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Functional somatic syndromes are associated with suboptimal outcomes and high cost after shoulder arthroplasty

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Background: The presence of functional somatic syndromes (chronic physical symptoms with no identifiable organic cause) in patients undergoing elective joint arthroplasty may affect the recovery experience. We explored the prevalence of functional somatic syndromes among shoulder arthroplasty patients, as well as their association with postoperative outcomes and costs.
Methods: We identified 480 patients undergoing elective total shoulder arthroplasty (anatomic or reverse) between 2015 and 2018 in our institutional registry with minimum 2-year follow-up. Medical records were queried for the presence of 4 well-recognized functional somatic syndromes: fibromyalgia, irritable bowel syndrome, chronic headaches, and chronic low-back pain. Multivariable linear regression modeling was used to determine the independent association of these diagnoses with hospitalization time-driven activity-based costs and 2-year postoperative American Shoulder and Elbow Surgeons (ASES), Single Assessment Numeric Evaluation (SANE), and pain scores.
Results: Nearly 1 in 5 patients (17%) reported at least 1 functional somatic syndrome. These patients were more likely to be women, to be chronic opioid users, to report more allergies, to have a diagnosis of anxiety, and to have shoulder pathology other than degenerative joint disease (all $P \leq .001$). After multivariable adjustment, the presence of at least 1 functional somatic syndrome was independently predictive of lower 2-year ASES (−9.75 points) and SANE (−7.63 points) scores and greater residual pain (+1.13 points) (all $P \leq .001$). When considered cumulatively, each additional functional disorder was linked to a stepwise decrease in ASES and SANE scores and an increase in residual pain ($P < .001$). These patients also incurred higher hospitalization costs, with a stepwise rise in costs with an increasing number of disorders ($P < .001$).
Conclusions: Functional somatic syndromes are common in patients undergoing shoulder arthroplasty and correlate with suboptimal outcomes and greater resource utilization. Efforts to address the biopsychosocial determinants of health that affect the value proposition of shoulder arthroplasty should be prioritized in the redesign of care pathways and bundling initiatives.
Level of evidence: Level III; Retrospective Cohort Comparison; Prognosis Study

Keywords: Shoulder arthroplasty; value; functional somatic syndromes; outcomes; cost; pain

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The term "functional somatic syndromes" (FSSs), described by Barsky and Borus[3] in 1999, refers to "several related syndromes that are characterized more by symptoms, suffering, and disability than by disease-specific, demonstrable abnormalities of structure or function." Examples of such conditions include fibromyalgia, irritable bowel syndrome, chronic headaches, chronic fatigue syndrome, atypical chest pain, chronic temporomandibular joint dysfunction, chronic low-back pain, and chronic whiplash.[3,10,17,26,29,32,36] Although the etiology of these conditions is debated and likely multifactorial,[3,5] many patients with FSSs have significant disability and disproportionately utilize health care resources.[4,23,35,36] For example, patients with chronic fatigue syndrome report worse disability than those with conditions such as congestive heart failure.[20]

The relationship between FSSs and outcomes after discretionary orthopedic surgery, such as shoulder arthroplasty, is currently unclear. It is interesting to note that emerging evidence in the lower-limb arthroplasty literature has demonstrated an association between fibromyalgia and suboptimal surgical results.[7-9,34] However, these studies are limited in that they have evaluated a single FSS without considering functional syndromes collectively. Given the similarities between these syndromes (eg, comorbid psychiatric disorders, similar effective treatments, co-occurrence with other FSSs, and overlap in definitions of specific syndromes), studying individual FSSs may incidentally limit our understanding of their relationship to surgical recovery and outcomes.[3,36] In fact, given their interrelatedness, previous authors have argued that FSSs should be thought of as one condition as opposed to many conditions.[36,37] It is possible that patients with FSSs may lie on a continuum, on which those with more symptoms and diagnoses represent a more severe disease state.[13,21,33]

With the growing interest in optimizing value after elective orthopedic surgery, we sought to determine the prevalence of FSSs in patients undergoing shoulder arthroplasty, as well as their association with postoperative outcomes and costs.

