Prevalence of Rotator Cuff Repairs with and Without Concomitant Subacromial Decompressions Has Not Changed

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Abstract *Background:* Recent research from the American Board of Orthopaedic Surgery database indicates a decreasing rate of subacromial decompression (SAD) performed with rotator cuff repair (RCR) by younger orthopaedic surgeons. *Questions/Purposes:* The purpose of this study was to determine the rate of RCR with and without SAD and whether the rate of RCR with SAD decreased over time. Further, we set out to determine if there was significant variation in the rate of RCR with SAD by state. *Methods:* Rates of RCR with and without open or arthroscopic SAD from 2010 to 2012 were determined based upon de-identified data from a national health insurance carrier. Data were normalized per 10,000 insured patients for comparative analysis. *Results:* Rates of RCR with concomitant SAD were higher than RCR without SAD in each year analyzed. In patients 50 years old and older, this same significant difference was also seen for each year. The rate of RCR with or without SAD did not decrease over the 3-year time period. The rate of RCR performed concomitantly with SAD was significantly higher than RCR performed without SAD in all

patient age groups combined. There was wide variation in the rate of RCR with or without concurrent SAD across states. *Conclusion:* Disproving our hypothesis, the overall rate of RCR with or without SAD did not decrease over the period from 2010 to 2012. There was wide variation in the rate of RCR by state; however, this variation was not seen in the incidence of SAD performed concomitant with the RCR.

Keywords subacromial decompression · rotator cuff repair · variation · rate · geography · age

Introduction

The open acromioplasty, originally described by Neer, has been widely used in the surgical management of subacromial impingement syndrome and rotator cuff repairs (RCR) [8]. As arthroscopic means of intervention for rotator cuff pathology became more available, a shift to arthroscopic subacromial decompression (SAD) and RCR has occurred [10]. Recent studies have suggested that SAD may not be a necessary part of RCR [4, 7]. American Board of Orthopaedic Surgery data shows evidence that the use of SAD in patients undergoing RCR is decreasing [6]. It was our hypothesis that the rate of RCR with SAD would decrease from 2010 to 2012 based on available literature but significant regional variation would be evident on a state-by-state analysis.

Materials and Methods

Institutional Review Board (IRB) submission was completed, and this study was exempted due to its retrospective epidemiological design not involving human subjects. After establishing a research agreement with a large American health insurance company, the authors were provided with a summary limited data set, devoid of all potentially identifying individual health information. The provided summary

Level of Evidence: Therapeutic Study: Level IV

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Table 1 CPT codes and descriptions for associated procedures

CPT code	Description
29827	Arthroscopy, shoulder, surgical; with rotator cuff repair
23410	Repair of ruptured musculotendinous cuff (e.g., rotator cuff) open, acute
23412	Repair of ruptured musculotendinous cuff (e.g., rotator cuff) open, chronic
23420	Reconstruction of complete shoulder (rotator) cuff avulsion, chronic (includes acromioplasty)
29826	Arthroscopic subacromial decompression
23415	Coracoacromial ligament release, with or without acromioplasty
23130	Acromioplasty or acromionectomy, partial, with or without coracoacromial ligament release

data set was aggregated by the number of operations done according to their type, service year, state, and age group. The aggregate database included over 60 million patient years from all 50 states and included data from insured members between the ages 10 and 84. Results were normalized per 10,000 insured patients for comparative analysis.

The database included American Medical Association Current Procedural Terminology (CPT) codes for RCR and SAD based on claims by members from 2010 through 2012. CPT codes utilized to identify RCR and SAD procedures are included in Table 1 [3].

In order to verify that the health insurance company data breakdown by age was consistent with the overall population of each state, 2010 US census data was compared to the raw numbers of insured members' ages per state. The percentage of each state's census population represented by a specific decade of life (i.e., 20 to 29 years of age, 30 to 39 years of age, etc.) was compared to the representation of that same age range as a percentage of the state's membership in the provided data set.

