 2006;22(11):1168-73.
- Milano G, Grasso A, Zarelli D, Deriu L, Cillo M, Fabbriani C. Comparison between single-row and double-row rotator cuff repair: a biomechanical study. *Knee Surg Sports Traumatol Arthrosc.* 2008;16(1):75-80.
- Sobhy MH, Khater AH, Hassan MR, El Shazly O. Do functional outcomes and cuff integrity correlate after single- versus double-row rotator cuff repair? A systematic review and meta-analysis study. *Eur J Orthop Surg Traumatol.* 2018;28(4):593-605.
- Zhang Q, Ge H, Zhou J, Yuan C, Chen K, Cheng B. Single-row or double-row fixation technique for full-thickness rotator cuff tears: a meta-analysis. *PLoS One.* 2013;8(7):e68515.
- Ying Z, Lin T, Yan S. Arthroscopic single-row versus double-row technique for repairing rotator cuff tears: a systematic review and meta-analysis. *Orthop Surg.* 2014;6(4):300-12.
- King GJ, Richards RR, Zuckerman JD, Blasler R, Dillman C, Friedman RJ, et al. A standardized method for assessment of elbow function. Research Committee, American Shoulder and Elbow Surgeons. *J Shoulder Elb Surg.* 1999;8(4):351-4.
- Constant CR, Murley AH. A clinical method of functional assessment of the shoulder. *Clin Orthop Relat Res.* 1987;(214):160-4.
- Patte D. Classification of rotator cuff lesions. *Clin Orthop Relat Res.* 1990;(254):81-6.
- Flurin P-H, Landreau P, Gregory T, Boileau P, Brassart N, Courage O, et al. Arthroscopic repair of full-thickness cuff tears: a multicentric retrospective study of 576 cases with anatomical assessment. *Rev Chir Orthop Reparatrice Appar Mot.* 2005;91(58):31-42.
- Khoriaty A-A, Antonios T, Gulihar A, Singh B. Single Vs Double row repair

- in rotator cuff tears - A review and analysis of current evidence. *J Clin Orthop Trauma*. 2019;10(2):236–40.
20. Maassen NH, Somerson JS. A Majority of Single Versus Double-Row Rotator Cuff Repair Comparisons Fail to Consider Modern Single-Row Techniques: A Systematic Review. *JBJS Rev*. 2020;8(5):e0203.
21. Xu C, Zhao J, Li D. Meta-analysis comparing single-row and double-row repair techniques in the arthroscopic treatment of rotator cuff tears. *J Shoulder Elb Surg*. 2014;23(2):182–8.
22. Gerhardt C, Hug K, Pauly S, Marnitz T, Scheibel M. Arthroscopic single-row modified mason-allen repair versus double-row suture bridge reconstruction for supraspinatus tendon tears: a matched-pair analysis. *Am J Sports Med*. 2012;40(12):2777–85.
23. Perser K, Godfrey D, Bisson L. Meta-analysis of Clinical and Radiographic Outcomes After Arthroscopic Single-Row Versus Double-Row Rotator Cuff Repair. *Sports Health*. 2011;3(3):268–74.
24. Heuberger PR, Smolen D, Pauzenberger L, Plachel F, Salem S, Laky B, et al. Longitudinal Long-term Magnetic Resonance Imaging and Clinical Follow-up After Single-Row Arthroscopic Rotator Cuff Repair: Clinical Superiority of Structural Tendon Integrity. *Am J Sports Med*. 2017;45(6):1283–8.

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