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Distal Clavicular Resection Worsens Outcomes in Rotator Cuff Repair: A National Database Study

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Abstract

Introduction: Distal clavicular resection (DCR) is a procedure used to alleviate acromioclavicular joint (ACJ) pain, often done alongside rotator cuff repair (RCR). This investigation explored the relationships between DCR and RCR, outcomes of DCR during RCR, and complication rates of DCR.

Methods: This retrospective study used electronic medical record data from the TriNetX database. Cohorts were subdivided based on the timeline of DCR in comparison to RCR, as well as comparing RCR with DCR against RCR without DCR.

Results: In total 46 534 patients underwent RCR with 14.8% (6898) of these patients also undergoing DCR. And 72.8% (5021) had DCR during RCR, and 10.7% (740) had DCR after RCR. Less than 5% (<10) of patients with preexisting ACJ pain required DCR 3 years postoperatively, and 0.002% (78) patients without ACJ pain developed ACJ pain within 3 years. Less that 20 patients underwent DCR within 3 years of being diagnosed with ACJ pain. Patients who had RCR with DCR were more likely to have chronic pain postoperatively ($P < .0001$).

Conclusion: Patients undergoing RCR do not require subsequent DCR. Performing DCR does not offer significant benefit when compared to performing isolated RCR without DCR in patients with preexisting ACJ pain, but increases risk for ACJ instability and chronic pain.

Keywords

Shoulder, rotator cuff tear, outcomes

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Introduction

Rotator cuff tears and associated shoulder pathologies are prevalent musculoskeletal disorders that significantly impact patients' quality of life and functional capabilities.[1] Surgical repair of the rotator cuff is frequently employed to alleviate symptoms, restore shoulder functionality, and improve overall patient outcomes.[2,3] Distal clavicular resection (DCR), often performed concomitantly with rotator cuff repair (RCR), has been utilized to address acromioclavicular joint (ACJ) pain and associated pathology.[4,5] However, the indications, benefits, and potential risks of DCR during RCR remain topics of ongoing research and clinical investigation.[6,7]

The ACJ plays a critical role in shoulder biomechanics, and its dysfunction can lead to pain, impingement, and limited range of motion.[4,5] The decision to perform DCR alongside RCR is based on the belief that addressing ACJ pathology concurrently with RCR may lead to better postoperative outcomes and overall patient satisfaction.[7–10] Nevertheless, controversies persist regarding the necessity of DCR in all cases of RCR, and its potential association with complications following surgery.[7,8,11,12] While some studies have been performed regarding the outcomes of DCR performed with RCR, few have evaluated clinical outcomes in conjunction with recurrence or necessity of subsequent repair, and fewer have evaluated these surgeries in the context of ACJ pathology.

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In this study, we utilized TriNetX, a large multisite national database to analyze a large cohort of patients undergoing RCR. This study aims to address when most patients receive DCR with respect to RCR and whether patients with known ACJ pain benefit from DCR at the time of RCR. This study seeks to address 2 main questions. We sought to explore when most patients receive DCR with respect to RCR and if patients with known ACJ pain benefit from DCR at the time of RCR. Additionally, this study evaluates the development of ACJ pain following RCR and the risks of performing concomitant DCR and RCR versus RCR alone. The findings of this study may serve to refine surgical practices, enhance patient selection criteria, and improve the overall efficacy and safety of RCR as well as DCR.

Methods

Study Design and Data Collection

The TriNetX database is a health research network which provides access to longitudinal electronic medical records from 81 healthcare organizations and over 98 million patients. The TriNetX network was retrospectively queried on June 28, 2023 using cohorts developed with current procedural terminology (CPT) and International Classification of Disease 10th edition (ICD-10) codes. Only patient data collected over the past 10 years was considered in the study.

Cohort Selection

Patients in all cohorts underwent rotator cuff repair, which was identified by CPT codes (Table 1). Laterality was determined by ICD-10 codes (Table 2). DCR CPT codes 29 824 (arthroscopic DCR) and 23 120 (open DCR) were combined with RCR, with the temporal relationship either before, during, or after the procedure. Additionally, patients were grouped based on prevalence of ACJ pain before or after surgery, and if they received distal clavicular resection within 3 years of the diagnosis of ACJ pain.