Methods

Study design

A retrospective cohort study was performed at a metropolitan hospital in the United States. We queried our prospectively maintained registry to include all patients who underwent elective primary total shoulder arthroplasty (anatomic or reverse) between February 2015 and November 2018 performed by a single fellowship-trained shoulder surgeon and who had complete 2-year follow-up data. We decided a priori to exclude patients undergoing revision shoulder arthroplasty or those whose indication for surgery was traumatic (acute fracture and post-traumatic conditions).

Functional somatic syndromes

Our study focused on the influence of FSSs on outcomes and costs after shoulder arthroplasty. We considered 4 well-recognized diagnoses as FSSs: fibromyalgia, irritable bowel syndrome, chronic headaches, and chronic low-back pain (with or without a history of surgery).[3,10,17,26,29,32] Patients were considered to have these conditions if a diagnosis was documented in the medical record. Although many other less common FSSs have been described, these 4 FSSs were chosen given the substantial literature on these specific conditions. Furthermore, owing to the limitations of a retrospective review, we believed that the 4 FSSs we chose to include would be more accurately recorded—as opposed to more obscure conditions such as post-viral fatigue syndrome or multiple chemical sensitivity.

Patient-reported outcomes

The primary outcomes of interest included the 2-year postoperative American Shoulder and Elbow Surgeons (ASES) score,[31] Single Assessment Numeric Evaluation (SANE) score,[14,38] and pain score on a visual analog scale.[11] The ASES score uses a 100-point scale, weighted 50% for pain and 50% for function, with higher scores representing better shoulder health.[31] The SANE score, which also uses a 100-point scale, simply asks patients to rate the overall status of their shoulder from 0% to 100%, where 100% is normal.[14,38] Finally, the visual analog scale for pain is a numeric rating scale from 0 to 10, where a higher score represents worse pain.[11] These scores are routinely collected by our research staff during office visits.

Time-driven activity-based costing

Our secondary outcome of interest was total hospitalization costs, which were estimated using time-driven activity-based costing methodology. This methodology provides more accurate and granular cost estimates than traditional hospital cost accounting and is increasingly being used in shoulder surgery.[2,27] Cost is calculated by multiplying the cumulative time each resource is used by the cost per unit of time of each resource across a hospitalization. For example, if a case manager spends 2 hours with a patient during the hospitalization and the cost of the case manager's time is $100 per hour, then the total cost of case management throughout the hospitalization is $200. Total hospitalization costs are calculated by adding the costs of each resource during an episode of care. We included costs beginning at check-in on the date of surgery and ending with room cleaning on the day the patient was discharged. These costs were calculated using software provided by Avant-garde Health (Boston, MA, USA).

Covariates

Potentially confounding data were collected pertaining to the association between FSSs and outcomes after shoulder arthroplasty. Specifically, we collected data on age, sex, number of patient-reported allergies, American Society of Anesthesiologists score,[19] body mass index, history of ipsilateral shoulder surgery, procedure type (anatomic vs. reverse total shoulder arthroplasty), and

diagnosis, as well as several comorbid conditions—diabetes, depression, anxiety, and preoperative chronic opioid use (defined as taking opioids daily before surgery). Preoperative ASES, SANE, and pain scores were also collected.

Statistical analysis

Bivariate analyses using the Pearson χ^2 test for categorical variables and independent-samples *t* test for continuous variables were performed to determine the association between patient characteristics and the presence of at least 1 FSS. Categorical variables were presented as frequencies and percentages, whereas continuous variables were reported as means and standard deviations.

To minimize confounding, all variables with $P \leq .05$ in the bivariate analysis were inserted into multivariable linear regression models to determine the independent association of FSSs with 2-year postoperative ASES, SANE, and pain scores. All covariates were entered into the models simultaneously, without further selection. The results were presented as adjusted score differences in the form of regression coefficients (β) with 95% confidence intervals. Notably, each regression was also adjusted for its corresponding preoperative patient-reported outcome measure. For example, the multivariable regression analysis used to predict factors associated with 2-year postoperative ASES scores was adjusted for preoperative ASES scores but not for preoperative SANE and pain scores. Additionally, an analysis of variance was performed to identify differences in postoperative outcomes based on the cumulative number of FSSs present. Patients were categorized into 3 groups based on the number of FSSs present—0, 1, and 2-4. Patients with 2, 3, and 4 FSSs were grouped because of the limited number of patients with ≥3 FSSs.

