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Septuagenarians aged 75 years and older do benefit from arthroscopic rotator cuff repair: a propensity matched-pair analysis

Akshay Padki, MB BCh BAO, MRCS*, Jerry Yongqian Chen, MBBS, FRCS, FAMS,
Merrill Jian Hui Lee, MBBS, MRCS, Benjamin Fu Hong Ang, MBBS, FRCS, FAMS,
Denny Tjiauw Tjoen Lie, MBBS, FRCS (Edin), FAMS

Academia, Singapore General Hospital, Singapore

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Background: Numerous studies show that patients who failed conservative management, benefit from open, mini open and arthroscopic rotator cuff repair (ARCR). However, there is a paucity of literature addressing ARCR and outcomes in patients older than the age of 75 years. The purpose of our study was to compare the outcomes of ARCR in patients older than 75 years and younger than 75 years of age.

Methods: Between January 2010 and December 2016, 397 patients underwent unilateral ARCR; of which, 23 patients were 75 years of age and older. Outcome measures recorded include the Constant Shoulder Score (CSS), University of California, Los Angeles Shoulder Score (UCLASS), Oxford Shoulder Score (OSS), and visual analog scale (VAS) for pain assessment.

Results: There were no statistically significant differences in VAS, CSS, and UCLASS between the two groups at all time points of follow-up (all $P > .05$). At 2 years after surgery, the OSS was 2 ± 5 points better in the <75 group ($P = .012$). However, the improvement in OSS was comparable between both groups. The improvement in VAS, CSS, and UCLASS at 2 years after surgery compared with baseline was also similar between the two groups (all $P < .05$).

Conclusions: The improvement in VAS, CSS, and UCLASS was similar in both groups of patients. We conclude that septuagenarians with symptomatic cuff tears, who have failed conservative management, experience significant improvement in pain, and function after surgery and should not be excluded from the benefits of ARCR.

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Rotator cuff tears are a very common pathology, becoming more prevalent as patients age.^{5,15,19} With an ever-aging population and a combined emphasis on an active lifestyle and extended work life,¹⁴ it becomes imperative that elderly patients remain physically fit and active. As the incidence of rotator cuff pathology is likely to significantly increase over the years,^{5,19} a greater number of the elderly may require surgical intervention. Elderly patients are increasingly regarded as a unique subset of patients as they suffer from several age-specific conditions such as cardiovascular disease, diabetes mellitus, and cognitive impairment. In fact, rotator cuff

tears with associated shoulder dysfunction led to similar patient-reported outcomes as that of major medical diseases such as congestive heart failure, acute myocardial infarction, diabetes mellitus, and clinical depression.⁸ Often times, elderly patients are precluded from surgical intervention in view of their higher than normal anesthetic risks and increased surgical complications.³

Second, it allows for faster mobilization and subsequent return to activity.⁸ However, rehabilitation may be more prolonged in this group of patients as they tend to have poorer preoperative muscle strength and tissue quality.^{1,6} This is corroborated by basic science studies which have found that histologic analysis of rotator cuff tendon showed significant reduction in tendon vascularity and cellularity in patients aged 70 years and older when compared with their younger counterparts.^{1,17} When analyzing bone quality, elderly patients are again at a disadvantage as they tend to have more osteoporotic bone, which may predispose to poor suture anchor fixation.^{5,9,17}

There are numerous studies in the current body of literature which show that patients benefit from open, mini open and

This study was approved by our institutional review board and ethical committee (CRIB Ref 2019/2777). This study has been performed in accordance with the ethical standards in the 1964 Declaration of Helsinki and has been carried out in accordance with relevant regulations of the US Health Insurance Portability and Accountability Act (HIPAA). Details that might disclose the identity of the individuals under study should be omitted.

* Corresponding author: Akshay Padki, Mb BCH BAO, MRCS, Singapore General Hospital, Academia, Singapore General Hospital, Outram Road, Singapore, 169068.

E-mail address: akshay.padki@mohh.com.sg (A. Padki).

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arthroscopic rotator cuff repair (ARCR).^{6,12,13,16} However, there is a paucity of literature addressing ARCR in patients older than the age of 75 years and outcomes after ARCR. Based on all of the aforementioned information, our study hypothesized that patients over the age of 75 years would benefit from ARCR, as measured through standardized shoulder scoring systems.

Materials and methods

Participants

This retrospective, case-control study was approved by the hospital's ethics committee and institutional review board. Between January 2010 and December 2016, 397 patients diagnosed with full-thickness rotator cuff tears (RCTs) on either ultrasonography or magnetic resonance imaging underwent a unilateral ARCR by a fellowship-trained shoulder surgeon at our tertiary institution.