Finally, outcomes were compared between patients who had undergone DCR concomitantly with RCR and patients who had solely undergone RCR, as well as patients who underwent RCR concomitantly with DCR as compared to patients undergoing DCR after initial RCR. Once cohorts were created, they were then propensity matched on age, race, body mass index (BMI), nicotine use, history of osteoarthritis, and history of diabetes.

Outcomes

Several postoperative outcomes were compared between the cohort that received DCR alongside RCR and the cohort that had solely received RCR. These outcomes were assessed at 1 month, 6 months, and 1 year postoperatively. The outcomes assessed include general surgical complications, injury to the rotator cuff, need for upper extremity repair, musculoskeletal, neurological, and circulatory postoperative complications, infection, acute pain, heterotopic ossification, ACJ instability, and chronic pain (Table 3).

Statistical Analysis

In order to compare postoperative outcomes between patients who had received DCR with RCR and patients who had solely received RCR, both cohorts were propensity matched based on sex, age, nicotine dependence, BMI, and prior history of osteoarthritis in the same shoulder. Outcomes of the 2 cohorts were compared with odds ratios. A P value of $<.05$ was deemed significant between the cohorts.

About TriNetX

TriNetX is a "global health research network that optimizes clinical research and enables discoveries through the generation of real-world evidence," and has been described well in other

Table 1. Procedural Definitions.

Code		Definition
Rotator cuff repair	29 807	Arthroscopy, shoulder, surgical; repair of SLAP lesion
	29 827	Arthroscopy, shoulder, surgical; with rotator cuff repair
	23 410	Repair of ruptured musculotendinous cuff (eg, rotator cuff) open; acute
	23 412	Repair of ruptured musculotendinous cuff (eg, rotator cuff) open; chronic
	23 420	Reconstruction of complete shoulder (rotator) cuff avulsion, chronic (includes acromioplasty)
	23 430	Tendonesis of long tendon of biceps
Distal clavicular resection	23 120	Claviculectomy; partial
	29 824	Arthroscopy, shoulder, surgical; distal claviculectomy including distal articular surface

Abbreviation: SLAP, superior labral anterior posterior.

Table 2. Diagnostic Definitions.

Code	Definition
S46.011	Strain of muscle(s) and tendon(s) of the rotator cuff of right shoulder
S46.012	Strain of muscle(s) and tendon(s) of the rotator cuff of left shoulder
S46.111	Strain of muscle, fascia, and tendon of long head of biceps, right arm
S46.112	Strain of muscle, fascia, and tendon of long head of biceps, left arm
S46.121	Laceration of muscle, fascia and tendon of long head of biceps, right arm
S46.122	Laceration of muscle, fascia and tendon of long head of biceps, left arm

Table 3. Outcome Definitions.

Code		Definition
ACJ pain	S43.51	Sprain of right acromioclavicular joint
	S43.52	Sprain of left acromioclavicular joint
General surgical complications	T80-T88	Complications of surgical and medical care, not elsewhere classified
Injury/strain to the rotator cuff	S46.0	Injury of muscle(s) and tendon(s) of the rotator cuff of shoulder
	S46.01	Strain of muscle(s) and tendon(s) of the rotator cuff of shoulder
	S46.8	Injury of other muscles, fascia, and tendons at shoulder and upper arm level
Musculoskeletal, neurological, and circulatory postoperative complications	G97	Intraoperative and postprocedural complications and disorders of nervous system, not elsewhere classified
	I97	Intraoperative and postprocedural complications and disorders of circulatory system, not elsewhere classified
	M96	Intraoperative and postprocedural complications and disorders of musculoskeletal system, not elsewhere classified
Infection	T81.4	Infection following a procedure
Acute pain	G89.1	Acute pain, not elsewhere classified
	G89.18	Other acute postprocedural pain
Chronic pain	G89.2	Chronic pain, not elsewhere classified
	G89.28	Other chronic postprocedural pain
ACJ instability	S43.1	Subluxation and dislocation of acromioclavicular joint

Abbreviation: ACJ, acromioclavicular joint.

published literature[13] (TriNetX: Answers at the Speed of Thought, 2019. https://www.trinetx.com/.). The data encompasses various aspects such as demographics, diagnoses (coded using ICD-10), procedures (coded with ICD-10 PCS and CPT), medications, laboratory values, and genomic data. To achieve accurate analysis, the data is processed using parallel R and Python queries within the analytics platform. TriNetX functions as a federated network and has obtained a waiver from the Western Institutional Review Board. The data received by TriNetX consists solely of aggregated counts and statistical summaries of de-identified information.

