Journal of Clinical Orthopaedics and Trauma 36 (2023) 102083

Contents lists available at ScienceDirect

Journal of Clinical Orthopaedics and Trauma

journal homepage: www.elsevier.com/locate/jcot

Rates of medial and lateral row failure and risk factors for Re-tear in arthroscopic double row rotator cuff repair☆,☆☆

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ARTICLE INFO

Article history:
Received 1 March 2022
Received in revised form
25 October 2022
Accepted 24 November 2022
Available online 29 November 2022

Keywords:
Rotator cuff repair
Double row repair
Medial row failure
Rotator cuff re-tear
Complications

ABSTRACT

A common postoperative complication after rotator cuff repair is re-tear requiring a secondary procedure. Double row and trans-osseous equivalent repair techniques have become increasingly popular in recent years, however repair failure remains a relatively common complication after primary rotator cuff repair. A retrospective observational study of 389 consecutive patients undergoing arthroscopic double-row rotator cuff repair from February 1, 2014 to March 31, 2020 was conducted. Univariate and multivariate statistics were used to assess differences in demographics, comorbidities, and tear characteristics between patients who experienced re-tear and those who did not. Repair failures were confirmed by plain MRI or intraoperatively during repeat surgical treatment. A subgroup analysis of patients who experienced re-tear due to medial row failure was conducted. The overall re-tear rate was 8.2% (32 patients). Six patients (1.5%) experienced medial row failure, while 26 patients (6.7%) experienced lateral row failure. The average time to re-tear was 279.3 ± 291.2 days. On multivariate analysis, patients with Goutallier Classification ≥3 (OR: 4.274, $p = 0.046$) and 3 anchor repair (OR: 5.387, $p = 0.027$) were at significantly increased risk for any re-tear after controlling for other tear characteristics. No statistically significant independent risk factors for medial row failure were identified after controlling for confounding variables. Goutallier classification greater than 3 and a primary repair with 3 anchors are significant risk factors for re-tear after double row rotator cuff repair, however they are not associated with increased occurrence of medial row failure. Further evaluation of risk factors for medial row failure is required to avoid this rare but serious re-tear pattern.

1. Introduction

Rotator cuff tears are a common injury leading to pain, discomfort, and shoulder disability.[1,2] Arthroscopic rotator cuff repair (RCR) has proven effective in treating this condition, however debate remains around which patient factors most influence postoperative healing.[3,4] Poor overall patient health, tendon quality, and older age have been associated with reduced tendon healing.[4–6] In addition to evaluating the relationship between patient demographics and RCR healing, recent works have investigated different repair techniques, with the goal of determining the best way to maximize healing by recreating the anatomic footprint of the shoulder. Common repair techniques include double row, transosseous equivalent (TOE), and single row.[7] Double row and transosseous techniques have shown superior biomechanical strength due to the improved contact area and pressure at the tendon-bone interface.[8–10] Double row repairs maximize the contact area at the rotator cuff footprint to enhance the biological healing process and to improve the mechanical strength of the repaired tendon.[11] In addition, the double row technique incorporates a medial and lateral row of suture anchors which increases load to failure, and contributes to a decreased gap at the tendon insertion.[10,12] Gap formation at the bone tendon interface plays an important role in rotator cuff repair failure. The medial knots used in both the double row and double row TOE techniques contribute to increased mechanical stability which allows for improved load sharing with the lateral anchor and suture.[13] Sugaya et al.[11] compared single and double row repairs and found no

☆ No grant support or research funding was received for this work.

☆☆ No authors have proprietary interests in any materials described in the article.

