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Corticosteroid Infiltration to Treat Shoulder Stiffness After Rotator Cuff Repair

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Abstract

Purpose: To investigate whether the preoperative shoulder range of motion (ROM), would increase the risk of postoperative shoulder stiffness, or whether it would be associated with other preoperative patient characteristics.

Methods: The authors retrospectively analysed the 372 shoulders that underwent rotator cuff repair by 4 surgeons, between January 2010 and January 2011. All patients were followed up at 3 and 6 months by 2 independent observers to collect the ROM, including active forward elevation (AFE), passive forward elevation (PFE), and external rotation (ER), as well as subjective shoulder value (SSV).

Results: Of the initial cohort of 372 patients, 10 were lost to follow-up (2.7%), leaving a final cohort of 362 patients available for outcome assessment at a minimum follow-up of 6 months. Of the 362 patients, 281 did not require corticosteroid infiltration, 68 received corticosteroid infiltrations for shoulder stiffness with no apparent cause, and 13 received corticosteroid infiltrations for other reasons. None of the variables were associated with infiltration for shoulder stiffness. Older patients had greater SSV scores ($\beta = 0.3$; 95% CI [0.1, 0.6]; $P = .015$), while both manual and repetitive workers had lower SSV scores ($\beta = -10.7$; 95% CI [−15.8, −5.6]; $P < .001$, and $\beta = -10.2$; 95% CI [−15.1, −5.3]; $P < .001$).

Conclusion: Postoperative SSV was significantly associated with age, as well as manual or repetitive work. Furthermore, postoperative PFE, AFE, and ER were significantly associated with preoperative PFE. Finally, at 3 and 6 months postoperative, patients who required infiltration for shoulder stiffness had significantly lower PFE, AFE, and ER compared to patients who did not require infiltration.

Level of Evidence: IV, Case series.

Keywords

rotator cuff repair, shoulder stiffness, range of motion, infiltration

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Introduction

As the population is aging, the prevalence of rotator cuff tears has risen to 13% in patients over 50, and up to 50% in patients over 80.[1,2] Rotator cuff repair (RCR) techniques have improved over the years, offering satisfactory long-term functional outcomes, but not without adverse events. The most common of which is shoulder stiffness, as it occurs in 10% to 32% of cases.[3–5]

Postoperative shoulder stiffness is defined by an active forward elevation (AFE) between 100° and 120°, and an active external rotation (AER) under 30°,[5–10] and its treatments include, capsular release, corticosteroid or hyaluronic acid injections, and physiotherapy, which can alleviate pain and increase range of motion (ROM).[4,10] Prior identification of high-risk patients, however, could improve patient care and expectations, as they often encounter a decline in quality of life and difficulty in activities of daily living. Several studies have investigated predictors of shoulder stiffness,[7,11] but no consensus has been made on what factors it correlates with.[5,12,13]

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The aim of this study was, therefore, to investigate whether the preoperative shoulder ROM would increase the risk of postoperative shoulder stiffness, or whether it would be associated with other preoperative patient characteristics.

Methods

Patient Characteristics

The authors retrospectively analysed the 372 shoulders that underwent RCR by 4 surgeons, between January 2010 and January 2011. The inclusion criteria were patients who received partial or complete RCR and had a minimum follow-up of 6 months. Informed consent for the use of personal data for research was obtained from every participant, and the study was approved by the ethical board in advance (Institution Review Board approval number: COS-RGDS-2023-03-004-GODENECHE-A).

Preoperative Assessment

Prior to RCR, patients were placed in a supine position for preoperative joint mobility assessment. ROM (AFE, passive forward elevation [PFE], and AER) was evaluated symmetrically by comparing the contralateral to the ipsilateral shoulder. Clinical scores were assessed using the subjective shoulder value (SSV).