For regional data on the distribution of orthopedic surgeons, we used 2010 data from the American Association of Orthopaedic Surgeons [2]. To investigate possible correlations with orthopedic subspecialties, we used the membership breakdown by state for American Shoulder and Elbow Surgeons (ASES), Arthroscopy Association of North America (AANA), and American Orthopaedic Society of Sports Medicine (AOSSM).

Statistics

An aggregate total of over 60,000,000 patient years were analyzed for all 50 states. An analysis of data based upon patient age was conducted, and χ -square analysis was used to determine significant differences in rates. Spearman correlations were also used to determine the relationships between variables. Statistics were performed with SPSS v.21 (SPSS, Inc., Chicago, IL, USA) with the significance level set at 0.05.

Results

In comparing our data with that of the 2010 census data, 44 of the 50 states had less than a 5% difference between the population breakdown and membership breakdown for each decade of age (Fig. 1). This confirmed that for the vast majority of states, the age distribution in the provided data set used for analysis in this study was similar to the actual population data for each state. Only the data from Hawaii and Vermont was found to have meaningful differences in more than one decade of age when compared to national census data.

Nationally, rates of RCR with concomitant SAD were higher than RCR without SAD in each of the 3 years analyzed ($p < 0.01$). In patients less than 50 years old, this same significant difference was also seen throughout all 3 years

Fig. 1. The sample breakdown of insurance database membership vs. state population by age, representing the age distribution breakdown for a single state.

Table 2 Procedural rate of incidence per 10,000 members with *p* values representing the difference between isolated RCR rate and RCR-with-SAD rate. Note the increase in rate of RCR-with-SAD from 2010 to 2011, with no change from 2011 to 2012 in both the all-ages and under-50 age groups

	Isolated RCR rate	RCR + SAD rate	<i>p</i> value	All RCR rate	Ratio RCR + SAD/all RCR
All ages					
2010	3.42	9.06	< 0.01	12.47	0.73
2011	3.08	9.68	< 0.01	12.76	0.76
2012	3.16	9.71	< 0.01	12.88	0.75
Age < 50					
2010	1.05	2.78	< 0.01	3.83	0.73
2011	0.94	2.91	< 0.01	3.85	0.76
2012	0.96	2.87	< 0.01	3.83	0.75

analyzed ($p < 0.01$) (Table 2). Further, the ratio of patients undergoing RCR with SAD compared to the total number of patients undergoing RCR did not decrease during the 3 years studied.

Not only did the rate of RCR with SAD not decrease over the 3-year time period (Fig. 2), but also the data actually revealed a statistically significant increase in the rate from 2010 to 2011 ($p < 0.01$), and this increase stabilized from 2011 to 2012 ($p = 0.708$). Conversely, the rate of isolated RCRs had a statistically significant ($p < 0.01$) decrease from 2010 to 2011 and stabilized from 2011 to 2012 (Table 2).

There was a wide variation by state in the rate of RCRs. However, this variation was not seen in the incidence of SAD performed concomitant with RCR. The states with rates of RCR that were significantly higher and lower than the overall national average for each year are depicted in Table 3. States with a consistently elevated rate for all 3 years were Idaho, Wyoming, Oklahoma, Alabama, and Utah.

Finally, when our regional RCR-with-SAD rates were compared to data from the professional orthopedic associations, there was no correlation found between the numbers of procedures performed and the number of orthopedic surgeons per state when compared with AANA, AOSSM, or ASES membership data.

Fig. 2. The rate of rotator cuff repair with subacromial decompression per 10,000 members. Note a statistically significant increase in rotator cuff repairs with a subacromial decompression ($p < 0.01$) from 2010 to 2011 that remained stable from 2011 to 2012 ($p = 0.708$).

Discussion

The purpose of this study was to evaluate the relative number of RCRs that included concomitant SAD, specific geographic variations, and changes in rates from 2010 to 2012. This study found that the rate of RCRs including concomitant SAD increased significantly during the time period studied, and wide variation in RCR-with-SAD rates existed across states.