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https://doi.org/10.1016/j.jcot.2022.102083
0976-5662/

difference in clinical outcome, but increased structural integrity was seen in the double row repairs on follow-up MRI examination. Despite the developments in RCR techniques, tendon re-tear remains a common postoperative complication with some studies citing failure rates as high as 94%.[3]

Possible mechanisms of repair failure include suture cutting through the suture anchor, suture breakage, knot slippage, suture anchor pullout, or tendon failure at the suture-tendon junction. Depending on the number of anchors used, there are multiple failure sites where each mechanism can occur in both the medial and lateral rows.[14] The suture-tendon interface is the most common site of failure likely caused by tendon overload.[15] Revision RCR becomes increasingly complicated depending on the degree of tendon tissue loss and the chronic retraction of the rotator cuff tear.[16] Medial cuff failure has been associated with increased tendon shortening, making it especially challenging to manage with revision RCR. The decreased working length of the tendon can cause make adequate tendon release challenging, and can lead to excessive tension when attempting to attach the torn tendon to the anatomic footprint.[17] Medial row sutures through the musculotendonous junction are particularly vulnerable to failure. Although failure at the suture-tendon interface after double row repair has been well investigated, few studies have evaluated medial row failure as a mechanism of re-tear following arthroscopic RCR. The purpose of our study was to evaluate rates and risk factors for failed rotator cuff repairs, including both lateral and medial row failures. To our knowledge, this is the first study to describe the relationship between patient demographic factors, comorbidities, tear characteristics and occurrence of medial row failure.

2. Methods

2.1. Study population and setting

This study was deemed institutional review board exempt by the institution's clinical research committee. A retrospective observational study of patients undergoing arthroscopic double-row rotator cuff repair from February 1, 2014 to March 31, 2020 was conducted. Procedures were performed by seven board certified orthopedic surgeons in a single hospital based outpatient surgery center. Patients were excluded from the study if they underwent open rotator cuff repair, or if preoperative magnetic resonance imaging (MRI) was not available for review; no other exclusion criteria were used.

2.2. Double row repair techniques

Arthroscopic double row rotator cuff repair is a construct composed of two rows of anchors, a medial and a lateral row, in order to provide anatomic footprint restoration. Double row repairs are more suitable for tears that are mobile and can be reduced to the rotator cuff footprint without undue tension. The conventional double row technique places the medial row anchors at the articular margin and can consist of different stitch configurations. Subsequently, the lateral row anchors are placed and tied with the rotator cuff at the appropriate amount of tension, and the medial row is tied last. The transosseous equivalent technique consists of a medial row of suture anchors with mattress sutures that are tied and then pulled laterally to a second row compressing the tendon to the footprint. Knotless transosseous equivalent technique uses the same method without knot fixation at the medial row. In this study, a variety of suture configurations (ie. conventional double row and transosseous equivalent), suture types (ie. suture and suture tape), and medial row anchors (ie. knotted and knotless) were performed based on surgeon preference. Knotless anchors were used for the lateral row in all repairs. Three-anchor transosseous equivalent repairs were performed using one medial double loaded suture anchor pulled out to two lateral anchors, with two horizontal mattress sutures used for medial row fixation.

2.3. Data collection and analysis

Demographics, comorbidities, and details of the tear and primary repair were manually recorded from the electronic medical record (EMR). The primary endpoint of the study was re-tear confirmed by plain MRI or intraoperatively during repeat surgical treatment. Medial row failure was identified by plain MRI and confirmed intraoperatively during revision arthroscopy. Re-tears were then grouped by mechanism of failure as medial row or lateral row failures. Univariate statistics (two-sided independent samples t-tests and chi-square tests) were performed to evaluate differences in demographics, comorbidities, and tear characteristics between patients who experienced a re-tear and those who did not. A subgroup analysis of comparing patients who experienced a re-tear due to medial row failure compared to those who did not was then conducted. Finally, multivariate logistic regression was performed to evaluate risk factors for any re-tear and medial row failure after controlling for potentially confounding variables. Models evaluating the tear characteristics of tear size, tear thickness, tear chronicity, Goutallier Classification $\geq$3, and 3-anchor repair were then created to evaluate each variables influence on the risk of re-tear and medial row failure, after controlling for confounding variables. Three-anchor repair was excluded from the medial row failure model, as all medial row failures were four-anchor repairs. All statistical analysis was performed in SPSS version 27 (IBM, Armonk, NY) and statistical significance was assessed at $\alpha = 0.05$.

