



# Preoperative opioid use associated with worse outcomes after anatomic shoulder arthroplasty

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**Background:** Preoperative opioid use has been associated with worse clinical outcomes after orthopedic surgery. The purpose of this study was to evaluate the impact of preoperative opioid use on outcomes and patient satisfaction after anatomic total shoulder arthroplasty (TSA).

**Methods:** We identified 224 TSAs performed for primary glenohumeral joint osteoarthritis with 2- to 5-year follow-up in a prospective shoulder arthroplasty registry. Sixty patients with a history of preoperative opioid use for shoulder pain were compared with a control group of 164 patients. Patient-reported outcome measurements, range of motion measurements, and patient satisfaction were assessed preoperatively and at most recent follow-up.

**Results:** Preoperative opioid use was associated with significantly worse preoperative patient-reported outcome scores for nearly all outcome measures. Both groups significantly improved on all outcome scores and range of motion measurements from preoperative to most recent follow-up; however, the nonopioid group had significantly better postoperative outcome scores. There was a statistical difference between the 2 groups regarding the number of satisfied patients, with 80% satisfied in the opioid group (48 of 60 patients) compared with 91% satisfied in the nonopioid group (149 of 164 patients) ( $P = .03$ ).

**Conclusion:** Patients with a history of preoperative opioid use can achieve significant improvements in patient-reported outcome measurements and patient satisfaction after anatomic TSA for primary glenohumeral joint arthritis. However, patients with preoperative opioid use have a significantly lower preoperative baseline and achieve significantly lower final outcome scores after TSA compared with patients without a history of preoperative opioid use.

**Level of evidence:** Level III, Retrospective Cohort Design, Treatment Study.

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**Keywords:** Anatomic total shoulder arthroplasty; opioid use; glenohumeral joint osteoarthritis

Institutional Review Board approval was obtained from Texas Orthopedic Hospital (TOH161).

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Primary glenohumeral joint osteoarthritis is a chronic, sometimes debilitating condition that may lead to operative treatment for pain relief and improved function. Nonoperative management is the first line of treatment, including activity modification with selective rest, nonsteroidal anti-inflammatories, corticosteroid injections, and exercises. Opioid medications are used to treat chronic, noncancer

pain, including nonoperative treatment of osteoarthritis-associated pain.<sup>2,20</sup> The impact of opioid use is not limited to potential abuse and misuse. Preoperative opioid use has been associated with postoperative “doctor shopping” and worse outcomes after orthopedic surgeries.<sup>6,10,11,15-17,20</sup> Preoperative opioid use has recently been associated with worse patient-reported outcome scores after reverse shoulder arthroplasty.<sup>16</sup> There have been no studies investigating outcomes after anatomic total shoulder arthroplasty (TSA) in patients with a history of preoperative opioid use. It is unclear if this association would apply to a different population with primary glenohumeral joint osteoarthritis.

The purpose of this study was to evaluate the impact of preoperative opioid use on outcomes and patient satisfaction after TSA. We hypothesized that patients reporting preoperative opioid use would demonstrate lower preoperative and postoperative outcome scores and that a significantly lower number of patients with preoperative opioid use would be satisfied with their procedure compared with the nonopioid group.

## Materials and methods

### Patient inclusion criteria and demographics

We identified 224 patients in a prospective shoulder registry who underwent TSA for the treatment of primary glenohumeral arthritis with 2- to 5-year follow-up. The senior author (T.B.E.) performed all of the surgeries at a high-volume shoulder arthroplasty center. All patients who underwent revision surgery or had an intraoperative or postoperative complication were excluded ( $n = 22$ ). Sixty patients with a history of preoperative opioid use for shoulder pain were identified, and 164 patients without a history of preoperative opioid use served as the control group. Preoperative opioid use was determined prospectively by asking, Do you take narcotic pain medication (codeine or stronger) for your shoulder—yes or no?

