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Inferior outcomes and higher complication rates after shoulder arthroplasty in workers' compensation patients

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Background: Outcomes of shoulder surgery in workers' compensation (WC) patients have generally been inferior to those in non-WC patients. The purpose of this study was to compare the complication rates and clinical outcomes after shoulder arthroplasty in WC patients and control non-WC patients.

Methods: An institutional shoulder arthroplasty database was queried for patients with minimum 2-year follow-up who underwent total shoulder arthroplasty, reverse total shoulder arthroplasty, or hemiarthroplasty. WC patients were age and sex matched with non-WC patients and retrospectively evaluated for complication rates, patient-reported outcome (PRO) scores, and range of motion.

Results: We matched 45 WC and 45 non-WC patients by age and sex, with the WC group having a higher rate of prior surgery (82% vs 38%, $P < .001$). Both groups experienced significant improvements in all PROs, forward elevation, and external rotation ($P < .05$ for all). The WC group had inferior 2-year outcomes for all PROs and forward elevation ($P \leq .001$ for all), as well as a higher reoperation rate (16% vs 2%, $P = .030$) and higher rate of persistent pain at final follow-up (33% vs 11%, $P = .021$). On multivariate regression controlling for other variables including number of prior surgical procedures, WC status remained associated with lower improvements in American Shoulder and Elbow Surgeons ($P < .001$), functional ($P < .001$), and Simple Shoulder Test ($P < .001$) scores, as well as a higher reoperation rate ($P = .015$) and higher rate of persistent pain ($P = .027$).

Conclusion: Although both WC and non-WC patients experienced significant clinical improvements after shoulder arthroplasty, WC patients had a higher reoperation rate, inferior PROs, and a higher rate of persistent pain.

Level of evidence: Level III; Retrospective Cohort Comparison; Treatment Study

This study was approved by the Rush University Medical Center Institutional Review Board (Office of Research Affairs No. 16010802-IRB01).

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Outcomes of shoulder surgery in workers' compensation (WC) patients have generally been inferior to those in patients who do not have a work-related injury, although both groups generally experience pain relief and functional improvement from the surgical procedure.[4,7,10,15,16,19] Potential etiologies of inferior outcomes for WC patients include a high level of occupational physical demand; potential secondary gain; and various demographic differences including educational level, comorbidities, prior treatments, and patient expectations.[6] Surgeons treating WC patients can expect their patients to improve after surgery although often with a slower recovery time course and to a lesser extent than non-WC patients.

Shoulder arthroplasty is an increasingly common procedure that provides patients with improved shoulder function and pain relief. It has also been shown to be cost-effective.[1,2,5,9,11,12,14,17] Limited literature is available regarding the outcomes of WC patients undergoing shoulder arthroplasty. Jawa et al[10] found that WC total shoulder arthroplasty (TSA) patients had lower outcome scores in a younger, predominantly male population compared with controls, with only 4 of 13 (31%) returning to work. Morris et al[15] found that WC patients improved after reverse shoulder arthroplasty; however, the outcomes were lower than those in controls, with a 57% satisfaction rate and 14.2% return-to-work rate. Therefore, the literature to date have suggested that WC patients undergoing shoulder arthroplasty have lower outcome scores and satisfaction than other patients, with a low rate of return to work.

The purpose of this study was to compare the complication rates and clinical outcomes after shoulder arthroplasty in WC patients and age- and sex-matched non-WC patients. We hypothesized that WC patients would have inferior outcomes and higher complication rates than matched non-WC controls.

Materials and methods

Patient selection

Our single-institution shoulder arthroplasty database was retrospectively queried for WC patients who underwent TSA, reverse total shoulder arthroplasty (RTSA), or shoulder hemiarthroplasty (HA) between January 2008 and March 2015. The database consists of patient-reported outcome (PRO) data beginning at the preoperative appointment and continuing to the postoperative time frame. Among a total number of 1439 surgical procedures performed during the study period, there were 63 WC patients (4.4%). A case-control study design was used. Of the 63 WC patients identified, 45 (71.4%) were available for minimum 2-year follow-up. From the database, we identified a control group of 45 age- and sex-matched non-WC patients. Matching was performed in a 1-to-1 fashion. Surgery was performed by 2 senior surgeons (A.A.R. and G.P.N.). The surgical technique and rehabilitation were determined by senior surgeon preference and varied by type of procedure.