3. Results

Three hundred eighty nine patients were included in this study. Patients had confirmed follow up with an orthopedic provider at an average of 1.4 ± 1.2 years postoperatively. On average, patients were 58.9 ± 9.0 years old, had a BMI of 30.8 ± 6.0 kg/m^2, and 41.9% of patients were female. The overall re-tear rate was 8.2% (32 patients). Six patients (1.5%) experienced medial row failure, while 26 patients (6.7%) experienced lateral row failure. Figs. 1 and 2 depict an example medial row failure as seen on MRI and intraoperatively, respectively. The average time to re-tear was 279.3 ± 291.2 days (Table 1). Of the 32 patients experiencing re-tear, 18 (56.3%) underwent repeat surgical treatment. Seventeen of these patients (94.4%) underwent revision rotator cuff repair, while one (5.6%) underwent arthroscopic lysis of adhesions and manipulation under anesthesia. All medial row failures underwent revision rotator cuff repair. In patients experiencing re-tears, a wide variety of classical symptoms including combinations of pain, stiffness, and weakness were observed. Of note, no remarkable differences in clinical presentation were observed in the six medial row failures. These patients presented with a variety of symptoms including pain, stiffness, snapping, and reduced range of motion.

In comparison to patients not experiencing re-tear, those with a re-tear of any type (medial or lateral row), had no statistically significant differences in age, race, gender, or BMI. Similarly, there were no differences between groups in rates of smoking, diabetes mellitus, osteoarthritis, or overall comorbidity burden as measured by the percent of the population with an American Society of Anesthesiologists score $\geq$3. No differences in the rate of preoperative steroid injections stratified by < 6 months, 3–6 months, <3 months, or tear characteristics—including Goutallier Classification, tear thickness, tear size, or tear chronicity were observed. Although