Patients who had multiple tears of the rotator cuff, symptomatic bilateral rotator cuff pathology, glenohumeral instability, and traumatic tears and patients with comorbidities that would have prevented adequate rehabilitation (cognitive impairment, previous stroke) or did not have sufficient 12- and 24-month follow-up data were excluded from this study. From the 397 patients, 112 patients were excluded, and 23 patients remained were older than 75 years of age. A second group was selected from the remaining 256 patients who were younger than 75 years and met the aforementioned inclusion criteria after matching for body mass index (BMI), hand dominance, and gender.

All the patients' preoperative data were collected as part of a standard perioperative protocol which allowed for assessment of overall functional status together with objective outcome measures. All the patients underwent trial of conservative therapy with standard physiotherapy regime before being considered for ARCR.

All the patients underwent arthroscopic double-row RCR by a fellowship-trained shoulder surgeon under general anesthesia. The main indication for surgery was failure of conservative management with main complaint being either pain alone or pain causing functional limitations. The surgeries were performed with a patient in the beach-chair position with standard anterior, posterior, and lateral arthroscopic portals used.

Postoperatively, all the patients were admitted 1 night for observation with arms placed in an arm sling. The patients were allowed pendular exercises on postoperative day 1 and subsequently were allowed to start range of motion (ROM) and strengthening exercises after 4–6 weeks and underwent the same ARCR rehabilitation protocol. They were prospectively followed up for 2 years.

Patient evaluation

Preoperatively, the patients underwent a thorough evaluation that included shoulder ROM, visual analog scale (VAS), Constant Shoulder Score (CSS), University of California, Los Angeles Shoulder Score (UCLASS), Oxford Shoulder Score (OSS) and patient self-reported satisfaction scores. For the purposes of this study, a constant Murley score of <40 was considered an indication for ARCR where conservative management had failed.

The various standardized scores mentioned previously, along with the ROM and patient-reported satisfaction scores were measured and recorded by an independent observer preoperatively and then followed up prospectively for 3, 6, 12, and 24 months postoperatively. Patients were also clinically evaluated to assess for complications including superficial and deep infection and wound-related complications.

Statistics

Statistical analysis was carried out using SPSS 20.0 (IBM Corp, Armonk, NY, USA). Statistical significance was defined as a *P* value of less than .05. The patients were matched for gender, side of surgery, comorbidities, and BMI. Statistical analysis was performed using Students *t*-test for continuous variables, Pearson's chi-squared test for categorical variables, and a *post hoc* power analysis was performed.

Results

The gender distribution, side of surgery (hand dominance), and BMI were comparable between the two groups. The mean age for the >75-years group was 78 years, while the mean age for the younger matched control cohort (<75 years group) was 60 years. The older-than-75-years cohort included 7 men and 16 women. The younger matched cohort included 12 men and 34 women (Table 1).

For the >75 years group, the mean preoperative VAS was 7.0 ± 2 (P = .24), CSS was 35.0 ± 19.8 (P = .81), UCLASS was 14.4 ± 5.3 (P = .23), and OSS was 33.9 ± 14.0 (P = .78).

At 2 years, the mean scores for the > 75 years group showed improvement with mean VAS at 1.9 ± 2.6 (P = .56), mean CSS at 67.0 ± 8.9 (P = .45), mean UCLASS at 28.3 ± 5.0 (P = .11) and mean OSS at 17.0 ± 7.5 (P = .67).

For the < 75 years group, the mean preoperative VAS was 6.9 ± 2.9 (P = .24), CSS was 38.8 ± 19.0 (P = .48), UCLASS was 15.7 ± 5.4 (P = .840) and OSS was 31.5 ± 11.1 (P = .047). At 2 years, these numbers improved to 1.7 ± 2.4 (P = .41), 68.7 ± 9.1 (P = .55), 29.2 ± 4.6 (P = .63), and 15.1 ± 4.8 (P = .012) respectively (Table 1).

CSS, UCLASS, and OSS were all higher in the <75 years cohort at 2 years postoperatively compared with the > 75 years group. The

Table 1
Patient demographics and perioperative outcomes.