To identify variation in hospitalization costs based on the cumulative number of FSSs present, patients were similarly categorized into 3 groups based on the number of recorded FSSs: 0, 1, and 2-4. Owing to the confidentiality of hospital cost data, actual dollar amounts could not be reported. Instead, patients were categorized into 2 separate groups based on cost throughout the study: those in the top quartile (≥75th percentile) of total in-hospital cost vs. those in the lower 3 quartiles (<75th percentile).[27] Cost data were available for 410 of 480 patients in our cohort (76 of 82 patients with at least 1 FSS). A threshold of $P < .05$ was used to denote statistical significance.

Results

Nearly 1 in 5 patients (17%) reported at least 1 FSS. These patients were more likely to be women (78% vs. 54%), to be chronic opioid users (31% vs. 6.5%), to report more allergies (3.6 ± 3.6 vs. 1.7 ± 2.7), and to have anxiety (35% vs. 14%) (all $P < .001$). Furthermore, patients with at least 1 FSS were more likely to have a diagnosis other than degenerative joint disease (eg, rotator cuff arthropathy, avascular necrosis, capsulorrhaphy arthropathy, or rheumatoid arthritis) ($P = .005$) (Table I).

Patients with at least 1 FSS had lower 2-year postoperative ASES (72.1 ± 21.9 vs. 86.6 ± 13.9) and SANE (76.9 ± 22.8 vs. 87.8 ± 16.2) scores, as well as greater residual pain at 2 years (2.1 ± 2.5 vs. 0.62 ± 1.3) (all $P < .001$). They also demonstrated less improvement in ASES (39.4 ± 25.0 vs. 48.7 ± 28.9, $P < .001$), SANE (46.2 ± 27.9 vs. 55.7 ± 24.0, $P = .002$), and pain (–4.2 ± 3.1 vs. –5.2 ± 2.5, $P = .006$) scores after surgery compared with patients without an FSS. Additionally, a higher percentage of patients with at least 1 FSS were in the top quartile of total in-hospital cost compared with patients without an FSS (38.2% vs. 21.9%, $P = .003$). These trends also generally held true when each FSS was evaluated separately (Table II).

After controlling for potential confounding effects in multivariable regression modeling, the presence of at least 1 FSS was independently predictive of lower 2-year ASES (–9.75 points, $P < .001$) and SANE (–7.63 points, $P = .001$) scores, as well as greater residual pain (+1.13 points, $P < .001$) (Table III).

When our cohort was analyzed based on the cumulative number of FSSs present, 398 patients (82.9%) did not have a diagnosis of an FSS, 64 (13.3%) carried a diagnosis of 1 FSS, and 18 (3.8%) had diagnoses of 2, 3, or 4 FSSs. Each additional functional disorder was linked to a stepwise decrease in ASES and SANE scores (Fig. 1) and an increase in residual pain (Fig. 2) (all $P < .001$). These patients also incurred higher hospitalization costs, with a stepwise rise in costs with an increasing number of disorders (Fig. 3) ($P < .001$).

Discussion

Owing to the growing demand for shoulder arthroplasty coupled with the consequent financial strain on the health care system, it seems timely to explore the association of FSSs with postoperative outcomes and costs. The primary findings of our study revealed that the presence of at least 1 FSS was associated with worse 2-year postoperative ASES and SANE scores, as well as greater residual pain. Furthermore, each additional functional disorder was linked to a stepwise decrease in ASES and SANE scores and an increase in residual pain and hospitalization costs.

FSSs have garnered considerable attention in many medical specialties because they are common, incessant, and frequently associated with disability, psychological distress, and high health care utilization rates.[3,36] It is estimated that FSSs account for up to 20% of primary care consultations.[28] Our knowledge is limited regarding the etiologic contributions of the biological, sociocultural, and psychological factors of these conditions.[30] Many authors have suggested that FSSs share enough similarities to justify considering them together as "variants of a common biopsychosocial process."[3] Some argue that specific FSSs are an "artifact of medical specialization" and that FSSs should instead be thought of as one syndrome as opposed to many syndromes.[36,37] Furthermore, emerging evidence suggests that FSSs may be better understood on a continuum, on which patients with more functional