Results

From January 2013 to June 2023, there were 46 534 patients who underwent RCR from over 45 healthcare organizations in the database. Regarding demographics, patients who underwent RCR were more likely to be individuals with a higher BMI and a history of osteoarthritis, with African American and Asian populations being less likely to undergo DCR with RCR (Table 4).

Data regarding temporality of DCR in the context of RCR can be found in Table 5. Of the 46 534 patients who underwent RCR, there were 6898 patients who have at some point undergone DCR. In total 1137 patients underwent DCR before their RCR, 740 patients underwent DCR after the initial RCR, and 5021 patients underwent DCR during their RCR procedure. Additionally, there were 318 diagnoses of isolated ACJ pain in patients who underwent RCR. Two hundred and forty patients were diagnosed with ACJ pain before their RCR procedure, and 72 of those patients underwent DCR at the time of their RCR procedure. Of those who did not get DCR at the time of RCR, <10 of those patients required future DCR over the next 3 years. Additionally, 82 patients were diagnosed with ACJ pain within 3 years of their RCR procedure, and <20 of these patients elected to undergo DCR within 3 years of undergoing RCR (Table 6).

When comparing risk of postoperative complications between RCR and DCR as compared to RCR without DCR, we determined that there are few differences in risk for general postoperative surgical complications. These include musculoskeletal, neurological, or circulatory complications, risk of rotator cuff injury, risk of general perioperative complications, infection, or acute pain. There are no significant differences in complication rates in patients undergoing DCR during RCR as compared to patients who undergo DCR within 3 years of initial RCR (Table 7). We found that patients undergoing RCR and DCR concomitantly as compared to patients undergoing RCR alone had a slightly higher risk for chronic pain, primarily after 6 months and onwards (*1.74% increase at 12 months, $P < .0001$*). We also determined that there is a slightly higher risk for ACJ instability within a relatively short postoperative period of 6 months and onwards when comparing these same groups (*0.16% increase at 12 months, $P < .0001$*) (Table 8).

Discussion

The purpose of this study was to identify general trends in use of DCR with respect to RCR as well as address whether patients with ACJ pain benefit from undergoing DCR and RCR concomitantly. We also sought to further characterize the relationship of ACJ pain to RCR and the complications of concomitant RCR and DCR versus RCR alone.

Table 4. Demographics of RCR Compared to RCR and DCR (in Right Shoulder).

		Before propensity score matching			After propensity score matching		
		RCR without DCR	RCR with DCR	*P* value	RCR without DCR	RCR with DCR	*P* value
Gender	Male (%)	4972 (57.1%)	1257 (58.9%)	.1285	1261 (59.2%)	1256 (58.97%)	.8762
	Female (%)	3662 (42.1%)	856 (40.15%)	.104	856 (40.2%_	855 (40.14%)	.9751
Age at index (±SD)		58.4 ± 11.4	58.5 ± 9.61	.8954	58.5 ± 9.97	5.58 ± 9.59	.9875
Race (% of operative group)	White	6796 (78.1%)	1678 (78.7%)	.547	1727 (81.08%)	1677 (78.73%)	.0559
	Black or African American	860 (9.9%)	253 (11.9%)	**.0069**	236 (11.1%)	252 (11.83%)	.442
	Asian	152 (1.75%)	19 (0.89%)	**.0045**	13 (0.61%)	19 (0.9%)	.287
	Unknown race	290 (3.3%)	61 (2.86%)	.27	47 (2.21%)	61 (2.86%)	.172
BMI (±SD)		29.6 ± 5.91	30.6 ± 5.8	**.0142**	29.9 ± 6.2	30.6 ± 5.8	.342
Personal history of nicotine dependance *(% of operative group)*		1859 (21.4%)	418 (19.6%)	.074	397 (18.6%)	417 (19.6%)	.4357
Family history of diabetes mellitus *(% of operative group)*		663 (7.62%)	142 (6.6%)	.1301	169 (7.94%)	142 (6.7%)	.11
Primary osteoarthritis, right shoulder *(% of operative group)*		3870 (44.5%)	1289 (60.46%)	**<.0001**	1322 (62.1%)	1288 (60.5%)	.285

Abbreviations: BMI, body mass index; DCR, Distal clavicular resection; RCR, rotator cuff repair.
Bold text denotes significant results.

