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Corticosteroid injection prior to surgery had no effect on 2-year outcomes following arthroscopic rotator cuff repair

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Background: Corticosteroid injections (CSIs) can be an effective nonsurgical treatment for patients with rotator cuff tears. Recent large database studies have raised concern that CSI may result in a higher reoperation rate, increased infection risk, and worse outcome after arthroscopic rotator cuff repair (ARCR). The purpose of this study was to evaluate the reoperation rate, incidence of postoperative infection, and two-year outcomes of patients undergoing ARCR with and without the use of preoperative CSI.

Methods: An institutional database generated from fellowship-trained orthopedic sports surgeons was retrospectively queried for patients who underwent ARCR with a minimum of two-year follow-up. Inclusion criteria consisted of 1) primary full-thickness rotator cuff tear and 2) preoperative and minimum two-year patient-reported outcome measures (PROMs). Of the 219 patients identified, 134 patients had preoperative subacromial CSI administered within one year of ARCR. Reoperation rate, number of injections, Visual Analog Scale, American Shoulder and Elbow Surgeons Score, Single Assessment Numeric Evaluation, and Veterans Rand 12-Item Health Survey Physical Component Score/Mental Component Score were compared between groups at six months, one year, and two years. Chi-square and *t*-tests were used to compare baseline differences, postoperative infections, and reoperations. A repeated measures Analyses of Covariance was used to measure differences between PROMs at each time point. Simple Analyses of Covariance were used for the two-year sub-analyses for patients receiving CSI within 90 days of surgery and if multiple preoperative CSI had been given ($\alpha \leq 0.05$).

Results: There were no significant demographic differences between groups ($P > .05$). Preoperative use of subacromial CSI within one year prior to ARCR did not increase reoperation rate ($P = .85$) or impact PROMs at any timepoint. There were two reoperations during the study period in the CSI group (2 lysis of adhesions). No infections occurred in either cohort. No differences were found if injections were performed within 90 days of surgery or if more than one CSI was administered within the year prior to surgery ($P > .05$).

Conclusion: Our results show that preoperative CSI prior to primary ARCR did not increase risk of reoperation, infection, or influence PROMs with a minimum follow-up of 2 years.

Rotator cuff injuries affect one-fifth of the adult population as one of the most common causes of shoulder pain.[19] The number of rotator cuff surgeries also continues to increase annually, with roughly half a million repairs being performed in the United States in 2021.[9,22] This poses a significant financial burden on the medical system, as an estimated five billion dollars per year is spent on rotator cuff-related health care.[27,30]

Achieving a healed intact rotator cuff improves strength and functional outcome.[15,34,35] However, despite technical advances, the retear rate remains unacceptably high after repair, and the need to identify risk factors that alter healing potential could have an immense societal impact.[17,20,23] The risk factors may be intrinsic to the patient and nonmodifiable or modifiable,

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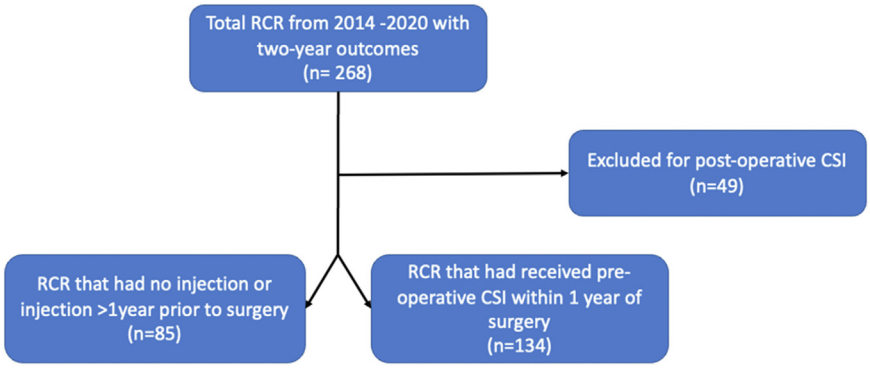

Figure 1 Flow chart of inclusion/exclusion criteria applied to queried database. *CSI*, corticosteroid injection; *RCR*, rotator cuff repair.

suggesting an opportunity for optimizing the chance for healing.[2,7,12,34]