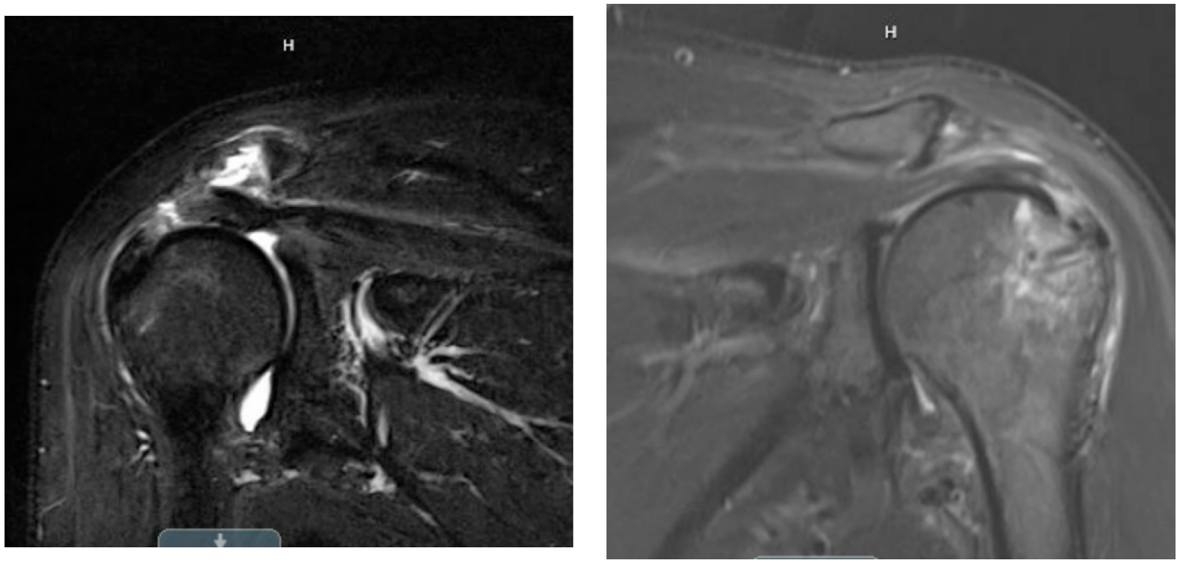

Fig. 1. MRI imaging depicting medial row failure
1a. 3T MRI of a right shoulder s/p double row rotator cuff repair demonstrating a medial row failure. 1b. 3T MRI of a left shoulder s/p double row rotator cuff repair demonstrating a medial row failure.

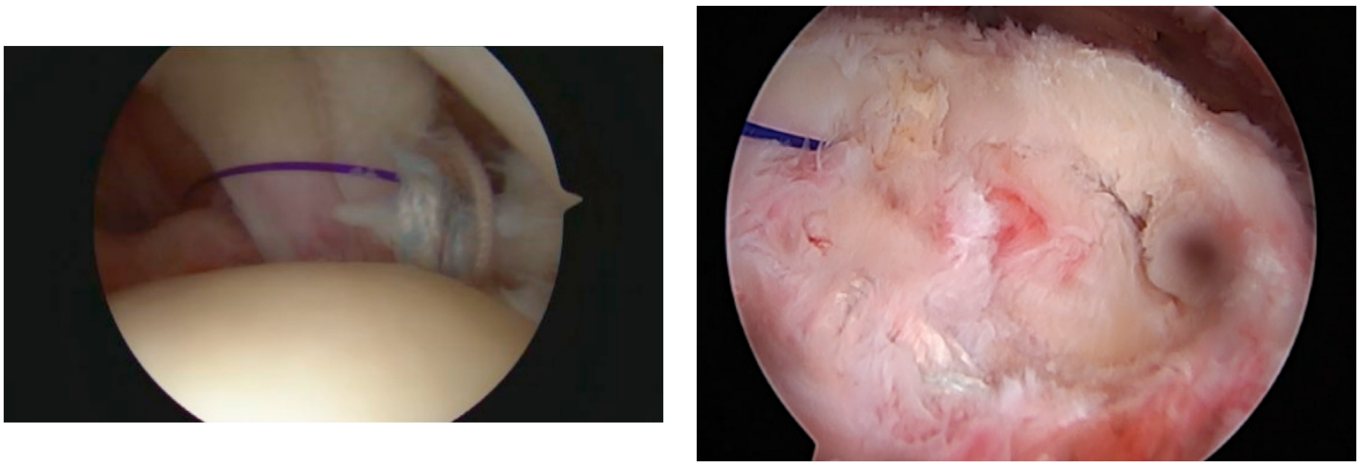

Fig. 2. Intraoperative arthroscopic views of medial row failure
2a. Arthroscopic view from a posterior portal of a medial row rotator cuff re-tear marked with a PDS suture for later identification on the bursal surface. 2b. Arthroscopic view from the lateral portal of medial row rotator cuff re-tear marked with a PDS suture.

Table 1
Patient demographics and outcomes.

Variable	Result
Demographics	
Patient Volume – n	389
Age – avg. ± SD	58.9 ± 9.0
BMI – avg. ± SD	30.8 ± 6.0
Female – n (%)	163 (41.9)
Outcomes	
Re-tear – n (%)	32 (8.2)
Medial row failure – n (%)	6 (1.5)
Lateral row failure – n (%)	26 (6.7)
Time to re-tear – avg. days ±SD	279.3 ± 291.2
Confirmed follow up – avg. Yrs. ± SD	1.4 ± 1.2

BMI – body mass index in kg/m.^{2}.

statistical significance was not achieved, trends toward higher rates of re-tear in patients with Goutallier classification ≥3 and chronic tears were observed, with each of these risk factors demonstrating a p-value <0.2 (Table 2). Statistically significant differences in failure rate by number of anchors were observed, with 3 anchor repairs having the highest failure rate at 33.3% ($p = 0.021$). When comparing patients who experienced medial row failure to the rest of the population, no statistically significant differences in any of the demographic, comorbidity, or tear characteristics were observed. Trends toward higher rates of medial row failure were observed in patients ≥65 years old, patients with diabetes mellitus, and patients with Goutallier Classification ≥3 (all $p < 0.2$) (Table 3).