As a retrospective epidemiological study relying on a database, our study has several limitations. First, the analyzed database was based on claims information from a single specific national insurer. Thus, the claims information, and the inferences that could be drawn from that information, might depend on that insurer's market penetration at a state level. However, further evaluation of the data indicated that only a few states had a significantly different age distribution in the data set analyzed, as compared with the state's age distribution as recorded in the 2010 census. This similarity is evidence that the analyzed data set reflects a cohort of people that is likely representative of the overall population. A second limitation could lie in evolving national coding practices, such as CPT code 29826 changing in 2012 from a stand-alone code to an add-on code for codes 29806–29825, 29827, and 29828. This change may have resulted in over- or underreporting of the code, as the change was in effect for only a portion of the data set. Third, the data is based on the patient's mailing address and may not accurately reflect the location the procedure occurred. Fourth, the study is unable to control for issues that might be related to socioeconomic factors including the uninsured and/or patients who may not be able to afford the associated costs of shoulder surgery.

Subacromial impingement syndrome has been historically divided by 2 theories of pathology, the intrinsic and the extrinsic. Within the extrinsic theory, the 3 stages of impingement syndrome [8] and acromial morphology have received the greatest attention. The intrinsic theory stresses degenerative breakdown of the rotator cuff from metabolic sources, indicating a decompression is not necessary. While several studies have concluded that SAD may not be a necessary procedure, these studies have not controlled for coracoacromial morphology, nor have they been well controlled from a nonoperative standpoint of conservative management prior to RCR [5].

Table 3 Data for states with significantly ($p < 0.01$) higher and lowest rates of RCR with SAD per 10,000 members compared to national average

2010		2011		2012	
Significantly higher state	ALL RCR rate	RCR + SAD rate	Significantly higher state	ALL RCR rate	RCR + SAD rate
AK	24.67	13.46	ID	21.57	16.08
ID	17.45	11.50	WY	18.32	12.63
WY	17.06	11.11	OK	16.37	12.07
OK	16.96	11.95	AL	16.04	12.43
AL	15.08	11.70	UT	15.27	11.41
NM	14.96	8.38	NC	14.47	11.26
UT	14.19	10.08	WI	14.12	11.15
CO	13.37	9.85			
OH	13.35	9.94			
Significantly lower state		Significantly lower state		Significantly lower state	
FL	11.50	8.41	FL	11.53	8.96
MO	11.40	8.54	TX	11.38	8.34
GA	11.39	8.06	CT	11.37	8.58
KY	11.08	6.86	IN	11.12	7.90
IN	11.07	7.48	MA	10.95	9.37
SC	10.69	7.91	VA	10.88	8.20
CT	10.69	8.15	GA	10.48	7.75
MA	10.56	8.50	KS	10.41	7.32
KS	10.49	7.17	MS	10.24	7.67
TX	10.25	7.30	MD	10.07	7.66
IA	10.12	7.13	NY	9.52	7.44
MD	10.02	7.29	AZ	9.20	6.92
NY	9.81	7.48	IL	8.90	6.67
VA	9.79	6.83	MN	8.48	6.21
AZ	8.90	7.00	WV	8.35	5.30
MN	8.62	6.03	CA	8.34	6.53
CA	8.57	6.31	MI	8.29	6.06
PA	8.55	5.78	PA	7.96	5.87
IL	8.24	6.10	NJ	7.63	6.00
MI	8.20	5.69			
WV	7.19	4.93			
NJ	6.98	4.78			
Significantly lower state		Significantly lower state		Significantly lower state	
FL	11.64	11.30	FL	11.64	11.30
KY	11.27	7.34	KY	11.27	7.34
WA	10.97	9.13	WA	10.97	9.13
RI	10.92	6.83	RI	10.92	6.83
IA	10.87	8.24	IA	10.87	8.24
TX	10.86	8.29	TX	10.86	8.29
CT	10.78	8.93	CT	10.78	8.93
NV	10.77	7.85	NV	10.77	7.85
VA	10.75	7.60	VA	10.75	7.60
IN	10.44	6.60	IN	10.44	6.60
OR	10.25	8.13	OR	10.25	8.13
AZ	10.21	7.83	AZ	10.21	7.83
GA	10.09	7.49	GA	10.09	7.49
MD	9.53	7.09	MD	9.53	7.09
NY	9.49	7.03	NY	9.49	7.03
PA	9.40	7.15	PA	9.40	7.15
MI	9.30	7.28	MI	9.30	7.28
IL	9.22	7.37	IL	9.22	7.37
MA	8.66	5.40	MA	8.66	5.40
WV	8.37	5.22	WV	8.37	5.22
MN	8.09	6.44	MN	8.09	6.44
NJ	7.63	6.08	NJ	7.63	6.08