Patient evaluation and outcomes

Patients underwent a standard preoperative evaluation including radiographs, range of motion (ROM) measured by a goniometer, and preoperative PRO scores. Demographic information was recorded including age, sex, body mass index (BMI), and prior surgery. The scores used were as follows: functional, visual analog scale (VAS) pain, Simple Shoulder Test (SST), and American Shoulder and Elbow Surgeons (ASES) scores. Postoperatively, patients underwent evaluation at minimum 2-year follow-up for complications, reoperations, postoperative ROM measured by a goniometer, and PRO scores (functional, VAS, SST, and ASES scores). Persistent pain was defined as patient-reported shoulder pain at final follow-up.

Statistical analysis

The data were assessed for normality and found to be normally distributed via Kolmogorov-Smirnov testing, and therefore parametric statistics were used. Paired and unpaired *t* tests were used as appropriate for continuous data. Analysis of variance was used to compare continuous data across the 2 groups. We used χ^2 and Fisher exact tests for categorical data based on expected values above 5 and below 5, respectively. Associations between preoperative variables and PROs were performed using multivariate, stepwise linear regression with bidirectional elimination. Variables included in the initial model were age, BMI, procedure, insurance, laterality, sex, race, prior surgery, previous glenohumeral injections, smoking status, and number of comorbidities. SPSS software (version 22.0; IBM, Armonk, NY, USA) was used for statistical analysis. $P < .05$ was set as the threshold for statistical significance.

Results

The WC and non-WC groups each contained 45 patients and were well matched with respect to age and sex (Table I). The overall average follow-up period was 40.9 ± 15.8 months (range, 24.0-91.0 months), which did not significantly differ between the WC and non-WC groups ($P = .858$). In addition, no differences between the WC and non-WC groups were found with respect to BMI ($P = .090$) and type of surgery ($P = .219$). No difference was noted in the age of patients undergoing HA (55.4 ± 4.3 years), TSA (53.2 ± 6.1 years), or RTSA (56.9 ± 4.5 years) ($P = .871$). The WC group had significantly more patients with prior surgery (82% vs 38%, $P < .001$) and with multiple prior surgical procedures (40.0% vs 8.9%, $P < .001$). The average number of surgical procedures before arthroplasty was 2.0 ± 1.4 in WC patients and

Table I Demographic characteristics in WC and non-WC groups

	WC (n = 45)	Non-WC (n = 45)	Overall (N = 90)	*P* value
Age, mean ± SD, yr	55.2 ± 5.4	55.4 ± 5.6	55.3 ± 5.5	.864
Male sex, n (%)	31 (69)	31 (69)	62 (69)	>.99
BMI, mean ± SD	33.1 ± 8.8	30.3 ± 6.3	31.7 ± 7.7	.090
Follow-up, mean ± SD, mo	41.2 ± 18.5	40.6 ± 12.6	40.9 ± 15.8	.858
Prior surgery, n (%)	37 (82)	17 (38)	54 (60)	<.001
Prior surgery, mean ± SD (range)	2.0 ± 1.4 (0-4)	0.8 ± 1.2 (0-4)	1.4 ± 1.4 (0-4)	<.001
Prior surgery type, n (%)				.133
RCR	35 (78)	2 (4)	37 (41)	
DCE	4 (9)	0 (0)	4 (4)	
Glenohumeral débridement	14 (31)	6 (13)	20 (22)	
Labral repair	7 (16)	5 (11)	12 (13)	
BT	8 (18)	1 (2)	9 (10)	
SAD	14 (31)	6 (13)	20 (22)	
ORIF	2 (4)	1 (2)	3 (3)	
Other*	3 (7)	6 (13)	9 (10)	
Surgery type, n (%)				.219
TSA	19 (42)	25 (56)	44 (49)	
RTSA	21 (47)	13 (29)	34 (38)	
HA	5 (11)	7 (15)	12 (13)	
Diagnosis, n (%)				.979
Osteoarthritis	21 (47)	29 (73)	50 (56)	
RCT or RCA	21 (47)	13 (29)	44 (38)	
AVN	3 (7)	0 (0)	3 (3)	
RA	0 (0)	2 (4)	2 (2)	
Instability	0 (0)	1 (2)	1 (1)	
PHFx	0 (0)	1 (2)	1 (1)	
Implant, n (%)				>.99
Univers II (Arthrex, Naples, FL, USA)	10 (22)	21 (47)	31 (34)	
Univers Reverse (Arthrex)	13 (29)	9 (20)	22 (24)	
Univers Stem (Arthrex)	3 (7)	6 (13)	9 (10)	
Simpliciti (Wright Medical Group, Memphis, TN, USA)	9 (20)	4 (9)	13 (14)	
Aequalis Ascend (Wright Medical Group)	8 (18)	4 (9)	12 (13)	
Aequalis Fx (Wright Medical Group)	2 (4)	1 (2)	3 (3)	