The use of preoperative corticosteroid injections (CSIs) has been recently scrutinized as a factor that could negatively impact rotator cuff healing.[3,8,10,11,16,21,24-26,29,32,33] The injections are often used in the initial preoperative treatment algorithm for chronic rotator cuff disease, along with physical therapy, activity modification, and oral anti-inflammatory medication. According to the AAOS clinical practice guidelines, the use of a single CSI with local anesthetic for a patient with a rotator cuff tear carries a moderate recommendation.[31] However, recent studies have questioned the safety of CSI, suggesting a higher retear rate after rotator cuff repair (RCR), increased rate of postoperative infection, and worse patient-reported outcome measures (PROMs).[3,8,10,11,16,21,24-26,29,32,33] Many of these studies are larger Medicare and private payer database studies and have reported a nearly double rate of infection with the use of CSI within one month of surgery[13] and two to three times increased rate of retear.[6,10,14,32] However, other studies have demonstrated no significant difference[5,16,18] or improved outcomes.[11,28] The purpose of this investigation was to study the impact of a preoperative CSI on RCR reoperation rate, postoperative RCR infection, and two-year PROMs after RCR.

Methods

Approval from the institutional review board was obtained. The retrospective single institution database, generated from fellowship-trained orthopedic sports surgeons, was queried for patients having undergone RCR with a minimum of two-year follow-up. Inclusion criteria included prior primary RCR and completion of preoperative and two-year postoperative PROMs. Patients were excluded if they had received a postoperative CSI. The selection of the final cohort is illustrated in the flowchart (Fig. 1). A total of 219 patients were identified from 2014 to 2020. Of those, 134 patients had a preoperative CSI within one year prior to their operation and were included in the injection group. All injections were administered by a fellowship-trained orthopedic surgeon in the subacromial space from a posterior approach without radiographic or ultrasound guidance. The injection medication consisted of 40 mg triamcinolone and 4 cc of 0.25% bupivacaine. Those patients who never received an injection or had an injection greater than one year prior to the index RCR were considered the no injection group.

Reoperations, postoperative infections, and PROMs (VAS pain, ASES, SANE, VR-12 PCS, VR-12 MCS) were compared between groups at six months, one year, and two years. Postoperative infection was defined as an infection requiring formal open or arthroscopic shoulder irrigation and débridement in the operating room.

All RCRs were done arthroscopically with either single or double row suture anchor fixation per surgeon preference. All patients received standard preoperative weight-based cefazolin (or clindamycin if allergic). All patients followed the same rehabilitation protocol with a licensed physical therapist.

Statistical analysis

T-tests and chi-square analyses were used to compare baseline demographic differences, postoperative infections, and reoperations between groups. A repeated measures Analyses of Covariance was used to measure differences between PROMs at each timepoint while controlling for baseline scores. Simple Analyses of Covariance controlling for baseline measures were used for the two-year subanalyses for patients receiving CSI within 90 days of surgery and for patients who had received multiple (two or more) CSIs preoperatively ($\alpha \leq 0.05$).

Results

Of the 219 patients who had RCR, 134 patients received a preoperative CSI within one year before surgery, and 85 patients did not. There were no significant differences between groups with regard to age, sex, race or ethnicity, laterality, tear size, worker's compensation status, smoking, diabetes, dyslipidemia, hypercholesterolemia, renal failure, or Parkinson's disease ($P > .05$, Table I). There were no differences between groups in PROMs at six months, one year, or two years postoperatively (Table II, Fig. 2).

There was no difference in reoperation rates between groups ($P = .85$). Two reoperations for lysis of adhesions were done in the CSI group. One patient had a small initial tear and the other patient had a medium initial tear, both were completely healed at repeat surgery. Both had motion significantly improved and had good eventual outcomes. There were no postoperative infections in either cohort.

Sub-analysis demonstrated no differences if the injection was performed within 90 days of the operation ($P > .05$, Table III) or if one or more CSIs had been given within the year prior to RCR ($P > .05$, Table IV).

Discussion

This single institution analysis of 219 RCRs demonstrated that one or more preoperative CSIs performed within a year prior to primary RCR had no association with revision surgery, postoperative infection, or change in outcomes through the initial two years. These findings are important as they reinforce the common practice of attempted nonoperative management with a CSI. In

Table I
Demographics comparison of RCR with and without CSI.