On multivariate analysis, patients with Goutallier Classification ≥3 (OR: 4.274, $p = 0.046$) and 3 anchor repair (OR: 5.387, $p = 0.027$) were at significantly increased risk for any re-tear after controlling for other tear characteristics. No statistically significant independent risk factors for medial row failure were identified after controlling for confounding variables (Table 4).

4. Discussion

There were no statistically significant differences between the patient demographics of those who had re-tear after RCR and those who did not. Unadjusted comparison of injury and surgery specifics such as Goutallier classification and tear characteristics were also not significantly different among these groups, with the exception of 3 anchor repairs, which demonstrated increase risk of failure. These trends remained consistent when comparing patients with medial row failure to those without, although no medial row failures occurred in 3 anchor repairs. After controlling for tear size, chronicity, and thickness, a Goutallier classification ≥3 and 3 anchor repairs were identified as significant risk factors for re-tear. Given the low incidence of medial row failure, this study was underpowered to identify significant risk factors for this specific mechanism of failure.

Patient demographic factors influence surgical outcomes due to their impact on healing and other aspects of overall health. Multiple studies have reported a negative impact on tendon healing with increasing age, which contributes to an increased risk of re-tear.[5,18] Boileau et al.[5] reported significantly lower rates of healing in patients older than 65 years. Age was included a potential impact factor for re-tear in our study, however, there were no significant differences in the occurrence of re-tear between patients older than 65 years and those younger than 65. In addition to demographics, Nho et al.[18] also investigated the relationship between initial tear size and occurrence of re-tear. Re-tears were more common in patients with a larger tear, a higher degree of tendon retraction, and more severe fatty degradation. The relative risk of re-tear increased 2.29 times with every 1 cm increase in tear size. While our study results align with the assertion that the severity of fatty degradation is associated with risk of re-tear, we did not observe the significantly increased risk of repair failure in larger tears reported in the Nho study. Comorbidities of smoking and diabetes can also have detrimental effects on healing tendon.[19] Neyton et al.[20] found a higher occurrence of re-tear in smoking patients compared to non-smokers. Despite previous evidence, our results indicated no difference in occurrence of re-tear depending on smoking or diabetes status. All of the aforementioned studies investigated the relationship between patient demographic factors or tear characteristics and re-tear following primary RCR, however to our knowledge very few studies have evaluated these factors as they pertain to the possibility of medial row failure following double row or double row TOE repair.

Chronic rotator cuff tears can induce pathologic changes such as muscular atrophy and fatty infiltration within the rotator cuff muscles. Fatty infiltration of the supraspinatus, infraspinatus, and subscapularis are assessed with the Goutallier classification system.[21] There are five stages of increasingly severe fatty infiltration of the muscle on the scale, which can be evaluated using magnetic resonance imaging or computed tomography results. Liem et al.[6] demonstrated higher rates of re-tear with Goutallier stage 2 compared to stages 0 and 1, leading to the conclusion that more extensive fatty infiltration of the muscle classified via Goutallier could be a potential risk factor for RCR failure. Similarly, a systematic review of 925 shoulders across 11 studies identified higher rates of re-tear in Goutallier stage ≥2 RCRs in comparison to grade 0 and 1 repairs.[22] This large pooled sample provides a high-level view of the risk associated with RCR in patients with fatty infiltration, but its translatability to practice is limited by the incorporation of a relatively heterogeneous population of patients undergoing both open and arthroscopic repairs using various techniques. While our unadjusted analysis found no significant difference in the occurrence of recurrent tear in patients with Goutallier stage 1–2 compared with Goutallier stage ≥3, when entered into multiple logistic regression controlling for tear size, chronicity, and thickness, Goutallier stage ≥3 was a significant risk factor for any re-tear. However, fatty infiltration was not a significant risk factor for medial row failure, specifically. These findings reinforce the utility of using Goutallier classification for patient selection and preoperative surgical planning when considering the use of double row repair.