WC, workers' compensation; *BMI*, body mass index; *SD*, standard deviation; *TSA*, total shoulder arthroplasty; *RTSA*, reverse total shoulder arthroplasty; *HA*, hemiarthroplasty; *RCT*, rotator cuff tear; *RCA*, rotator cuff arthropathy; *AVN*, avascular necrosis; *RA*, rheumatoid arthritis; *PHFx*, proximal humeral fracture; *RCR*, rotator cuff repair; *DCE*, distal clavicle excision; *BT*, biceps tenodesis; *SAD*, subacromial decompression; *ORIF*, open reduction internal fixation.

* Suprascapular nerve decompression, Putti-Platt procedure, or latissimus transfer for rotator cuff in WC group; iliac crest bone block for shoulder instability, closed reduction, suprascapular nerve decompression, RTSA, irrigation and débridement, hemiarthroplasty, or trabecular metal RTSA in non-WC group.

0.8 ± 1.2 in non-WC patients ($P < .001$). No significant difference in the distribution of prior surgery types was found between patients insured by WC and those not ($P = .133$). Moreover, no significant difference between groups was noted with respect to surgery performed, diagnosis, and implant used ($P = .219$, $P = .979$, and $P > .99$, respectively) (Table I).

Reoperations occurred more commonly in WC patients than non-WC patients (7 WC patients [16%] vs 1 non-WC patient [2%], $P = .030$) (Table II). Most reoperations involved treatment of infection, conversion to RTSA, or arthroscopic capsular release and subacromial decompression for postoperative pain and stiffness (Table III). Subscapularis insufficiency was identified in 2 WC patients and 1 non-WC patient (4% vs 2%, $P = .999$). Infections occurred in 2 WC patients and 0 non-WC patients (4% vs 0%, $P = .494$). WC patients had a higher rate of reporting persistent pain at final follow-up than non-WC patients (15 WC patients [33%] vs 5 non-WC patients [11%], $P = .021$) (Table II).

At minimum 2-year follow-up after shoulder arthroplasty, significant improvements from preoperatively to postoperatively were found in all functional scores, VAS scores, SST scores, ASES scores, forward elevation, and external rotation for both the WC and non-WC groups ($P < .001$ for all) (Table IV). Preoperatively, no differences in PRO scores and ROM were noted between WC and non-WC patients ($P > .05$ in all cases). Postoperatively, WC patients had lower values for all PRO scores as well as lower forward elevation ($P < .05$ in all cases). No significant difference in postoperative external rotation was found between the 2 groups ($P = .526$).

Table II Postoperative complications, reoperations, and persistent pain

	WC	Non-WC	Overall	*P* value
Reoperation, n (%)	7 (16)	1 (2)	7 (8)	.030
Infection, n (%)	2 (4)	0 (0)	2 (2)	.494
Subscapularis insufficiency, n (%)	2 (4)	1 (2)	3 (3)	.999
Persistent pain at final follow-up, n (%)	15 (33)	5 (11)	20 (22)	.021

WC, workers' compensation.