Table I Characteristics of study population

Parameter	All patients	Functional somatic disorder		*P* value
		Yes	No	
Total	480	82 (17.1)	398 (82.9)	
Age, yr	69 ± 7.8	69.9 ± 7.8	68.8 ± 7.8	.256
Sex[†]				
Female	279 (58.1)	64 (78)	215 (54)	<.001[*]
Male	201 (41.9)	18 (22)	183 (46)	
No. of patient-reported allergies[*]	2.0 ± 2.9	3.6 ± 3.6	1.74 ± 2.7	<.001[*]
ASA score[†]				
≤2	380 (79.2)	59 (72)	321 (80.7)	.077
≥3	100 (20.8)	23 (28)	77 (19.3)	
BMI[*]	30.5 ± 5.9	30.7 ± 6.2	30.5 ± 6.0	.833
Comorbid conditions[†]				
Preoperative opioid use	51 (10.9)	25 (30.5)	26 (6.5)	<.001[*]
Diabetes	65 (13.5)	15 (18.3)	50 (12.6)	.167
Depression	103 (21.5)	23 (28)	80 (20.1)	.11
Anxiety	85 (17.7)	29 (35.4)	56 (14.1)	<.001[*]
Preoperative ASES score[*]	36.8 ± 25.5	32.7 ± 17.2	37.7 ± 26.8	.107
Preoperative SANE score[*]	31.9 ± 19.8	31.1 ± 20.8	32.1 ± 19.6	.676
Preoperative pain (VAS) score[*]	5.9 ± 2.3	6.3 ± 2.5	5.8 ± 2.3	.104
Prior shoulder surgery[†]	150 (31.3)	28 (34.1)	122 (30.7)	.534
Procedure type[†]				
Anatomic TSA	138 (28.7)	17 (20.7)	121 (30.4)	.078
Reverse TSA	342 (71.3)	65 (79.3)	277 (69.6)	
Diagnosis				
Rotator cuff arthropathy	109 (22.7)	28 (28.0)	86 (21.6)	.005[*]
Degenerative joint disease	340 (70.8)	48 (58.5)	292 (73.4)	
Other[†]	31 (6.5)	11 (13.4)	20 (5.0)	

ASA, American Society of Anesthesiologists; *BMI*, body mass index; *ASES*, American Shoulder and Elbow Surgeons; *SANE*, Single Assessment Numeric Evaluation; *VAS*, visual analog scale; *TSA*, total shoulder arthroplasty.

Data are given as mean ± standard deviation or number of patients (percentage).

[*] Statistically significant ($P < .05$).

[†] Includes avascular necrosis, rheumatoid arthritis, and capsulorrhaphy arthropathy.

symptoms represent a more severe disease state.[8,13,21,33] Consequently, our study aimed to replicate this approach, with the aim of obtaining new insight into FSSs and their relationship with surgical outcomes and cost.

Nearly 1 in 5 patients in our study undergoing shoulder arthroplasty had at least 1 FSS. These patients were more likely to be women, to be chronic opioid users, to report more allergies, to have anxiety, and to have a primary shoulder diagnosis other than degenerative joint disease. This finding is in line with previously reported data, as female sex, chronic opioid use, and anxiety are well-known risk factors for FSSs.[1,3,36] Furthermore, we found a close relationship between each FSS and poor outcomes as well as high costs. Previous literature has demonstrated poor surgical outcomes and high health care utilization among patients with various FSSs.[6,15,22,24] For example, patients with a diagnosis of fibromyalgia undergoing lower-limb arthroplasty are more likely to require long-term narcotics, experience postoperative complications, and undergo revision surgery than those without fibromyalgia.[7,8,34] It is possible that these patients have more ineffective coping skills, making recovery more difficult. Moreover, patients undergoing knee and hip arthroplasty with a history of chronic headaches or chronic low-back pain were more likely to require opioids up to 1 year after surgery.[18] However, these studies were limited in that they examined individual conditions without considering FSSs collectively. When considering FSSs together, we demonstrated a powerful association between FSSs and postoperative outcomes.

We also observed that the presence of a greater number of FSSs was associated with worse outcomes and greater resource utilization. These results lend support to the theory that individual FSSs may in fact be a part of a single larger disorder[36]—where more symptoms and diagnoses represent a more severe disease state. Similarly to other disease states (eg, diabetes mellitus or depression), surgeons should view FSSs as a spectrum.