Double row repairs have been shown to be biomechanically superior to single row repairs. They demonstrate better restoration of the rotator cuff footprint with increased contact pressure and subsequent decreased gap formation.[23] This has been hypothesized to lead to better rotator cuff healing potential and enable a more aggressive postoperative rehabilitation protocol. Numerous studies have shown better functional outcomes with double row repairs for large and massive rotator cuff repairs (Tear size >3 cm).[24,25] However, the musculotendonous junction has been pointed out as a common point of failure for double row and transosseous equivalent repairs.[26,27] This could be related to placing the rotator cuff repair under excessive tension or placing the medial row sutures too close to the musculotendonous junction. Medial row suture fixation a minimum of 5 mm lateral to the musculotendonous

Table 2
All re-tear rates by demographics, comorbidities, and tear characteristics.

Variable	# of Patients	# (%) Re-tears	P-Value
Gender			0.598
Male	226	20 (8.8)	
Female	163	12 (7.4)	
Race			0.580
White	318	25 (7.9)	
Non-white	71	7 (9.9)	
Age			0.582
< 65	288	25 (8.7)	
≥ 65	101	7 (6.9)	
BMI			0.534
< 35	297	23 (7.7)	
≥ 35	92	9 (9.8)	
Smoker			0.953
No	245	20 (8.2)	
Yes, current or former	144	12 (8.3)	
Diabetes			1.000*
No	347	29 (8.4)	
Yes	42	3 (7.1)	
Osteoarthritis			0.843
No	286	24 (8.4)	
Yes	103	8 (7.8)	
ASA			0.477
< 3	288	22 (7.6)	
3	101	10 (9.9)	
Goutallier Classification			0.099*
1-2	375	29 (7.7)	
≥ 3	14	3 (21.4)	
Tear Thickness			0.306*
Partial thickness	60	7 (11.7)	
Full thickness	304	25 (7.6)	
Tear Chronicity			0.137
Acute tear	118	6 (5.1)	
Chronic tear	271	26 (9.6)	
Tear Size			0.517
Small or medium	285	25 (8.8)	
Large or massive	104	7 (6.7)	
Preoperative Steroid Injection			0.775
None within 6 months	346	28 (8.1)	
>3 months ≤ 6months	17	1 (5.9)	
≤ 3 months	26	(11.5)	
# Anchors Used			**0.021**
3	9	3 (33.3)	
4	355	27 (7.6)	
5+	25	2 (8.0)	

BMI – body mass index in kg/m.^{2}.
ASA – American Society of Anesthesiologists Score.

Table 3
Medial row failure rates by demographics, comorbidities, and tear characteristics.