Table III Details of reoperations

Patient group	Primary surgery	Reoperation and indication	Postoperative timing of reoperation
WC	TSA	(1) TSA explantation and antibiotic spacer implantation for infection and (2) second-stage RTSA	(1) 5.5 yr and (2) 6 yr
WC	HA	RTSA for pain and rotator cuff deficiency	3 yr
WC	TSA	Irrigation and débridement for infection	4 weeks
WC	RTSA	Closed reduction for dislocation	2 weeks
WC	HA	RTSA for anterosuperior escape	1.75 yr
WC	TSA	RTSA for glenoid loosening and rotator cuff failure	2.33 yr
WC	HA	Arthroscopy, débridement, SAD, acromioplasty, and capsular release for postoperative pain and stiffness	1 yr
Non-WC	HA	Arthroscopy, débridement, SAD, acromioplasty, and capsular release for postoperative pain and stiffness	1.08 yr

WC, workers' compensation; *TSA*, total shoulder arthroplasty; *RTSA*, reverse total shoulder arthroplasty; *HA*, hemiarthroplasty; *SAD*, subacromial decompression.

After we accounted for other variables via multivariate regression, undergoing HA with glenoid reaming ($P = .041$) and being a nonsmoker ($P = .027$) were associated with greater improvement in the ASES score, whereas right-sided surgery ($P < .001$) and WC status ($P < .001$) were associated with less improvement in the ASES score. WC status was independently associated with less improvement in functional ($P < .001$) and SST ($P < .001$) scores. Undergoing RTSA and undergoing TSA were associated with achieving greater improvements in the VAS score ($P = .004$ and $P = .005$, respectively), whereas right-sided surgery was associated with less improvement ($P < .001$) (Table V). Undergoing RTSA (odds ratio [OR], 0.044; 95% confidence interval [CI], 0.003-0.622; $P = .021$) and undergoing TSA (OR, 0.025; 95% CI, 0.002-0.372; $P = .007$) were associated with a reduced likelihood of reoperation. However, WC status (OR, 108.392; 95% CI, 2.473-4751.392; $P = .015$) and having greater comorbidities (OR, 1.675; 95% CI, 1.135-2.473; $P = .009$) were associated with an increased likelihood of reoperation. WC status was also associated with an increased likelihood of persistent pain at final follow-up (OR, 5.345; 95% CI, 1.208-23.657; $P = .027$), as was receiving surgery on the right shoulder (OR, 5.006; 95% CI, 1.057-23.713; $P = .042$) (Table VI).

Among the WC patients, 41 of 45 (91%) were able to return to work at an average of 202.7 ± 161.5 days (range, 8-811 days). Most patients had permanent work restrictions, with restrictions for 38 of the 41 patients (92.7%) who returned to work. The 3 patients without permanent restrictions comprised 2 TSA patients and 1 HA patient, with all RTSA patients having permanent restrictions. The specified weight for permanent restrictions was 7.1 ± 4.9 kg (range, 2.3-22.7 kg). The timing of return to work did not differ among surgery types (HA, 198.8 ± 228.0 days; TSA, 237.4 ± 182.4 days; and RTSA, 172.7 ± 121.4 days; $P = .498$). No significant correlation was found between patient age and timing of return to work ($R = –0.051$, $P = .753$).

Discussion

This study showed that patients undergoing shoulder arthroplasty are expected to have improvement in function and ROM regardless of whether they are WC or non-WC patients. Despite no difference in PRO scores and ROM preoperatively, WC patients at minimum 2-year follow-up after shoulder arthroplasty had significantly lower postoperative scores for all PROs. WC patients also had higher reoperation rates and higher rates of persistent shoulder pain at final follow-up than non-WC patients. These results remained significant on multivariate regression to control for differences in the number of prior surgical procedures between the WC and non-WC groups.