Table 5. Temporality of DCR.

Total patients who have had rotator cuff repair	46 534
DCR before RCR	1137
DCR During RCR	5021
DCR after RCR	740
Total patients with both DCR and RCR	6898

Abbreviations: DCR, Distal clavicular resection; RCR, rotator cuff repair.

Table 6. ACJ Pain in the Context of RCR.

	ACJ pain before/during RCR	ACJ pain within 3 years after RCR
Total numbers	240	82
DCR at the time of RCR	72	N/A
DCR within 3 years of RCR	<10	<20

Abbreviations: ACJ, acromioclavicular joint; DCR, Distal clavicular resection; N/A, not applicable; RCR, rotator cuff repair.

With respect to the general trends in use of DCR with respect to RCR, our results show that roughly a minority of patients (15% in our cohort) undergoing RCR have also undergone or will undergo DCR. Of those that do undergo DCR, the vast majority of these DCR procedures occur concomitantly with RCR. While our numbers are larger than some other studies, the overall temporality is similar to contemporary literature.[7,14] DCR does not appear to benefit patients with ACJ pain, nor is it beneficial when used in a preventative manner. Of the 46 534 patients who received RCR, only 240 patients had a diagnosis of ACJ pain prior to surgery. Of the 168 patients who did not undergo DCR and RCR, <10 patients required DCR within 3 years postoperatively. Furthermore, only 82 patients or 0.17% of the total cohort went on to develop ACJ pain following RCR, and only 20 of these patients subsequently underwent DCR. Again, these findings corroborate newer literature showing no difference in postoperative reoperation, revision, ACJ injection, and complications.[15] Overall, DCR does not appear to have a preventative or therapeutic role for most patients. Of the 240 patients diagnosed with ACJ pain before RCR, 72 received a DCR at the time of their RCR, and if they did not, less than ten of the remaining patients underwent DCR within 3 years. In patients who did not undergo DCR during or before their RCR, the frequency of developing ACJ pain is very low, with <0.01% (n = 82) of patients receiving a diagnosis of ACJ pain within 3 years following RCR. Of these patients, even fewer eventually underwent DCR within 3 years. While correlating these differences in performed procedure to postoperative outcomes, the only difference observed between the RCR and DCR and the RCR group was the risk of chronic pain and ACJ instability. The patients who underwent DCR were more likely to have either chronic pain or ACJ instability. Specifically, patients undergoing RCR and DCR had a 0.16% greater chance of developing ACJ instability ($P < .0001$) 1 year

Table 7. Postoperative Complications in Patients Receiving DCR During RCR versus DCR After RCR.