	Received preoperative injection	Did not receive preoperative injection	*P* value
	N = 134	N = 85	
Age	61.13 (9.24)	58.92 (8.49)	.08
Sex (male)	74	53	.29
Involved shoulder (right)	89	54	.65
Race (white)	74	53	.29
Ethnicity (Hispanic)	2	1	.84
Small/medium full thickness tears	69	39	.42
Large/massive full thickness tears	65	46	
Worker's compensation (yes)	3	3	.64
Diabetes (yes)	71	15	.31
Smoker (yes)	46	24	.42
Hypercholesterolemia (yes)	5	4	.72
Dyslipidemia (yes)	18	6	.14
Renal failure (yes)	5	0 (0%)	.07
Parkinson's (yes)	1	1	.74
Fall risk (yes)	52	49	**.03**

CSI, corticosteroid injection; *RCR*, rotator cuff repair.
Bold indicates statistical significance P value <.05.

Table II
RM ANCOVA (with imputation) comparing injection with no injection.

	Preoperative	Six months	1 year	2 years	*P* value	Eta squared
Pain						
Yes injection	4.56 (2.28)	0.91 (0.90)	0.89 (1.32)	0.76 (1.30)	.98	0.000
No injection	4.49 (2.13)	0.97 (1.10)	0.73 (1.23)	0.86 (1.67)		
ASES index						
Yes injection	51.54 (17.23)	85.10 (11.28)	89.61 (11.59)	90.09 (13.43)	.67	0.001
No injection	52.07 (17.31)	84.75 (10.62)	89.11 (11.19)	90.36 (12.50)		
SANE						
Yes injection	38.58 (20.78)	73.55 (23.77)	82.68 (24.47)	84.20 (22.61)	.37	0.005
No injection	38.76 (20.64)	76.11 (18.14)	80.87 (23.52)	80.01 (26.49)		
VR-12 PCS						
Yes injection	36.87 (7.84)	46.55 (6.34)	48.01 (8.09)	48.05 (7.71)	.16	0.011
No injection	38.38 (7.93)	45.80 (6.99)	47.06 (7.71)	48.37 (7.39)		
VR-12 MCS						
Yes injection	53.64 (9.71)	57.06 (7.17)	57.76 (6.24)	56.61 (6.98)	.18	0.010
No injection	54.04 (9.95)	55.48 (8.88)	56.18 (8.17)	55.74 (8.58)		

Controlled for baseline measures and fall risk.
RM ANCOVA, repeated measures analyses of covariances; *VR-12*, Veterans Rand 12-Item Health Survey.

addition, the utility of a CSI with anesthetic can be helpful diagnostically in determining to what degree pain is contributing to a patient's weakness and functional impairments. However, the findings should not suggest CSI is the correct choice for all patients, as some patient factors and tear types have shown superior results with acute treatment, such as a traumatic tear in a younger patient.[1]

Current literature has shown mixed results as to the risks of preoperative CSIs on RCR outcomes. Several systematic reviews and large database studies have shown a small but statistically significant increased risk of CSI with infection and retear.[3,8,16,25] In a retrospective national insurance database study, Weber et al demonstrated a time- and dose-dependent effect of CSI and revision rate in RCRs.[32] If more than one injection had been administered preoperatively, the odds ratio for revision was 2.1, compared to an odds ratio of 1.3 with one injection. They found an increase of 1.5% revision rate if a patient had received any preoperative injection. If the injection was given within a month of surgery, there was an increased odds of a revision surgery.[32] This increase is consistent with several other studies showing an increased revision rate.[3,29] In another large database study, Desai et al found an increased odds of revision if more than two injections were administered within the year before RCR, but no difference if only one injection was given.[10] We did not find a higher reoperation rate in the CSI group. There were only two revision operations, and both patients were in the CSI group, and the repeat surgeries were done for stiffness.

In general, patients in both groups demonstrated significant improvements in PROMs from the time of surgery to six months postoperatively. Only modest gains in PROMs were seen from six months to two years. We excluded postoperative CSIs to limit confounding variables. However, several studies have demonstrated both the safety and efficacy of postoperative CSI administered outside the acute postoperative window of 6 weeks.[8,16,18] This could have allowed for further improvements in some patients later in the recovery period.