WC status is known to impact outcomes of shoulder surgery, including a longer time frame for recovery and inferior outcomes.[4,6,7,16] Limited literature to date have suggested that WC patients undergoing shoulder arthroplasty have inferior outcomes compared with control patients.[10,15] Prior

Table IV Patient-reported outcomes and range of motion in WC and non-WC patients

	WC		Non-WC		*P* value for WC vs non-WC
	Mean	SD	Mean	SD	
Functional score					
Pre	8.08	6.02	9.93	5.41	.129
Post	13.68	7.52	24.42	6.8	<.001
P value for improvement	<.001		<.001		
VAS score					
Pre	5.28	2.49	5.86	2.58	.281
Post	3.27	2.76	1.23	1.92	<.001
P value for improvement	.001		<.001		
SST score					
Pre	3.17	2.57	4.24	2.69	.057
Post	5.75	3.67	9.66	2.65	<.001
P value for improvement	<.001		<.001		
ASES score					
Pre	36.7	16.84	41.54	19.08	.209
Post	57.05	23.36	83.5	18.59	<.001
P value for improvement	<.001		<.001		
Forward elevation					
Pre, °	98.1	43.7	97.7	32.4	.961
Post, °	126.4	34.9	144.1	33.4	.015
P value for improvement	<.001		<.001		
External rotation					
Pre, °	34.6	22.4	28.2	22.3	.255
Post, °	51.9	15.4	54.4	21.4	.526
P value for improvement	<.001		<.001		

WC, workers' compensation; *SD*, standard deviation; *Pre*, preoperative; *Post*, postoperative.

studies evaluating shoulder arthroplasty in WC patients may have been more limited because of multiple factors. First, work-related injuries that require a shoulder arthroplasty might be less common in this younger working population. In addition, surgeons may be reluctant to perform arthroplasty in this patient population because of concerns of long-term implant survival. Finally, there may be difficulty establishing causality between a work incident and a shoulder diagnosis for which the treatment is shoulder arthroplasty.

Jawa et al[10] analyzed 13 WC TSA patients compared with 63 controls, finding lower outcome scores in the WC population than in controls. Only 4 of 13 WC patients (31%) were able to return to work. Morris et al[15] found that 14 WC patients improved after reverse shoulder arthroplasty but with inferior outcomes compared with matched controls, with a 57% satisfaction rate and 14.2% return-to-work rate. Chen et al[3] reported a lower satisfaction rate after shoulder arthroplasty in 5 WC patients compared with 65 non-WC patients, although other outcomes were not analyzed. Villacis et al[19] analyzed a statewide California database at 1-year follow-up, finding that WC patients had a complication rate 3 and 5.6 times the complication rates for TSA and RTSA, respectively, with infection being the most common complication, occurring in 2.9% and 4.7% of TSA and RTSA patients, respectively. Hsu et al[8] reported lower SST scores in a pooled group of patients with Medicaid or WC compared with other patients.

Our study is, to date, the largest reported series of clinical outcomes of WC patients undergoing shoulder arthroplasty, analyzing 45 patients and 45 age- and sex-matched controls. Similarly to prior studies, we found that WC patients had significant improvements in PROs but that these improvements were inferior to those of matched controls. Unlike prior studies, our study also showed an increased rate of reoperation in WC patients compared with controls, as well as a higher rate of persistent pain at final follow-up. Moreover, it is important to note that WC patients had a significantly higher number of prior surgical procedures, with 40% of patients having undergone multiple prior surgical procedures, which can significantly increase the risk of complications, in particular infection.[21] Furthermore, PROs are superior in patients without prior surgery.[13] To control for the effect of prior surgical procedures, we conducted a multivariate regression that showed that WC status was associated with failing to achieve improvement in ASES, functional, and SST scores, as well as having higher rates of reoperation and persistent pain at 2 years' follow-up.

Limitations of this study include the heterogeneous set of procedures including RTSA, TSA, and HA performed by 2 surgeons, although the rates of these procedures and each

Table V Stepwise multivariate linear regression for association of preoperative patient variables and patient-reported outcome measures after exclusion of nonpredictive variables

Variable	*P* value
American Shoulder and Elbow Surgeons score	
Hemiarthroplasty with glenoid reaming	.041*
Reverse total shoulder arthroplasty	.067
Total shoulder arthroplasty	.112
Workers' compensation	<.001*
Right-sided surgery	<.001*
Male sex	.155
Nonsmoker	.027*
Prior surgery	.375
Functional score	
Age	.116
Workers' compensation	<.001*
Nonsmoker	.043*
Comorbidities	.135
Prior surgery	.378
Visual analog scale score	
Hemiarthroplasty with glenoid reaming	.087
Reverse total shoulder arthroplasty	.007*
Total shoulder arthroplasty	.007*
Workers' compensation	.151
Right-sided surgery	<.001*
Prior surgery	.673
Simple Shoulder Test score	
Workers' compensation	<.001*
Right-sided surgery	.072
Comorbidities	.033*
Prior surgery	.656

* Statistically significant.