Rehabilitation Protocol

The shoulder was immobilized using an abduction cushion during the first 6 weeks. Elbow and wrist rehabilitation were immediately started following surgery. Pendulum exercises were allowed after 3 weeks, active exercises after 6 weeks, and strength activities after 6 months. Balneotherapy was highly recommended up until 3 months, and optional hereafter.

Postoperative Assessment

All patients were followed up at 3 and 6 months by 2 independent observers to collect the ROM and SSV. ROM (AFE, PFE, and AER) was evaluated in an identical manner to the preoperative assessments. Shoulder stiffness was defined as PFE under 120° and AER under 30°. Pain, sleep quality, and quality of life (QoL) were also noted at each follow-up, along with any complications that occurred.

Statistical Analysis

Continuous data was presented as means and standard deviations, and categorical data was presented as proportions. Univariable linear regression analyses were performed for postoperative ROM, namely PFE, AFE, and AER, as well as the SSV score, and the infiltrations for shoulder stiffness. Outcome analysis was performed using age, dominant shoulder operation, sex, type of work, state of the long head of the biceps, method of repair, and preoperative ROM as variables. Models were deemed sufficiently powered, considering the recommendations of Austin and Steyerberg of 2 subjects per variable.[14] Statistical analyses were performed using R version 4.2.3 (R Foundation for Statistical Computing, Vienna, Austria).

Results

Of the initial cohort of 372 patients, 10 were lost to follow-up (2.7%), leaving a study cohort of 362 patients available for outcome assessment at a minimum follow-up of 6 months (Figure 1 and Table 1). At index surgery, 333 patients had complete repairs, and the long head of the biceps either underwent a tenodesis ($n = 271$), tenotomy ($n = 54$), was left torn ($n = 28$), or intact ($n = 9$). Of the 362 patients, comprising 152 women and 210 men, aged 57.2 ± 8.6 (range: 24–80); 281 did not require corticosteroid infiltration, while 68 received corticosteroid infiltrations for shoulder stiffness with no apparent cause, and 13 received corticosteroid infiltrations for other reasons (retears, $n = 7$; symptomatic acromioclavicular joint arthropathy, $n = 4$; or subacromial bursitis, $n = 2$) (Table 2). All corticosteroid infiltrations were performed through a subacromial injection through the acromioclavicular space, for a peri-nervous block effect. Preoperatively, in both the ipsi- and contralateral shoulders there were no significant differences in PFE, AFE, or external rotation (ER) between patients that did not require infiltration or patients that required infiltration for shoulder stiffness or other reasons (Table 3).

Functional and Clinical Outcomes

At 3 and 6 months, PFE was significantly lower in patients who required infiltration for shoulder stiffness compared to patients who did not require infiltrations ($P < .001$ and $P < .001$) or patients who required infiltrations for other reasons ($P < .001$ and $P = .024$) (Table 3). AFE was significantly lower in patients who required infiltration for shoulder stiffness compared to patients who did not require

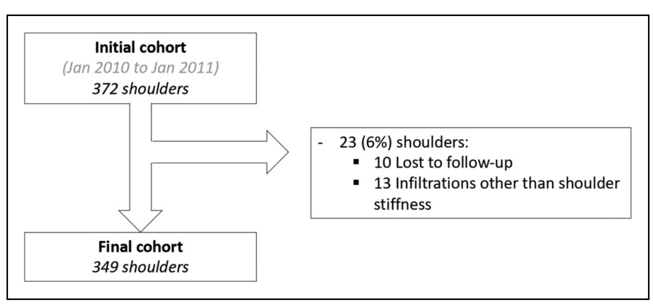

Figure 1. Flowchart of the study cohort.

Table 1. Demographics.