	>75 (n = 23)	<75 (n = 46)	<i>P</i> value
Age (yr)	78.00	60.00	<.001
Gender (male: female)	7: 16	12: 34	.46
Surgical side (left:right)	11:12	24:22	.26
Body mass index	23.0	22.9	.87
Mean VAS (SD)			
Preoperatively	7.0 (2.1)	6.9 (2.9)	.87
3 mo postoperatively	3.5 (2.7)	3.6 (3.0)	.89
6 mo postoperatively	3.4 (3.2)	2.4 (2.8)	.21
1 yr postoperatively	3.0 (2.7)	1.8 (2.4)	.09
2 yr postoperatively	1.9 (2.6)	1.7 (2.4)	.74
Mean CSS (SD)			
Preoperatively	34.7 (19.8)	38.8 (19.0)	.41
3 mo postoperatively	41.5 (14.8)	36.8 (15.6)	.24
6 mo postoperatively	49.2 (16.1)	52.0 (16.0)	.51
1 yr postoperatively	61.4 (14.9)	65.8 (13.0)	.25
2 yr postoperatively	67.0 (8.9)	68.7 (9.1)	.52
Mean UCLASS (SD)			
Preoperatively	14.3 (5.3)	15.7 (5.4)	.34
3 mo postoperatively	20.0 (6.0)	20.0 (5.5)	.96
6 mo postoperatively	22.7 (7.0)	25.0 (6.0)	.20
1 yr postoperatively	25.5 (6.5)	28.2 (5.0)	.08
2 yr postoperatively	28.2 (5.0)	29.2 (4.6)	.45
Mean OSS (SD)			
Preoperatively	33.9 (14.0)	31.5 (11.1)	.43
3 mo postoperatively	27.6 (10.4)	29.8 (10.3)	.42
6 mo postoperatively	23.2 (12.5)	22.0 (10.1)	.67
1 yr postoperatively	19.7 (9.8)	17.4 (6.5)	.30
2 yr postoperatively	17.0 (7.5)	15.1 (4.8)	.27

CSS, Constant Shoulder Score; OSS, Oxford Shoulder Score; SD, standard deviation; UCLASS, University of California, Los Angeles Shoulder Score; VAS, visual analog scale.

Table II
Change in scores preoperatively vs. 2 yr postoperatively*.

	>75	<75	P value
VAS	+5.1	+5.2	.039
CSS	+32.3	+29.9	<.001
UCLASS	+13.9	+13.5	.021
OSS	+16.9	+16.4	.019

CSS, Constant Shoulder Score; OSS, Oxford Shoulder Score; UCLASS, University of California, Los Angeles Shoulder Score; VAS, visual analog scale.

* Scores calculated by subtracting the larger value from the smaller value to yield a positive result.

OSS was also higher in the <75 years group ($P = .019$). However, the improvement in OSS was comparable between both groups. The improvement in VAS, CSS, and UCLASS at 2 years after surgery compared with baseline was also similar between the two groups (Table II).

There was a 0.2 point difference of VAS between both groups ($P = .15$). CSS was also only slightly improved in the <75 years group compared with the >75 years group, however, with 1.7 points difference ($P = .074$). Both UCLASS and OSS also showed marginal differences between the two groups at 2 year follow-up with <75 years group scoring 1 and 1.9 points better, respectively ($P = .29$) (Table III).

A *post hoc* power analysis performed using the aforementioned data points found that statistical comparison of the Oxford Shoulder Score at the 24-month follow-up yielded a power of .20.

Discussion

This retrospective, case-control study aims to ascertain whether patients older than 75 years of age with RCT will benefit from ARCR when conservative management has failed. The main finding of our study was that although patients in the >75 years cohort had poorer scores preoperatively, their overall improvement in scores and function were no different to the <75 years control group. This was regardless of hand dominance, gender, or BMI.

Sambandam¹⁵ reported that the prevalence of RCT in 60- to 69-year-old patients was observed at 20%, while in patients older than 70 years of age, it was as high as 40%. Yamamoto et al¹⁹ had similar findings in their study with prevalence rates as high as 45% in patients older than 70 years of age and > 50% in patients older than 80 years of age. A study by Lam and Mok¹¹ comparing conservative and surgical management of RCT found that patient's age and duration of symptoms before surgery were negatively correlated with outcomes; however, this study did not further subdivide patients by age. Flurin et al⁷ showed in their study however that although the Constant score improved after surgery, functional results with strength in particular were only obtained when the rotator cuff remained intact.

In their systematic review of ARCR for patients > 60 years of age, Downie and Miller⁴ found that all studies within their review

Table III
Difference in >75 yr and <75 yr groups at 2 yr.

Scores (SD)	>75	<75	Difference	P value
VAS	1.9 (2.1)	1.7 (1.6)	0.2	.15
CSS	67.0 (11.4)	68.7 (8.3)	1.7	.074
UCLASS	28.2 (5.5)	29.2 (4.9)	1.0	.034
OSS	17.0 (6.1)	15.1 (5.3)	1.9	.29

CSS, Constant Shoulder Score; OSS, Oxford Shoulder Score; SD, standard deviation; UCLASS, University of California, Los Angeles Shoulder Score; VAS, visual analog scale.