Table VI Stepwise multivariate logistic regression for predictive association of preoperative patient variables with risk of reoperation and persistent pain

Variable	*P* value	OR	95% CI
Reoperation			
Reverse total shoulder arthroplasty	.021*	0.044	0.003-0.622
Total shoulder arthroplasty	.007*	0.025	0.002-0.372
Workers' compensation	.015*	108.392	2.473-4751.392
No. of comorbidities	.009*	1.675	1.135-2.473
Prior surgery	.262	4.419	0.329-59.373
Persistent pain			
Age	.191	0.929	0.831-1.038
Workers' compensation	.027*	5.345	1.208-23.657
Right-sided surgery	.042*	5.006	1.057-23.713
White ethnicity	.748	0.597	0.026-13.915
Prior injection	.851	0.765	0.047-12.544
Prior surgery	.249	2.701	0.498-14.644

OR, odds ratio; *CI*, confidence interval.
* Statistically significant.

diagnosis did not differ significantly between the WC and non-WC groups. Furthermore, despite matching by patient age and sex in our retrospective case-control design, other differences between the WC and non-WC patient groups are potential sources of confounding. For instance, the WC patients had a higher rate of prior surgery, which is known to be associated with inferior outcomes after shoulder arthroplasty.[13] We performed multivariate regression to account for this difference, as well as the procedure performed. Other patient factors that may differ between WC and non-WC patients including depression, anxiety, and resilience are also potential confounding variables for the observed inferior outcomes in the WC population.[18,20] In addition, this study did not analyze radiographic outcomes or long-term outcomes including the potential for earlier implant loosening in patients returning to higher-demand physical occupations after shoulder arthroplasty.

Conclusion

Although both WC and non-WC patients experienced significant clinical improvements after shoulder arthroplasty, WC patients had a higher complication rate, higher reoperation rate, and inferior PROs.