	Initial Cohort ($n = 362$)	
	Mean ± SD N (%)	Range
Age at index surgery (year)	57.2 ± 8.6	(24–80)
Women	152 (42%)	
Dominant shoulder operated	251 (69%)	
Type of work		
Desk	119 (33%)	
Manual	119 (33%)	
Repetitive	124 (34%)	
Long head of biceps		
Tenodesis	271 (75%)	
Tenotomy	54 (15%)	
Torn	28 (8%)	
Intact	9 (2%)	
Repair		
Partial	29 (8%)	
Complete	333 (92%)	
Fatty infiltration of supraspinatus		
0	24 (7%)	
1	162 (45%)	
2	93 (26%)	
3	58 (16%)	
4	25 (7%)	
Fatty infiltration of infraspinatus		
0	191 (53%)	
1	47 (13%)	
2	36 (10%)	
3	22 (6%)	
4	64 (18%)	
Fatty infiltration of subscapularis		
0	224 (62%)	
1	64 (18%)	
2	29 (8%)	
3	20 (6%)	
4	25 (7%)	

Table 2. Infiltration.

	($n = 81$)	
	Mean ± SD N (%)	Range
Infiltration		
Number of first infiltrations	81 (100%)	
Number of second infiltrations	11 (14%)	
Time from surgery to first infiltration (months)	3.4 ± 1.4	(1–7)
Time from surgery to second infiltration (months)	4.0 ± 1.2	(3–7)

infiltrations ($P < .001$ and $P < .001$) or patients who required infiltrations for other reasons ($P = .035$ and $P = .034$). ER was significantly lower in patients who required infiltration for shoulder stiffness compared to patients who did not require infiltrations ($P < .001$ and $P < .001$), but was only significantly different between patients that required infiltrations for other reasons at 3 months ($P = .005$).

Univariable Analysis

None of the variables were associated with infiltration for shoulder stiffness (Table 4).

Older patients had greater SSV scores ($\beta = 0.3$; 95% CI [0.1, 0.6]; $P = .015$), while both manual and repetitive workers had lower SSV scores ($\beta = -10.7$; 95% CI [−15.8, −5.6]; $P < .001$, and $\beta = -10.2$; 95% CI [−15.1, −5.3]; $P < .001$).

Postoperative PFE was associated with age ($\beta = -0.4$; 95% CI [−0.6, −0.2]; $P < .001$), the dominance of operated shoulder ($\beta = 5.6$; 95% CI [1.2, 10.0]; $P = .013$), sex ($\beta = 4.6$; 95% CI [0.4, 8.7]; $P = .033$), manual job ($\beta = -7.8$; 95% CI [−12.8, −2.8]; $P = .002$), and preoperative PFE ($\beta = 0.4$; 95% CI [0.3, 0.5]; $P < .001$) and preoperative AFE ($\beta = 0.1$; 95% CI [0.1, 0.2]; $P < .001$).

Postoperative AFE was associated with age ($\beta = -0.4$; 95% CI [−0.7, 0.1]; $P = .016$), manual job ($\beta = -10.8$; 95% CI [−17.8, −11.6]; $P = .002$), and preoperative PFE ($\beta = 0.3$; 95% CI [0.2, 0.5]; $P < .001$) and preoperative AFE ($\beta = 0.2$; 95% CI [0.2, 0.3; $P < .001$). Finally, postoperative ER was associated with preoperative PFE ($\beta = 0.1$; 95% CI [0.0, 0.2]; $P = .007$) and preoperative ER ($\beta = 0.4$; 95% CI [−0.3, 0.5]; $P < .001$).

Discussion

The main findings of this study are that postoperative SSV was significantly associated with age ($P = .015$), as well as manual ($P < .001$) or repetitive work ($P < .001$). Furthermore, postoperative PFE, AFE, and ER were all significantly associated with preoperative PFE. Finally, at 3 and 6 months postoperative, patients who required infiltration for shoulder stiffness had significantly lower PFE, AFE, and ER compared to patients who did not require infiltration. The clinical relevance of these findings is that postoperative SSV and postoperative ROM can be predicted using preoperative patient characteristics or preoperative ROM.