It is interesting to note that our data did not show a significant difference in preoperative outcome scores between patients with FSSs and those without FSSs. This

Table II Patient-reported outcome measures and hospitalization costs

Parameter	Diagnosis of condition		*P* value
	Yes	No	
Functional somatic disorder			
Total	82 (17.1)	398 (82.9)	
2-yr Postoperative ASES score*	72.1 ± 21.9	86.6 ± 13.9	<.001*
ASES score Δ*	39.4 ± 25.0	48.7 ± 28.9	<.001*
2-yr Postoperative SANE score*	76.9 ± 22.8	87.8 ± 16.2	<.001*
SANE score Δ*	46.2 ± 27.9	55.7 ± 24.0	.002*
2-yr Postoperative pain (VAS) score*	2.1 ± 2.5	0.62 ± 1.3	<.001*
Pain (VAS) score Δ*	−4.2 ± 3.1	−5.2 ± 2.5	.006*
≥75th Percentile of total in-hospital cost (TDABC)†	29 (38.2)	73 (21.9)	.003*
Fibromyalgia			
Total	12 (2.5)	468 (97.5)	
2-yr Postoperative ASES score*	57.9 ± 25.3	84.8 ± 15.6	.004*
ASES score Δ*	29.1 ± 22.6	48.4 ± 21.2	.002*
2-yr Postoperative SANE score*	62.5 ± 31.7	86.6 ± 17.1	.023*
SANE score Δ*	30.3 ± 36.0	54.7 ± 24.4	<.001*
2-yr Postoperative pain (VAS) score*	3.6 ± 3.4	0.8 ± 1.5	.016*
Pain (VAS) score Δ*	−3.2 ± 3.4	−5.1 ± 2.6	.015*
≥75th Percentile of total in-hospital cost (TDABC)†	6 (60)	96 (24)	.009*
Irritable bowel syndrome			
Total	19 (4.0)	461 (96.0)	
2-yr Postoperative ASES score*	68.2 ± 22.7	84.8 ± 15.8	.005*
ASES score* Δ	35.9 ± 28.7	48.4 ± 21.0	.013*
2-yr Postoperative SANE score*	77.4 ± 21.0	86.3 ± 17.8	.033*
SANE score* Δ	49.2 ± 23.1	54.3 ± 25.1	.386
2-yr Postoperative pain (VAS) score*	2.7 ± 2.8	0.8 ± 1.6	.007*
Pain (VAS) score Δ*	−4.1 ± 3.5	−5.0 ± 2.6	.13
≥75th Percentile of total in-hospital cost (TDABC)†	8 (44.4)	94 (24)	.05*
Chronic headaches			
Total	28 (5.8)	452 (94.2)	
2-yr Postoperative ASES score*	72.8 ± 19.7	84.8 ± 16.0	.004*
ASES score Δ*	37.8 ± 26.6	48.6 ± 20.9	.01*
2-yr Postoperative SANE score*	80.8 ± 16.4	86.3 ± 18.0	.114
SANE score Δ*	52.7 ± 22.0	54.2 ± 25.2	.766
2-yr Postoperative pain (VAS) score*	1.8 ± 2.3	0.8 ± 1.6	.031*
Pain (VAS) score Δ*	−3.9 ± 3.4	−5.1 ± 2.6	.072
≥75th Percentile of total in-hospital cost (TDABC)†	10 (40)	92 (23.9)	.071
Chronic low-back pain			
Total	46 (9.6)	434 (90.4)	
2-yr Postoperative ASES score*	70.9 ± 22.4	85.5 ± 15.1	<.001*
ASES score Δ*	39.9 ± 24.9	48.8 ± 20.9	.007*
2-yr Postoperative SANE score*	74.6 ± 24.7	87.2 ± 16.7	.001*
SANE score Δ*	42.4 ± 28.2	55.3 ± 24.3	<.001*
2-yr Postoperative pain (VAS) score*	2.4 ± 2.7	0.7 ± 1.4	<.001*
Pain (VAS) score Δ*	−4.2 ± 3.1	−5.1 ± 2.6	.02*
≥75th Percentile of total in-hospital cost (TDABC)†	20 (44.4)	82 (22.5)	.001*

ASES, American Shoulder and Elbow Surgeons; *Δ*, difference between preoperative and 2-year outcome score; *SANE*, Single Assessment Numeric Evaluation; *VAS*, visual analog scale; *TDABC*, time-driven activity-based costing.

Data are given as mean ± standard deviation or number of patients (percentage).