The aforementioned differences calculated by subtracting larger value from smaller value to yield a positive result.

reported improvements in scores from before intervention to after, which were statistically significant; however, none of them demonstrated any differences between treatment arms at the final follow-up. Worland et al¹⁸ found that patients > 70 years of age with massive RCT would benefit from open rotator cuff repair with satisfactory results achieved in 78% of patients with a mean increase in UCLASS of 21.5 points. Gwark et al⁹ found in their study that structural and clinical outcomes of ARCR performed on patients >70 years were comparable with those < 70 years with most notable association with retear being initial tear size regardless of the age group.

Yoo et al²⁰ found in their study that clinical shoulder scores as well as Short Form-36 showed significant improvement in both healed and retear groups after ARCR. In our study, the >75 years group had clinically significant improvements across all scores preoperatively and postoperatively with differences in scores comparable with patients <75 years of age.

A study by Brewer¹ found that tendon cellularity and vascularity are markedly diminished at age 70 years with resultant loss of resiliency, disarray, fragmentation leading to tendon dissolution. Supporting this, several studies have found that ARCR had higher re-tear and failure rates correlated with size of initial tear and age of patient.^{2,9} This is in direct contrast with the clinical findings that patients clinical scores tend to improve over time, as seen in this study and several other studies, regardless of preoperative tear size or age.^{11–13} In our study, the >75 years group had clinically significant improvements across all scores both preoperatively and postoperatively with differences in scores comparable with patients <75 years. Both the groups had similar preoperative scores across the varying systems, with <75 years group having slightly better CSS, UCLASS, and OSS scores. None of the patients in this study clinically exhibited symptoms of retear. Although our study did not radiologically assess for repair integrity postoperatively, our findings are in keeping with previous studies in that shoulder scores improved over time with no patients showing worsening scores.¹⁸ None of the patients in this study suffered any surgical complications.

Our study also found that VAS, UCLAS, CSS, and OSS all showed marked improvement at the 6-month time period with even further improvement between 1 and 2 years postoperatively which was in keeping with a study by Wolfgang¹⁷ who found that maximum recovery of rotator cuff repair occurred between 6 and 9 months postoperatively¹ with less drastic change in scores occurring after 12 months.¹⁰

The mean clinically important difference (MCID) is defined as the smallest change in treatment outcome that an individual patient would identify as important. In their study, Xu et al²¹ found that the MCID for RCT assessed using CSS, UCLASS, and OSS at the 24-month follow-up was 6.3, 2.9, and 2.7, respectively. In our study, the mean improvement in scores at 2 years (Table II) are greater than the known MCID for both groups of patients, showing that both groups benefited from surgery after failure of conservative therapy.

One notable strength of our study is that all ARCRs were performed by a single, high-volume surgeon within our tertiary institution, allowing for minimal heterogeneity in surgical technique and postoperative care. Second, our study was able to measure ROM and outcome scores at various time points, allowing the authors to evaluate both short- and medium-term outcomes. Patients were also matched for preoperative functional outcomes as well as comorbidities, ensuring that any improvement across the varying scores was attributable to the surgical intervention and not to any preexisting functional or lifestyle differences.

One limitation of this study is that patients were not stratified by their tear size, as many previous studies have shown that tear size is associated with increasing age and duration of symptoms

preoperatively.^{5,15,19} Matching for tear size would have allowed for more robust understanding on the role surgical intervention alone would have on the two groups.

Finally, as the post hoc power analysis suggests, with a larger cohort of patients, statistically significant differences in outcome and quality of life scores may be detected. Postoperative rotator cuff repair integrity and its relationship with improved functional scores and outcomes remains a relatively controversial topic with several studies suggesting that outcome score improvement are not indicative of repair healing however.^{6,12,13,16} Imaging to show repair healing would have allowed further understanding the role repair integrity has on functional outcomes and whether there were significant differences between the two groups.

Conclusion

Overall, both groups had similar preoperative pain and functional outcome scores. At a 2-year follow-up, both groups showed improvements, although all three scores were poorer in the ≥ 75 years. The improvement across all 3 scores was similar between both groups. Furthermore, the improvement in scores across all 3 scores were more than what is reported in the literature to be the MCID for ≥ 75 years group which shows that although they likely start off at a lower point, their improvement is clinically significant.

We conclude that septuagenarians with symptomatic RCTs who have failed conservative management experience significant improvement in pain and function after surgery, and they should not be excluded from the benefits of ARCR on the basis of their elderly age alone.

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