Studies have shown that shoulder stiffness typically appears in the first 6 to 12 weeks following surgery, and slowly resolves 24 weeks after surgery.[9] It seems, however, that there is no consensus yet on the optimal treatment for limited mobility and pain, which are the 2 most frequent and hindering complications. Adequate rehabilitation programmes and physiotherapy are believed to be a solution for the management of shoulder stiffness, with early gentle mobilization reportedly leading to increased ROM and reduced pain.[1] Other solutions involve nonconservative treatments[4,10,13,15,16]; Rajani et al[10] assessed the effect of a corticosteroid injection at 6 postoperative weeks, and observed

Table 3. Functional Outcomes.

	Study Cohort ($n = 362$)		No Infiltration ($n = 281$)		Infiltration for Shoulder Stiffness ($n = 68$)		Infiltration for Other Reasons ($n = 13$)		Overall Kruskal–Wallis Test	No Infiltration Versus Infiltration for Shoulder Stiffness	No Infiltration Versus Infiltration for Other Reasons	Infiltration for Shoulder Stiffness Versus Infiltration for Other Reasons
	Mean ± SD	Range	Mean ± SD	Range	Mean ± SD	Range	Mean ± SD	Range				
Passive forward elevation												
Controlateral shoulder	168 ± 16.9	(0–180)	168 ± 17.5	(0–180)	168 ± 15.2	(110–180)	174 ± 11.2	(140–180)	0.355			
Preoperative	160 ± 20.5	(50–180)	160 ± 20.4	(50–180)	159 ± 22.1	(80–180)	165 ± 15.1	(130–180)	0.807			
Postoperative (3 months)	141 ± 27.8	(0–180)	145 ± 27.6	(0–180)	124 ± 23.1	(90–180)	149 ± 18.0	(110–180)	**<0.001**	**<0.001**	0.719	**<0.001**
Postoperative (6 months)	159 ± 19.6	(70–180)	163 ± 16.3	(110–180)	144 ± 24.2	(70–180)	160 ± 20.0	(110–180)	**<0.001**	**<0.001**	0.680	**0.024**
Active forward elevation												
Controlateral shoulder	170 ± 16.5	(0–180)	170 ± 17.5	(0–180)	171 ± 13.1	(120–180)	175 ± 9.7	(150–180)	0.530			
Preoperative	149 ± 36.3	(30–180)	149 ± 36.6	(30–180)	145 ± 35.9	(30–180)	156 ± 30.7	(80–180)	0.313			
Postoperative (3 months)	133 ± 37.5	(0–180)	139 ± 35.3	(0–180)	108 ± 36.8	(10–180)	134 ± 38.2	(70–180)	**<0.001**	**<0.001**	0.700	**0.035**
Postoperative (6 months)	156 ± 27.4	(0–180)	160 ± 24.8	(0–180)	140 ± 30.5	(50–180)	155 ± 33.6	(70–180)	**0.002**	**<0.001**	0.763	**0.034**
External rotation												
Controlateral shoulder	52 ± 18.8	(0–90)	53 ± 18.8	(0–90)	52 ± 19.3	(0–90)	51 ± 18.0	(20–80)	0.908			
Preoperative	46 ± 19.2	(0–90)	46 ± 19.1	(0–90)	47 ± 19.8	(0–90)	46 ± 18.9	(20–80)	0.786			
Postoperative (3 months)	24 ± 16.5	(−10 to 70)	26 ± 16.1	(−10 to 70)	14 ± 14.9	(−10 to 70)	26 ± 15.6	(0–60)	**<0.001**	**<0.001**	0.716	**0.005**
Postoperative (6 months)	37 ± 17.8	(0–90)	39 ± 17.1	(10–90)	31 ± 19.1	(0–80)	31 ± 18.0	(0–60)	**<0.001**	**<0.001**	0.174	0.885
Subjective shoulder value (%)												
Postoperative	68 ± 18.0	(0–100)	70 ± 17	(10–100)	61 ± 20	(0–95)	62 ± 16	(30–80)	**0.003**	**0.002**	0.098	0.949

Bold values indicate statistical significance.

Table 4. Univariable Analysis.