Disclaimer

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References

1. Adams JE, Sperling JW, Hoskin TL, Melton LJ 3rd, Cofield RH. Shoulder arthroplasty in Olmsted County, Minnesota, 1976-2000: a population-based study. J Shoulder Elbow Surg 2006;15:50-5. http://dx.doi.org/10.1016/j.jse.2005.04.009
2. Carter MJ, Mikuls TR, Nayak S, Fehringer EV, Michaud K. Impact of total shoulder arthroplasty on generic and shoulder-specific health-related quality-of-life measures: a systematic literature review and meta-analysis. J Bone Joint Surg Am 2012;94:e127. http://dx.doi.org/10.2106/JBJS.K.00204
3. Chen AL, Bain EB, Horan MP, Hawkins RJ. Determinants of patient satisfaction with outcome after shoulder arthroplasty. J Shoulder Elbow Surg 2007;16:25-30. http://dx.doi.org/10.1016/j.jse.2006.04.013
4. Denard PJ, Lädermann A, Burkhart SS. Long-term outcome after arthroscopic repair of type II SLAP lesions: results according to age and workers' compensation status. Arthroscopy 2012;28:451-7. http://dx.doi.org/10.1016/j.arthro.2011.09.005
5. Deshmukh AV, Koris M, Zurakowski D, Thornhill TS. Total shoulder arthroplasty: long-term survivorship, functional outcome, and quality of life. J Shoulder Elbow Surg 2005;14:471-9. http://dx.doi.org/10.1016/j.jse.2005.02.009
6. Gruson KI, Huang K, Wanich T, Depalma AA. Workers' compensation and outcomes of upper extremity surgery. J Am Acad Orthop Surg 2013;21:67-77. http://dx.doi.org/10.5435/JAAOS-21-02-67
7. Henn RF, Tashjian RZ, Kang L, Green A. Patients with workers' compensation claims have worse outcomes after rotator cuff repair. J Bone Joint Surg Am 2008;90:2105-13. http://dx.doi.org/10.2106/JBJS.F.00260
8. Hsu JE, Russ SM, Somerson JS, Tang A, Warme WJ, Matsen FA 3rd. Is the Simple Shoulder Test a valid outcome instrument for shoulder arthroplasty? J Shoulder Elbow Surg 2017;26:1693-700. http://dx.doi.org/10.1016/j.jse.2017.03.029
9. Jain NB, Higgins LD, Guller U, Pietrobon R, Katz JN. Trends in the epidemiology of total shoulder arthroplasty in the United States from 1990-2000. Arthritis Rheum 2006;55:591-7. http://dx.doi.org/10.1002/art.22102
10. Jawa A, Dasti UR, Fasulo SM, Vaickus MH, Curtis AS, Miller SL. Anatomic total shoulder arthroplasty for patients receiving workers' compensation. J Shoulder Elbow Surg 2015;24:1694-7. http://dx.doi.org/10.1016/j.jse.2015.04.017
11. Kim SH, Wise BL, Zhang Y, Szabo RM. Increasing incidence of shoulder arthroplasty in the United States. J Bone Joint Surg Am 2011;93:2249-54. http://dx.doi.org/10.2106/JBJS.J.01994
12. Mather RC 3rd, Watters TS, Orlando LA, Bolognesi MP, Moorman CT 3rd. Cost effectiveness analysis of hemiarthroplasty and total shoulder arthroplasty. J Shoulder Elbow Surg 2010;19:325-34. http://dx.doi.org/10.1016/j.jse.2009.11.057
13. Matsen FA 3rd, Russ SM, Vu PT, Hsu JE, Lucas RM, Comstock BA. What factors are predictive of patient-reported outcomes? A prospective study of 337 shoulder arthroplasties. Clin Orthop Relat Res 2016;474:2496-510. http://dx.doi.org/10.1007/s11999-016-4990-1
14. Montoya F, Magosch P, Scheiderer B, Lichtenberg S, Melean P, Habermeyer P. Midterm results of a total shoulder prosthesis fixed with a cementless glenoid component. J Shoulder Elbow Surg 2013;22:628-35. http://dx.doi.org/10.1016/j.jse.2012.07.005
15. Morris BJ, Haigler RE, Laughlin MS, Elkousy HA, Gartsman GM, Edwards TB. Workers' compensation claims and outcomes after reverse shoulder arthroplasty. J Shoulder Elbow Surg 2015;24:453-9. http://dx.doi.org/10.1016/j.jse.2014.07.009
16. Nicholson GP. Arthroscopic acromioplasty: a comparison between workers' compensation and non-workers' compensation populations. J Bone Joint Surg Am 2003;85:682-9.
17. Raiss P, Bruckner T, Rickert M, Walch G. Longitudinal observational study of total shoulder replacements with cement: fifteen to twenty-year follow-up. J Bone Joint Surg Am 2014;96:198-205. http://dx.doi.org/10.2106/JBJS.M.00079
18. Tokish JM, Kissenberth MJ, Tolan SJ, Salim TI, Tadlock J, Kellam T, et al. Resilience correlates with outcomes after total shoulder arthroplasty. J Shoulder Elbow Surg 2017;26:752-6. http://dx.doi.org/10.1016/j.jse.2016.12.070
19. Villacis D, Sivasundaram L, Pannell WC, Heckmann N, Omid R, Hatch GFR 3rd. Complication rate and implant survival for reverse shoulder arthroplasty versus total shoulder arthroplasty: results during the initial 2 years. J Shoulder Elbow Surg 2016;25:927-35. http://dx.doi.org/10.1016/j.jse.2015.10.012
20. Werner BC, Wong AC, Chang B, Craig EV, Dines DM, Warren RF, et al. Depression and patient-reported outcomes following total shoulder arthroplasty. J Bone Joint Surg Am 2017;99:688-95. http://dx.doi.org/10.2106/JBJS.16.00541
21. Werthel JD, Hatta T, Schoch B, Cofield R, Sperling JW, Elhassan BT. Is previous nonarthroplasty surgery a risk factor for periprosthetic infection in primary shoulder arthroplasty? J Shoulder Elbow Surg 2017;26:635-40. http://dx.doi.org/10.1016/j.jse.2016.10.020