Variable	# of Patients	# (%) Re-tears	P-Value
Gender			
Male	226	4 (1.8)	1.000*
Female	163	2 (1.2)	
Race			0.597*
White	318	6 (1.9)	
Non-white	71	0 (0.)	
Age			0.183*
< 65	288	3 (1.0)	
≥ 65	101	3 (3.0)	
BMI			1.000*
< 35	297	5 (1.7)	
≥ 35	92	1 (1.1)	
Smoker			
No	245	4 (1.6)	1.000*
Yes, current or former	144	2 (1.4)	
Diabetes			0.129*
No	347	4 (1.2)	
Yes	42	2 (4.8)	
Osteoarthritis			0.657*
No	286	4 (1.4)	
Yes	103	2 (1.9)	
ASA			0.652*
< 3	288	4 (1.4)	
3	101	2 (2.0)	
Goutallier Classification			0.199*
1-2	375	5 (1.3)	
≥ 3	14	1 (7.1)	
Tear Thickness			0.233*
Partial thickness	60	2 (3.3)	
Full thickness	329	4 (1.2)	
Tear Chronicity			0.672*
Acute tear	118	1 (0.8)	
Chronic tear	271	5 (1.8)	
Tear Size			0.660
Small or medium	285	4 (1.4)	
Large or massive	104	2 (1.9)	
Preoperative Steroid Injection			0.685
None within 6 months	346	6 (1.7)	
>3 months ≤ 6months	17	0 (0.0)	
≤ 3 months	26	0 (0.0)	
# Anchors Used			0.887
3	9	0 (0.0)	
4	355	6 (1.7)	
5+	25	0 (0.0)	

BMI – body mass index in kg/m.^{2}.
ASA – American Society of Anesthesiologists Score.

junction has been recommended to reduce the risk of medial row failure. Medial row knots have been shown to decrease tendon vascularity and thus potentially lead to an increased risk of tendon re-tear, as evidenced by Christoforetti et al.[28] showing a 44.67% reduction in tendon blood flow after a double row repair using Doppler flowmetry. Rhee et al.[29] detected lower rates of re-tear in the knotless transosseous equivalent rotator cuff repair group (5.9%) in comparison to the knotted group (18.6%) in 110 patients, with 72% of re-tears in the knotted group occurring at the musculotendonous junction. While evaluation of specific four anchor repair constructs was outside the scope of this study, prior work at our institution has demonstrated that the use of suture tape and a knotted medial row decreases the incidence of symptomatic re-tear.[30] In our study, three anchor double row repairs were found to be a significant risk factor for re-tear. All of these repairs used one medial double loaded suture anchor pulled out to two lateral anchors for a transosseous equivalent repair. The double loaded medial anchor used two horizontal mattress sutures for medial row fixation, as previously described by Kim et al. and Okubu et al.[31,32] Nine three-anchor transosseous equivalent repairs were performed in this study, 7 for small and 2 for medium sized tears. This suture anchor configuration may lead to inadequate restoration of the rotator cuff footprint with uneven compression at the tendon bone interface and potentially explain the increased re-tear rate. Interestingly, three anchor repairs were not associated with an increased occurrence of medial row failure, as this mechanism of failure occurred exclusively in four anchor repairs.

Medial row failures after a double row repair are difficult to treat due to loss of tendon length. Revision tears are often delaminated, retracted, and atrophied. Repair usually requires medialization of the rotator cuff footprint by debriding the humeral articular cartilage with a single row repair that is often placed in close proximity to the musculocutaneous junction. This often places the rotator cuff under tension and may require augmentation with various graft options available. Clearly, prevention of medial row failures would be ideal. Our study demonstrates an overall re-tear rate of 8.2% (32 patients). Six patients (1.5%) experienced medial row failure, while 26 patients (6.7%) experienced lateral row failure. Of the six patients experiencing medial row failure, 5 were successfully treated with revision arthroscopic rotator cuff repair. The sixth patient underwent mini-open rotator cuff reconstruction with graft augmentation. After experiencing continued symptoms at three months postoperatively, the patient elected to proceed with reverse total shoulder arthroplasty, and was satisfied with the outcome two-years postoperatively. Although our study was underpowered to detect specific risk factors for medial row failure, we suggest the presentation of the patient demographics comorbidities, and tear characteristics of patients experiencing this rare, and clinically difficult to manage mechanism of failure is of value. Failure of the medial row can be explained by several potential factors. In a double-row RCR the medial row is the tension bearing row therefore tension overload of the suture-tendon interface or decreased tendon perfusion due to stress could explain the failure.[33] Mazzocca et al.[34] conducted a cadaveric study investigating the load to failure, and found cyclic-loading of the double-row RCR resulted first in medial row failure with the sutures pulling through

Table 4
Multivariate logistic regression: Risk factors for any Re-tear and medial row failure.