Increased infection risk is also a concern with CSI due to the immunosuppressive properties of the medication and to potential inoculation of dermal *Cutibacterium acnes* into deeper joint spaces. Forsythe et al showed an increased infection risk by 0.5% (OR = 1.7) when a preoperative CSI was given within one month of surgery.[13] Cancienne et al found an increased risk of infection with an intraoperative CSI (0.16%, OR = 1.46),[30] but others showed no increased risk with a postoperative CSI.[8,16,18] When comparing to the adult hip and knee reconstruction literature, a recent systematic review found an increased odds ratio of 1.52 if a preoperative CSI was given within three months of total knee arthroplasty but not when given six months prior (OR 1.05).[4] Our study did not have any infections with or without preoperative CSI; however, the number of patients in our study is too small to draw conclusions on infection.

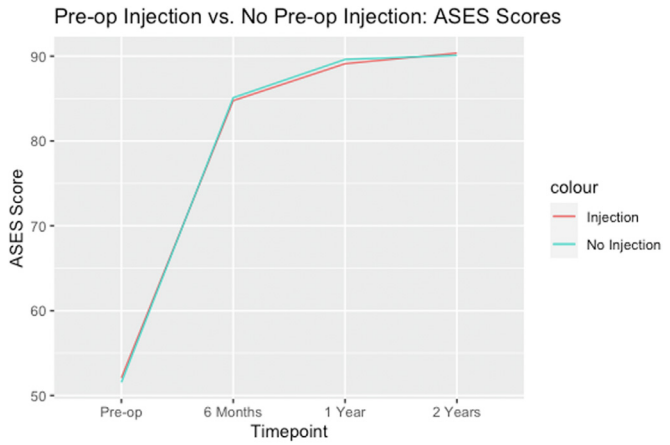

Figure 2 ASES score comparison between CSI and no CSI. *CSI*, corticosteroid injection.

Table III
Test of differences at 2 years between 1 vs. 2 injections.

	One injection	Two injections	*P* value
	N = 92	N = 41	
Pain VAS	1.09 (1.65)	1.01 (1.89)	.79
ASES index	88.76 (14.63)	88.27 (17.72)	.86
SANE	82.33 (25.05)	85.51 (20.57)	.47
SF 12 PCS	48.36 (7.75)	46.65 (7.88)	.24
SF 12 MCS	56.45 (7.08)	55.97 (7.62)	.73

Table IV
Test of differences at 2 years between within 90 days and after 90 days.

	Within 90 days	Past 90 days	*P* value
	N = 70	N = 63	
Pain VAS	1.05 (1.80)	1.08 (1.65)	.93
ASES index	88.33 (16.59)	88.92 (14.51)	.86
SANE	81.87 (26.00)	84.92 (21.01)	.47
SF 12 PCS	48.05 (7.72)	47.60 (7.94)	.24
SF 12 MCS	56.34 (7.13)	56.26 (7.28)	.73

Whether eventual PROMs are affected by preoperative CSIs is also debatable. Several studies have shown equivocal differences in PROMs between patients who had preoperative CSIs to those who did not.[5,8] Others have shown improvement in postoperative ASES scores at one year postoperative[28] and at two years postoperative[11] if an injection was given preoperatively. Our data demonstrated no significant difference in PROMs through two years postoperatively if a patient had received one or more CSIs within the year prior to RCR.

There are several limitations to our study. It is a retrospective analysis of a relatively small cohort with only two-year follow-up. Patient comorbidities known to contribute to RCR outcomes were found not to vary significantly between cohorts, and two years is likely sufficient to detect changes from a preoperative intervention. The accuracy of the CSIs cannot be verified, as most were done without ultrasound or fluoroscopy. All injections were administered by fellowship-trained surgeons with extensive experience in shoulder injections and surgery. The tear acuity, degree of fatty infiltration, and muscle atrophy were not compared between groups, which are additional known influences of outcomes. We also did not account for bone mineral density and level of work activity. Finally, CSIs given greater than one year prior to the index surgery were not controlled for, which if numerous injections were given may alter future outcomes.

Conclusion

There was no deleterious effect on revision rate, infection risk, or PROMs up to two years for patients who had a CSI within one year prior to RCR. This is contrary to recent large insurance database literature. Future study may be needed to examine the true impact CSIs have on patients with rotator cuff tears.

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