* Statistically significant ($P < .05$).

† Includes patients in highest quartile of total-in hospital cost within our sample.

finding suggests that FSSs may preferentially affect the postoperative period. Considering the biopsychosocial framework of FSSs, efforts to minimize the anticipation of surgery and set reasonable goals and expectations should be emphasized.[12] For instance, allowing a patient with FSSs to meet with another patient who recently underwent a similar

Table III Multivariable linear regression showing which factors account for variation in outcomes after total shoulder arthroplasty

Predictor	Presence of functional disorder (vs. no functional disorder)			*P* value	R^2
	Adjusted mean difference in value*	95% CI			
		Lower	Upper		
2-yr Postoperative ASES score	−9.75	−13.61	−5.89	<.001†	0.213
2-yr Postoperative SANE score	−7.63	−12.12	−3.15	.001†	0.113
2-yr Postoperative pain (VAS) score	1.13	0.72	1.53	<.001†	0.177

CI, confidence interval; *ASES*, American Shoulder and Elbow Surgeons; *SANE*, Single Assessment Numeric Evaluation; *VAS*, visual analog scale.

* Data represent regression coefficients. Regressions were adjusted for the number of patient-reported allergies; sex; anxiety; chronic preoperative opioid use; diagnosis; and preoperative ASES, SANE, and pain scores.

† Statistically significant ($P < .05$).

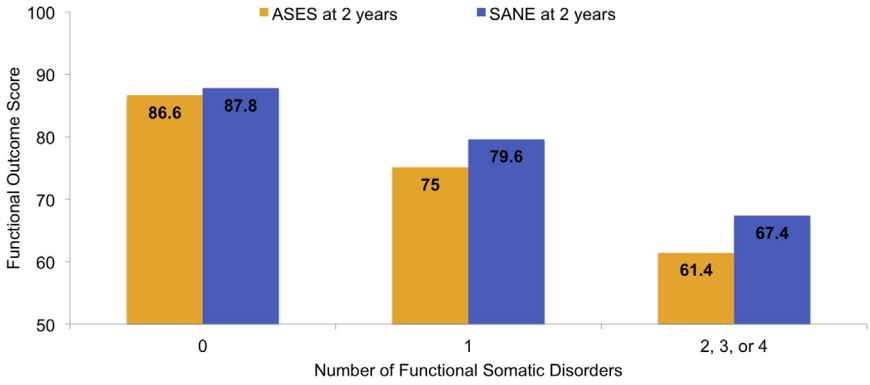

Figure 1 Bar graph showing 2-year postoperative American Shoulder and Elbow Surgeons (*ASES*) and Single Assessment Numeric Evaluation (*SANE*) scores stratified by number of functional somatic syndromes.

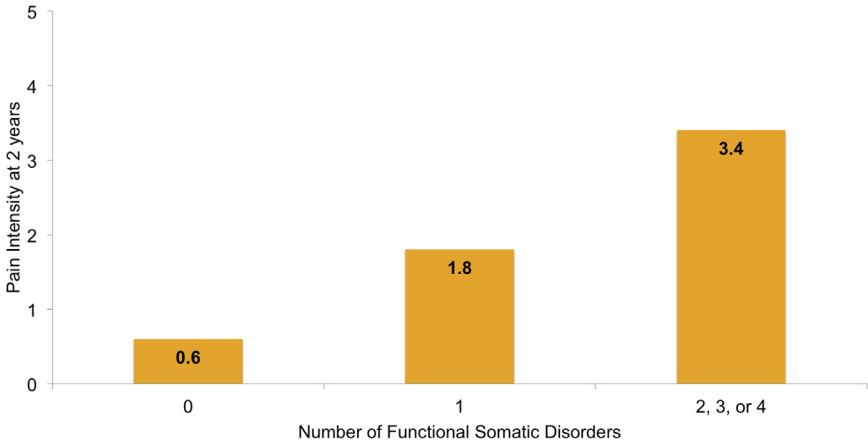

Figure 2 Bar graph showing 2-year postoperative pain scores stratified by number of functional somatic syndromes.

surgical procedure may provide an opportunity to alleviate certain fears or concerns in a low-stress environment.[25] Although not statistically significant, it should be noted that patients with at least 1 FSS trended toward having lower preoperative ASES scores and higher pain scores than those without an FSS. It is possible that our study was underpowered to detect a difference between groups.