Shin et al. evaluated the efficacy of acromioplasty performed concomitantly with small to medium rotator cuff tears in subjects without acromial enthesophyte [9]. The study found that subjects fared similarly in functional outcome tests (ASES score, 90.7 ± 13.1 vs. 87.5 ± 12.0 ; Constant score, 85.0 ± 11.3 vs. 83.3 ± 13.0 ; and UCLA Shoulder score, 33.4 ± 3.3 vs. 32.3 ± 3.5). The coracoacromial ligament was treated in both groups, completely released in the group undergoing acromioplasty and debrided without release in the group without acromioplasty. This study included postoperative imaging, which found a retear rate of 17% in those not undergoing concomitant acromioplasty and 20% in the group undergoing the concomitant acromioplasty ($p = .475$) [9]. Abrams et al. performed a similar study evaluating arthroscopic repair of full-thickness rotator cuff tears with and without acromioplasty [1]. The findings were similar, with each group demonstrating significant improvement ($p < 0.001$) in functional outcomes at postoperative follow-up. There was no significant difference reported between the groups at short-term 2-year follow-up. Additionally, the study evaluated acromial morphology and found no significant difference in outcomes in type I vs. type III acromion [1].

A recent analysis of the American Board of Orthopaedic Surgery database by Mauro et al. found the rate of arthroscopic SAD performed concomitantly with RCR changed between the period of 2004 to 2006 (65.3%) and 2007 to 2009 (53.2%) ($p < 0.001$) [6]. The study also found the candidates from the Northeast, Southwest, and “other” regions were more likely to perform an isolated SAD, while candidates from the Northwest were more likely to perform the procedure in conjunction with an arthroscopic RCR [6]. While these findings contradict those of the current study, it may be explained by the fact that our data included surgeons from all experience levels, while Mauro’s study included only surgeons who were currently in boards collections and therefore from a younger generation of orthopedic surgeons.

Our data did not show a decrease in the rate of SAD being performed with RCR during the period analyzed in this study. Rather, the percentage of patients undergoing RCR who also underwent a concurrent SAD was relatively constant over the 3 years of this study. This would indicate that a significant number of orthopedic surgeons still consider SAD a necessary portion of RCR in the vast majority of patients. Overall, about three-quarters of RCRs are performed in conjunction with a SAD.

The wide variance of all RCRs performed by state is interesting in that there is an approximate threefold difference between the state with the lowest rate of RCR and the state with the highest rate of RCR.

In conclusion, we have documented using a large national database that the rate of RCR performed concomitantly with SAD is significantly higher than RCR performed without SAD in all patient age groups. Disproving our

hypothesis, the overall rate of RCR with SAD did not decrease from 2010 to 2012. There is, however, a threefold difference of RCR rates when data is analyzed on a state-by-state basis.

Compliance with Ethical Standards

Conflict of Interest: Ned Tervola, MA, ATC; L. Pearce McCarty III, MD; and M. Russell Giveans, PhD, declare that they have no conflicts of interest. Daniel D. Buss, MD, reports that he serves as a member of the UnitedHealthCare Scientific Advisory Board. Steve H. Stern, MD, reports that he is an employee of UnitedHealth Group.

Human/Animal Rights: N/A

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Required Author Forms Disclosure forms provided by the authors are available with the online version of this article.

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