Patient characteristics prospectively assessed included age, gender, smoking status, follow-up duration, body mass index (BMI), history of chronic back pain, diabetes, depression, and heart disease. The Constant score,<sup>4</sup> the American Shoulder and Elbow Surgeons (ASES) score,<sup>14</sup> the Western Ontario Osteoarthritis Shoulder (WOOS) index,<sup>13</sup> the Single Assessment Numeric Evaluation (SANE),<sup>19</sup> range of motion measurements, and patient satisfaction were assessed preoperatively and 2 to 5 years postoperatively. Patients were asked to describe themselves as very dissatisfied, dissatisfied, satisfied, or very satisfied to determine satisfaction. Patients who were very satisfied or satisfied were categorized as being satisfied, and patients who were very dissatisfied or dissatisfied were considered dissatisfied for statistical purposes.

### Surgical technique and postoperative rehabilitation

The Aequalis, Aequalis Ascend, and Aequalis Ascend Flex (Tornier, Bloomington, MN, USA) anatomic TSA systems were used.

The surgical technique and postoperative rehabilitation protocols are well described.<sup>5,7,12</sup>

## Clinical assessment

The senior author (T.B.E.) performed all examinations. A hand-held goniometer was used to determine range of motion measurements. A hand-held digital dynamometer (Chatillon digital force gauge with 90.72 kilogram-force; AMETEK, Inc, Largo, FL, USA) was used to measure strength of abduction. All patients completed preoperative computed tomographic arthrography to evaluate the status of the rotator cuff and morphologic features of the glenoid, which were classified preoperatively by the senior author (T.B.E.) according to Walch et al.<sup>18</sup>

## Statistical analysis

Independent *t* tests were used to compare age, duration of follow-up, and BMI between the 2 groups.  $\chi^2$  tests were performed to determine if differences existed between the groups for sex, smoking status, back pain, depression, diabetes, heart disease, and satisfaction. Separate  $2 \times 2$  repeated-measures analyses of variance (grouped by preoperative and postoperative outcome scores) were used to determine if the relative change in each outcome score differed between those with and those without a history of preoperative opioid use. Statistical analyses were performed using Stata version 13.1 (StataCorp, College Station, TX, USA), with  $P < .05$  being considered statistically significant.

## Results

No statistical differences were noted between the preoperative opioid group and the nonopioid group regarding age, follow-up duration, smoking status, diabetes, heart disease, and glenoid morphology according to the Walch classification<sup>18</sup> (Table I). Whereas there was a significantly greater proportion of male patients in the nonopioid group ( $P = .001$ ), most of the outcomes did not differ between the sexes except for the Constant strength scores (men,  $17 \pm 6$  vs. women,  $8 \pm 3$ ;  $P < .001$ ), which was expected. Patients with preoperative opioid use had a significantly higher prevalence of chronic back pain (52% vs. 30%;  $P = .003$ ) and depression (13% vs. 4%;  $P = .04$ ) and higher BMI ( $32 \pm 7 \text{ kg/m}^2$  vs.  $29 \pm 5 \text{ kg/m}^2$ ;  $P = .01$ ). The average clinical follow-up was 3.5 years (standard deviation, 1.2 years; range, 2-5 years).

Preoperatively, the opioid group demonstrated significantly lower scores for all patient-reported outcome measurements except the SANE score ( $P = .88$ ) (Table II). Preoperative opioid use was associated with significantly lower preoperative Constant scores for pain ( $P < .001$ ), activity ( $P < .001$ ), mobility ( $P = .01$ ), and strength ( $P = .01$ ); total Constant score ( $P < .001$ ); adjusted Constant score ( $P < .001$ ); ASES score ( $P < .001$ ); ASES score for pain ( $P = .004$ ); and WOOS index ( $P < .001$ ) (Table II). The nonopioid group had significantly greater preoperative forward flexion (average  $16^\circ$  greater;  $P = .005$ ) and abduction (average  $12^\circ$  greater;  $P = .03$ ) (Table II).

**Table I** Comparison of patient demographics and clinical characteristics

	Preoperative opioid use		P value
	No	Yes	
Number	164 (117 M/47 F)	60 (29 M/31 F)	*.001
Age at surgery (years), mean $\pm$ SD [range]	67 $\pm$ 9 [43-93]	66 $\pm$ 10 [38-88]	.88
Follow-up (years), mean $\pm$ SD [range]	3.5 $\pm$ 1 [2-5]	3 $\pm$ 1 [2-5]	.42
BMI	29 $\pm$ 5	32 $\pm$ 7	.01
Active smoking	3 (2%)	2 (3%)	.61
Chronic back pain	49 (30%)	31 (52%)	.004
Depression	7 (4%)	8 (13%)	.04
Diabetes	11 (7%)	5 (8%)	.77
Heart disease	14 (8%)	9 (15%)	.24
Glenoid morphology (Walch classification <sup>18</sup> )			
A1	73 (45%)	30 (50%)	.56
A2	16 (10%)	3 (5%)	.42
B1	13 (8%)	9 (15%)	.13
B2	55 (34%)	13 (22%)	.12
C	5 (3%)	4 (7%)	.25

SD, standard deviation; BMI, body mass index.