Given the complex and heterogeneous nature of FSSs, as well as a lack of objective tissue pathology, many patients with FSSs are disregarded and dismissed in various medical specialties.[5] This may be partially because of a poor understanding of these conditions by the medical community, our own discomfort with these syndromes, and the fact that these patients often require longer clinic visits than other

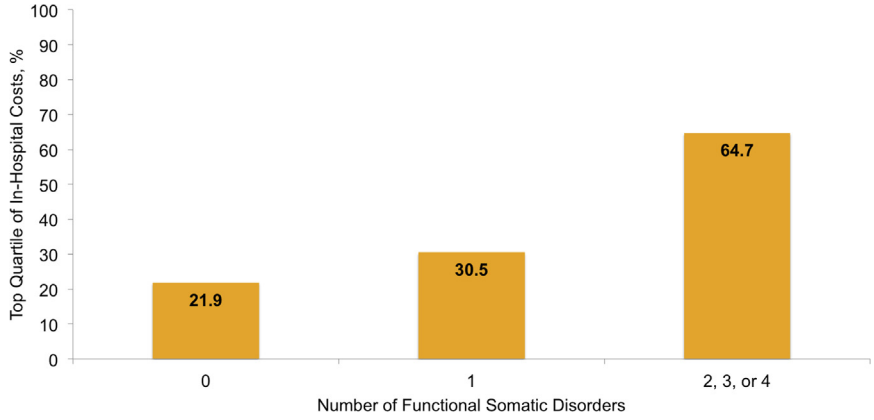

Figure 3 Bar graph showing percentage of patients in top quartile of in-hospital costs stratified by number of functional somatic syndromes.

patients.[5] Given the strength and consistency of our results, we encourage efforts to identify patients with FSSs and optimize their condition. Currently, treatment options such as cognitive behavioral therapy, antidepressants, hypnotherapy, and psychotherapy have shown promise in improving the symptoms of various FSSs.[16] Providers should consider referring patients with FSSs to practitioners with experience in treating these conditions prior to surgery. We hope that the information in our study is used to help improve the quality of these patients' outcomes as opposed to limiting access to care. Indeed, our results suggest that there is ample opportunity for improvement in the value of shoulder arthroplasty in this subset of patients.

The primary strengths of our study are its relatively large sample size, the use of granular clinical data, and the adoption of time-driven activity-based costing methodology to calculate hospitalization costs for each patient. Despite these strengths, our study did have several notable limitations. First, this study may not be generalizable to all populations because it was performed at an urban hospital in the northeast United States. Second, a diagnosis of an FSS was made retrospectively, which may be subject to information bias. It is possible that certain patients' diagnoses may have been missed or misclassified because we relied on the presence of a documented diagnosis of these conditions in the medical record. Future studies may benefit by inquiring about the presence of FSSs prospectively. Third, we considered a diagnosis of each FSS in binary terms rather than on a spectrum. For example, a patient may have had significant fibromyalgia-like symptoms but was not considered as having this condition because he or she fell just below an arbitrary cutoff necessary for a diagnosis. However, we did attempt to partially account for this by assessing outcomes and cost based on the cumulative number of FSSs present. Fourth, we did not report data on the rate of postoperative complications (eg, infection, dislocation, or acromial stress fracture). It is possible that this may be a confounding variable. Finally, our study only considered 4 individual FSSs, as opposed to the many others that have been described. However, given the difficulty of accurately categorizing infrequent conditions such as atypical chest pain or chronic post-viral fatigue syndrome in a retrospective chart review, we chose to limit our study to the 4 FSSs we believed would be most accurately reflected in the medical record.

Conclusion

This study is among the first to explore the concept of FSSs in orthopedic surgery. We found that FSSs are common in the shoulder arthroplasty setting and correlate with suboptimal outcomes and greater resource use. Efforts to address the biopsychosocial determinants of health that affect the value proposition of shoulder arthroplasty should be prioritized in the redesign of care pathways and bundling initiatives.

Disclaimer

Andrew Jawa is a paid speaker and consultant for DJO Global, is a paid consultant for Ignite Orthopedics, receives royalties from DePuy Synthes, and has equity in Boston Outpatient Surgical Suites. All the other authors, their immediate families, and any research foundations with which they are affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.

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