Complications	Time (months)	Patients in cohort		Risk difference	95% Confidence Level	Z	*P*	Risk ratio	95% Confidence Level	Odds ratio	95% Confidence Level
		During	After								
General surgical complications	1	32	17	0.28%	(0.009%,0.559%)	2.012	.0443	1.81	(1.007,3.256)	1.815	(1.007, 3.274)
	6	88	60	0.51%	(0.031%,0.985%)	2.08	.0375	1.411	(1.018,1.954)	1.418	(1.019,1.973)
	12	124	130	0.34%	(−0.254%,0.925%)	1.113	.2657	1.158	(0.894,1.499)	1.162	(0.892,1.513)
Injury to the rotator cuff	1	71	77	−0.23%	(−0.857%,0.395%)	−0.723	.4698	0.889	(0.646,1.223)	0.887	(0.64,1.228)
	6	141	149	−0.35%	(−1.22%,0.515%)	−0.797	.4257	0.912	(0.728,1.143)	0.909	(0.719,1.15)
	12	188	190	−0.24%	(−1.22%,0.748%)	−0.47	.6382	0.954	(0.784,1.161)	0.952	(0.774,1.17)
MSK, neuro, circulatory postoperative complications	1	10	10	0.00%	(−0.175%,0.168%)	−0.041	.9672	0.982	(0.409,2.357)	0.982	(0.408,2.361)
	6	18	24	−0.13%	(−0.373%,0.123%)	−0.987	.3234	0.736	(0.4,1.355)	0.735	(0.399,1.357)
	12	39	39	−0.01%	(−0.351%,0.323%)	−0.081	.9351	0.982	(0.631,1.528)	0.982	(0.629,1.533)
Infection	1	10	10	0.00%	(−0.166%,0.163%)	−0.018	.9859	0.992	(0.413,2.382)	0.992	(0.413,2.386)
	6	24	19	0.09%	(−0.15%,0.332%)	0.738	.4605	1.253	(0.687,2.285)	1.254	(0.686,2.293)
	12	31	33	−0.04%	(−0.336%,0.252%)	−0.282	.7776	0.932	(0.572,1.519)	0.932	(0.57,1.523)
Acute pain	1	60	39	0.53%	(0.05%,1.016%)	2.166	.0303	1.552	(1.039,2.316)	1.56	(1.04,2.34)
	6	105	65	1.01%	(0.384%,1.643%)	3.157	.0016	1.629	(1.199,2.213)	1.646	(1.204,2.25)
	12	125	110	0.40%	(−0.339%,1.135%)	1.059	.2896	1.146	(0.89,1.475)	1.151	(0.887,1.492)
ACJ instability	1	10	10	0%	(−0.165%,0.163%)	−0.009	.9926	0.996	(0.415,2.391)	0.996	(0.414,2.395)
	6	10	10	0%	(−0.165%,0.163%)	−0.009	.9926	0.996	(0.415,2.391)	0.996	(0.414,2.395)
	12	10	10	0.00%	(−0.165%,0.163%)	−0.009	.9926	0.996	(0.415,2.391)	0.996	(0.414,2.395)
Chronic pain	1	53	49	0.03%	(−0.496%,0.554%)	0.109	.9136	1.022	(0.695,1.503)	1.022	(0.691,1.511)
	6	176	166	0.01%	(−0.939%,0.951%)	0.013	.9896	1.001	(0.814,1.232)	1.001	(0.806,1.244)
	12	270	268	−0.36%	(−1.527%,0.813%)	−0.598	.5498	0.952	(0.809,1.12)	0.948	(0.795,1.13)

Abbreviations: ACJ, acromioclavicular joint; DCR, Distal clavicular resection; RCR, rotator cuff repair; MSK, general musculoskeletal complications.

Table 8. Postoperative Complications in Patients Receiving RCR Without DCR versus RCR Concomitantly With DCR.

Complications	Time (months)	Patients in cohort		Risk difference	95% Confidence Level	Z	*P*	Risk ratio	95% Confidence Level	Odds ratio	95% Confidence Level
		During	After								
General surgical complications	1	193	201	−0.03%	(−0.149%,0.097%)	−0.419	.6749	0.959	(0.787,1.167)	0.958	(0.786,1.169)
	6	541	551	−0.03%	(−0.238%,0.169%)	−0.331	.7409	0.98	(0.872,1.103)	0.98	(0.869,1.105)
	12	817	817	0.00%	(−0.252%,0.244%)	−0.031	.9751	0.998	(0.907,1.099)	0.998	(0.905,1.102)
Injury to the rotator cuff	1	363	376	0.00%	(−0.22%,0.225%)	0.024	.9809	1.002	(0.868,1.156)	1.002	(0.866,1.159)
	6	818	866	−0.07%	(−0.403%,0.261%)	−0.419	.6749	0.98	(0.892,1.077)	0.979	(0.889,1.079)
	12	1039	1122	−0.18%	(−0.556%,0.193%)	−0.949	.3426	0.961	(0.885,1.043)	0.959	(0.88,1.046)
MSK, neuro, circulatory postoperative complications	1	42	32	0.03%	(−0.022%,0.081%)	1.122	.2617	1.3	(0.821,2.059)	1.301	(0.821,2.06)
	6	150	143	0.02%	(−0.085%,0.12%)	0.329	.7425	1.039	(0.827,1.306)	1.039	(0.826,1.307)
	12	267	267	−0.01%	(−0.146%,0.131%)	−0.11	.9124	0.991	(0.837,1.173)	0.99	(0.835,1.174)
Infection	1	75	61	0.04%	(−0.026%,0.11%)	1.203	.229	1.23	(0.877,1.724)	1.23	(0.877,1.725)
	6	160	147	0.04%	(−0.063%,0.141%)	0.745	.456	1.089	(0.871,1.361)	1.089	(0.87,1.363)
	12	206	194	0.04%	(−0.081%,0.152%)	0.604	.5459	1.062	(0.873,1.291)	1.062	(0.873,1.293)
Acute pain	1	391	331	0.29%	(0.075%,0.498%)	2.66	.0078	1.218	(1.053,1.408)	1.221	(1.054,1.415)
	6	574	577	0.06%	(−0.207%,0.324%)	0.431	.6665	1.025	(0.915,1.149)	1.026	(0.913,1.153)
	12	745	768	0.00%	(−0.304%,0.303%)	−0.002	.9986	1	(0.905,1.104)	1	(0.903,1.108)
ACJ instability	1	10	17	−0.02%	(−0.051%,0.009%)	−1.355	.1755	0.587	(0.269,1.281)	0.586	(0.269,1.281)
	6	10	43	−0.10%	(−0.141%, −0.056%)	−4.545	**<.0001**	0.232	(0.117,0.461)	0.232	(0.116,0.461)
	12	10	63	−0.16%	(−0.207%, −0.108%)	−6.218	**<.0001**	0.158	(0.081,0.308)	0.158	(0.081,0.308)
Chronic pain	1	220	268	−0.25%	(−0.425%, −0.077%)	−2.837	**.0045**	0.774	(0.648,0.924)	0.772	(0.645,0.924)
	6	824	1083	−1.27%	(−1.608%,−0.93%)	−7.361	**<.0001**	0.717	(0.656,0.784)	0.708	(0.646,0.776)
	12	1389	1730	−1.74%	(−2.171%, −1.315%)	−8.006	**<.0001**	0.757	(0.707,0.811)	0.743	(0.691,0.799)