	Infiltration for Shoulder Stiffness			Subjective Shoulder Value at 6 Months			Passive Forward Elevation			Active Forward Elevation			External Rotation		
	OR	95% CI	*P*-value	β	95% CI	*P*-value	β	95% CI	*P*-value	β	95% CI	*P*-value	β	95% CI	*P*-value
Age	1.0	[1.0, 1.0]	.780	0.3	[0.1, 0.6]	**.015**	−0.4	[−0.6, −0.2]	**.001**	−0.4	[−0.7, −0.1]	**.016**	0.1	[−0.1, 0.3]	.267
Dominant shoulder	0.7	[0.4, 1.2]	.149	2.1	[−2.5, 6.7]	.370	5.6	[1.2, 10.0]	**.013**	4.6	[1.6, 10.8]	.147	0.4	[−3.7, 4.4]	.857
Sex															
Men	REF			REF			REF			REF			REF		
Women	1.3	[0.8, 2.3]	0.280	1.2	[−3.1, 5.5]	.574	4.6	[0.4, 8.7]	**.033**	−0.3	[−6.1, 5.5]	.920	3.6	[−0.2, 7.4]	.063
Type of work															
Desk	REF			REF			REF			REF			REF		
Manual	1.6	[0.8, 3.0]	0.174	−10.7	[−15.8, −5.6]	**<.001**	−7.8	[−12.8, −2.8]	**.002**	−10.8	[−17.8, −11.6]	**.002**	−2.6	[−7.2, −2.0]	.261
Repetitive	1.0	[0.5, 2.0]	1.000	−10.2	[−15.1, −5.3]	**<.001**	−3.2	[−8.2, 1.7]	.201	−4.7	[−11.6, 2.2]	.183	−1.9	[−6.4, 2.6871]	.419
Long head of the biceps															
Tenodesis	REF			REF			REF			REF			REF		
Tenotomy	1.7	[0.8, 3.3]	0.138	1.7	[−4.2, 7.6]	.575	−0.1	[−6.0, 5.8]	.978	−1.4	[−9.6, 6.7]	.727	2.1	[−3.2, 7.3]	.445
Torn	1.4	[0.5, 3.4]	0.520	.2	[−8.1, 8.5]	.957	0.7	[−7.3, 8.6]	.865	−1.6	[−12.7, 9.4]	.771	7.1	[−0.1, 14.2]	.053
Intact	0.6	[0.0, 3.2]	0.602	−5.9	[−18.2, 6.5]	.349	−0.4	[−13.5, 12.7]	.949	−3.3	[−21.5, 14.9]	.721	−5.7	[−17.5, 6.1]	.344
Repair															
Complete	REF			REF			REF			REF			REF		
Partial	1.1	[0.4, 2.8]	0.787	−6.9	[−14.6, 0.8]	.079	1.5	[−6.1, 9.1]	.699	−3.7	[−14.2, 6.9]	.497	−5.0	[−11.9, 1.8]	.151
Preoperative range of motion															
Passive forward elevation	1.0	[1.0, 1.0]	0.640	0.0	[−0.1, 0.1]	.922	0.4	[0.3, 0.5]	**<.001**	0.3	[0.2, 0.5]	**<.001**	0.1	[0.0, 0.2]	**.007**
Active forward elevation	1.0	[1.0, 1.0]	0.350	0.0	[−0.0, 0.1]	.714	0.1	[0.1, 0.2]	**<.001**	0.2	[0.2, 0.3]	**<.001**	0.0	[−0.0, 0.1]	.450
External rotation	1.0	[1.0, 1.0]	0.552	0.0	[−0.1, 0.1]	.559	0.1	[−0.0, 0.2]	.194	0.0	[−0.1, 0.2]	.977	0.4	[−0.3, 0.5]	**<.001**

Bold values indicate statistical significance.

significantly greater constant scores and lower pain on visual analog scale score from 9 weeks onwards when using injections, with no reported complications. Jeong et al[16] assessed the effects of hyaluronic acid injections and found no effect on forward elevation and retear rates. Finally, Huberty et al[13] investigated the use of capsular release for shoulder stiffness and found that it significantly improves ER, forward flexion, and internal rotation.