\* Significantly greater proportion of male patients in the nonopioid group.

**Table II** Comparison of patient-reported outcome measure scores and range of motion measurements (mean  $\pm$  SD)

	No preoperative opioid		Yes preoperative opioid	
	Preoperative	Postoperative	Preoperative	Postoperative
Constant score				
Pain <sup>*,†</sup>	5 $\pm$ 3	13 $\pm$ 3	3 $\pm$ 2	12 $\pm$ 5
Activity <sup>*,†</sup>	9 $\pm$ 4	18 $\pm$ 3	6 $\pm$ 4	16 $\pm$ 5
Mobility <sup>*,†</sup>	12 $\pm$ 8	36 $\pm$ 5	9 $\pm$ 8	34 $\pm$ 9
Strength <sup>†</sup>	6 $\pm$ 8	15 $\pm$ 6	3 $\pm$ 6	12 $\pm$ 7
Total <sup>*,†</sup>	32 $\pm$ 17	82 $\pm$ 12	21 $\pm$ 16	73 $\pm$ 20
Adjusted <sup>*,†</sup>	41 $\pm$ 21	107 $\pm$ 17	27 $\pm$ 19	100 $\pm$ 29
ASES <sup>*,†</sup>	44 $\pm$ 18	89 $\pm$ 15	33 $\pm$ 19	83 $\pm$ 20
Pain <sup>*,†</sup>	5 $\pm$ 3	1 $\pm$ 2	6 $\pm$ 3	1 $\pm$ 2
WOOS <sup>*,†</sup>	62 $\pm$ 18	11 $\pm$ 16	76 $\pm$ 13	19 $\pm$ 25
SANE	32 $\pm$ 24	71 $\pm$ 36	32 $\pm$ 28	67 $\pm$ 35
Forward flexion <sup>*,†</sup>	89 $\pm$ 37	164 $\pm$ 13	73 $\pm$ 39	155 $\pm$ 32
Abduction <sup>*,†</sup>	82 $\pm$ 36	164 $\pm$ 14	70 $\pm$ 39	153 $\pm$ 32
External rotation	11 $\pm$ 15	46 $\pm$ 13	11 $\pm$ 14	45 $\pm$ 13

SD, standard deviation; ASES, American Shoulder and Elbow Surgeons score; WOOS, Western Ontario Osteoarthritis Shoulder index; SANE, Single Assessment Numeric Evaluation.

\* Preoperative measures were significantly different between the 2 groups ( $P \leq .03$ ).

† Postoperative measures were significantly different between the 2 groups ( $P \leq .02$ ).

Postoperatively, both the opioid and nonopioid groups significantly improved on all patient-reported outcome measurements and range of motion measurements from preoperative to most recent follow-up ( $P < .001$ ). However, the opioid group demonstrated significantly lower scores for all patient-reported outcome measurements except the SANE score ( $P = .54$ ) and significantly lower range of motion measurements except external rotation ( $P = .58$ ) (Table II). Preoperative opioid use was associated with significantly lower postoperative Constant scores for pain

( $P = .01$ ), activity ( $P = .002$ ), mobility ( $P = 0.01$ ), and strength ( $P = .005$ ); total Constant score ( $P < .001$ ); adjusted Constant score ( $P = .01$ ); ASES score ( $P = .01$ ); ASES score for pain ( $P = .02$ ); and WOOS index ( $P = .01$ ) (Table II).

Although the nonopioid group achieved significantly improved postoperative patient-reported outcome measurements, the magnitude of change between the groups from preoperatively to the most recent follow-up was similar for all measures and range of motion measurements.