Abbreviations: ACJ, acromioclavicular joint; DCR, Distal clavicular resection; RCR, rotator cuff repair; MSK, general musculoskeletal complications.

postoperatively and a 1.74% greater chance of having later incidences of chronic pain ($P < .0001$) 1 year postoperatively. It could be extrapolated that the statistical risk would be even greater as time progresses. These results not only reinforce that DCR performed alongside RCR does not provide any measurable prophylactic advantage to reduce instances of ACJ instability, but also indicate that DCR may predispose patients toward worse outcomes.

These results may need to be interpreted with caution, as some significant limitations may be inherent in the study due to the format used. Use of TriNetX, while comprehensive, only includes data based on CPT codes and ICD-10 codes. When evaluating chronic pain, there is no ICD-10 code specific for chronic shoulder pain, so this specific result may be taken with caution. We attempted to create the best matches for ACJ pain, RCR, DCR, and complications for postoperative risk analysis, but this could not be completely comprehensive, as we did not have access to direct patient charts to evaluate patient data. For instance, when accounting for laterality, we attempted to include patients only with a diagnosis on the operative arm. However, that does not exclude patients with bilateral ACJ pain, or bilateral RCR, or other instances where patients may have been excluded or included unnecessarily. Additionally, we did not account for differences in outcomes for open versus arthroscopic procedures. This applies to all the statistical groups evaluated, so while there would not be any differences in the results, the implications of this study may not apply universally to DCR when considering open against arthroscopic procedures. We would recommend further research in this area to continue to evaluate the efficacy of open and arthroscopic procedures in this context. A further limitation of this study is due to the TriNetX database itself since it defaults to reporting a minimum value of 10, preventing analysis of single-digit values. As such, we cannot report exact values for some parameters, such as patients with ACJ pain undergoing DCR within 3 years of RCR. While this does not change the interpretation of the results, this does prevent complete accuracy of the reported values. Lastly, large database studies are not capable of evaluating causal relationships in the same manner as prospective studies. Due to this, none of the findings can be taken as causative, but are purely correlative.

Conclusion

This investigation found that patients who receive isolated RCR do not require subsequent DCR. Even in the setting of the above limitations, temporal data seems to indicate that DCR does not have any added benefit when performed to address diagnosed ACJ pain at the time of RCR, or to prevent development of ACJ pain following RCR. In fact, performing DCR at the same time as RCR may even predispose some patients to increased surgical complications and chronic ACJ pain. Such findings should be further studied in clinical trials for confirmation but are an important first step in highlighting an area for potential improvement.

Declaration of Conflicting Interests

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