In a recent meta-analysis,[17] the above-mentioned treatment methods were compared to determine the best management for shoulder stiffness. Results for AFE were generally higher for patients treated with surgical methods compared to rehabilitation alone. On the other hand, AER had a greater increase following rehabilitation in the same cohort. In the present study, the authors assessed all patients at 3 months to confidently diagnose shoulder stiffness, as during earlier assessment patients may have decreased ROM which is primarily due to postoperative pain. Patients were considered stiff if they had PFE $<120°$ and AER $<30°$. All patients with acute shoulder stiffness received injections at a mean of 3.4 ± 1.4 postoperative months for the first infiltration. In the majority of patients, one infiltration was sufficient to relieve symptoms of stiffness, however, in cases of persistent stiffness, a second infiltration was indicated. All corticosteroid infiltrations were performed through a subacromial injection through the acromioclavicular space. At a follow-up of 6 months, patients only had a 5° deficit in AFE compared to preoperative measurements, while AER had a greater deficit of 16°.

Identifying risk factors for shoulder stiffness can help anticipate and manage patient expectations after RCR. As all patients underwent the same rehabilitation protocol, it was not possible to identify whether differences in postoperative rehabilitation could lead to postoperative shoulder stiffness, although a recent study has shown that no immobilization leads to better functional scores compared to sling immobilization.[1] The present study has not identified any predictive factors for infiltration due to shoulder stiffness, the univariable analysis shows an association between female sex and an increase in postoperative PFE, which is in contrast to previous studies.[5,7,18] In the present study, age was associated with a deficit in postoperative AFE and PFE, which is in agreement with the previous literature on the effects of age.[5,7,18] Furthermore, in the present study, SSV, AFE, and PFE are significantly worse in manual workers. Previous publications have identified a greater likelihood of shoulder stiffness in patients receiving worker's compensation.[18–20] According to the literature, tear size is also an important predictive factor for shoulder stiffness; partial-thickness tears are more likely to result in shoulder stiffness, compared to full-thickness tears.[11,18] However, the present study did not identify a significant association between tear size and infiltration.

The findings of this study should be interpreted with the following limitations in mind. Firstly, patients were assessed at a follow-up of 6 months, which could be insufficient to ascertain the effects of the infiltration and investigate the evolution of the clinical scores and shoulder ROM. Secondly, the authors did not collect any preoperative scores, making it difficult to assess whether patients improved or worsened. Thirdly, the present study was a retrospective case series with no control group, making it difficult to establish the efficacy of intra-articular shoulder infiltration. Finally, the present study did not collect any data on risk factors such as diabetes, Dupuytrens, or metabolic diseases.

Conclusion

Postoperative SSV was significantly associated with age ($P = .015$), as well as manual ($P < .001$) or repetitive work ($P < .001$). Furthermore, postoperative PFE, AFE, and ER were all significantly associated with preoperative PFE. Finally, at 3 and 6 months postoperative, patients who required infiltration for shoulder stiffness had significantly lower PFE, AFE, and ER compared to patients who did not require infiltration. The clinical relevance of these findings is that postoperative SSV and postoperative ROM can be predicted using preoperative patient characteristics or preoperative ROM.

Authors' Contributions

FS contributed to conceptualization, data collection, interpretation of findings, and writing; JPL contributed to conceptualization, data collection, interpretation of findings, and writing; ReSurg contributed to project administration, data analysis, statistics, visualization, interpretation of findings, and writing; AG contributed to conceptualization, project administration, interpretation of findings, and writing.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethics Approval and Consent to Participate

Informed consent was obtained from all individual participants included in the study. The study was approved in advance by the institutional review board (IRB COS-RGDS-2023-03-004-GODENECHE-A).

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