There was a statistical difference between the 2 groups in terms of the number of satisfied patients (opioid group, 48 of 60 [80%] vs. nonopioid group, 149 of 164 [91%];  $P = .03$ ).

## Discussion

Preoperative opioid use has been associated with worse clinical outcomes after orthopedic surgery, and our investigation is the first to demonstrate the impact of preoperative opioid use on outcomes after anatomic TSA. A history of preoperative opioid use before TSA was associated with significantly lower preoperative and postoperative patient-reported outcome measurements compared with the nonopioid group; however, both groups had significant improvements in all shoulder function scores and range of motion measures after surgery. Patients with a history of preoperative opioid use had excellent results after anatomic TSA for primary glenohumeral joint osteoarthritis; however, they did not achieve the same final outcome scores compared with the nonopioid group.

Opioid medications are commonly used to manage chronic pain, including pain associated with osteoarthritis.<sup>1,3,8,20</sup> Preoperative opioid use has been associated with worse clinical outcomes after total knee arthroplasty, spine surgery, and more recently reverse TSA.<sup>7,10,11,16,17,20</sup> It is not unexpected to see similar results after anatomic TSA, but it is helpful to have clinical data for patients in this population. It is important to highlight similar results with a different shoulder diagnosis, with a different treatment, and in a more robust patient cohort. The reverse shoulder arthroplasty study that assessed the impact of preoperative opioid use evaluated a cohort of rotator cuff tear arthropathy patients with an average age of 70 years.<sup>16</sup> Our population was slightly younger at  $67 \pm 10$  years and consisted exclusively of patients with primary glenohumeral joint osteoarthritis. Furthermore, our cohort consisted of 224 patients with 60 patients in the preoperative opioid group compared with only 68 total patients in the reverse shoulder arthroplasty study with only 32 patients in the preoperative opioid group.<sup>16</sup> This information will allow us to better counsel patients with a history of preoperative opioid use before anatomic TSA to establish reasonable expectations for postoperative results. Furthermore, this will allow us to more critically look at our results after shoulder arthroplasty to consider preoperative opioid use as a potential variable affecting patient outcomes. Our results suggest that fewer patients in the preoperative opioid group were satisfied after surgery compared with the nonopioid group (80% vs. 91%;  $P = .03$ ).

We acknowledge that there are limitations of our investigation. Self-reported opioid use may under-report the prevalence of preoperative opioid use. Furthermore, we did not have access to state-controlled substance monitoring data or pharmacy records to confirm preoperative opioid

duration or dosing. Although this is the only cohort to date assessing the effects of preoperative opioid use after TSA, it is still a relatively small number of patients, and a multicenter cohort could strengthen the data. A larger prospective series is needed to confirm the results of this study and potentially to establish a dose-dependent impact of preoperative opioid use. The opioid group was also statistically different from the nonopioid group regarding BMI, history of chronic back pain, and depression. BMI has not been shown to have an impact on short-term functional outcomes after shoulder replacement, and the average BMI differences were  $30 \text{ kg/m}^2$  (nonopioid) vs.  $32 \text{ kg/m}^2$  (opioid), which would not be expected to translate to clinical differences. However, a higher prevalence of chronic back pain and depression in the opioid group may introduce potential bias in the opioid group as confounding variables.

Several strengths were noted in the study. First, our investigation was limited to a homogeneous patient population, with all patients requiring TSA for treatment of primary glenohumeral osteoarthritis, the most common indication for TSA.<sup>9</sup> Second, by performing a case-control study, we investigated associations between opioid use and variables that may contribute to pain and variations in postoperative outcome scores, including smoking status, chronic back pain, and depression. Finally, a single surgeon performed all TSAs with standardized surgical and rehabilitation protocols.

## Conclusions

Patients with a history of preoperative opioid use can achieve significant improvements in patient-reported outcome measurements and patient satisfaction after anatomic TSA for primary glenohumeral joint arthritis. However, patients with preoperative opioid use have a significantly lower preoperative baseline and achieve significantly lower final outcome scores after TSA compared with patients without a history of preoperative opioid use.

## Disclaimer

Brent J. Morris serves as a consultant for Tornier, Inc.

T. Bradley Edwards received financial support from Tornier, Inc, for the database that was used to collect results for the study and receives royalties from and serves as a consultant for Tornier, Inc.

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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