Variable	Odds Ratio	95% Confidence Interval	P-Value
Outcome: Any Re-tear			
Full tear	0.750	0.289–1.948	0.555
Large or massive tear	0.723	0.274–1.904	0.511
Chronic tear	1.916	0.759–4.838	0.169
Goutallier ≥3	4.274	1.024–17.841	**0.046**
3 anchor repair	5.387	1.211–23.957	**0.027**
Outcome: Medial Row Failure			
Full tear	0.286	0.043–1.881	0.193
Large or massive tear	1.476	0.201–10.858	0.702
Chronic tear	2.144	0.245–18.727	0.490
Goutallier ≥3	5.521	0.499–61.078	0.164

the tendon on the medial aspect of the repair site.[34,35] Although the biomechanical stress placed on the medial row is great, only limited number studies have reported the occurrence of medial row failure in their patient populations. Trantalis et al.[33] reported a case series of five patients with unusual cuff failure after double-row arthroscopic RCR. In this subset of patients ranging in age from 42 to 59 years, the tendon footprint was correctly fixed to the greater tuberosity and had normal thickness. There were full thickness tears through the previously repaired rotator cuff located medial to the intact footprint. Our findings indicated a slightly older average patient age of 61 for patients with a medial row failure. In contrast to our population, all of the patients described in Trantalis et al. were involved in Workers' Compensation claims and no other patient demographic information was investigated in this group of failed RCR. Yamakado et al.[15] presented four cases of medial row failure following arthroscopic RCR without arthroscopic subacromial decompression (ASAD). In all of these cases the mattress sutures were pulled out and the knots were caught between the greater tuberosity and the cuff. There were two female patients, two male patients, and the average age was approximately 70 years; the dominant shoulder was involved in all cases. There were no notable relationships observed between any patient demographic factors and the occurrence of medial row failure, however this was not the primary focus of the study. We hope that our findings, which are based on an additional six cases of medial row failure, may be used to inform future systematic reviews or meta-analyses, and suggest that future research based on multisite evaluation of medial row failures with standardized collection of risk factors be conducted.

The results of this study should be interpreted with the following limitations in mind. First, as a single institution study, the findings may not be representative of the larger patient population. However, we suggest our relatively large series of patients undergoing arthroscopic double row repair is a valuable contribution to the literature, especially due the homogeneity of repairs performed. The small sample size of medial row failures specifically makes this limitation especially applicable to any conclusions regarding this subset of patients. Second, this study is exposed to selection bias due to its retrospective design. While we attempted to mitigate this bias using multivariate analysis to control for factors that may influence patient selection and repair type selection by surgeons, it is unlikely that this was completely eliminated using statistical techniques. An example of a specific potentially confounding factor that was not addressed is the presence of osteopenia and osteoporosis in this population, as prior studies have demonstrated this to be an important risk factor for failure due to anchor pull out.[36] Third, because patient reported outcomes were not collected, we were unable to quantify the effect that repair failure had on functional outcomes and quality of life in this population. Fourth, the exact mechanism of failure was not available, making it unknown whether re-tear was due to biological failure to heal or non-biological factors such as suture technique. Future studies should further investigate the biomechanical aspects of, and risk factors for both medial and lateral row failures in order to enhance the success rate of double row rotator cuff repair.

In conclusion, Goutallier classification greater than 3 and a primary repair with 3 anchors are significant risk factors for re-tear after double row rotator cuff repair, however they are not associated with increased occurrence of medial row failure. Further evaluation of risk factors for medial row failure is required to avoid this rare but serious re-tear pattern.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Benjamin Petre reports a relationship with Smith and Nephew Inc that includes: consulting or advisory and funding grants. Daniel Redziniak reports a relationship with Smith and Nephew Inc that includes: consulting or advisory and funding grants.

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