INTRODUCTION

There is some evidence that positive patient expectations are associated with positive surgical outcomes. However, the literature within various surgical fields has identified that patient expectations are often inaccurate or unrealistic. Physicians also struggle to predict outcomes for their patients after surgery, and physician expectations may drastically differ from that of their patients in terms of expectations. Numerous studies have shown that unrealistically high preoperative patient expectations are more likely to lead to unmet postoperative expectations, which is associated with dissatisfaction. At present, patient expectations appear to be varied and inconsistently correlated with worse healthcare outcomes in general. (Plast Reconstr Surg Glob Open 2021;9:e3823; doi: 10.1097/GOX.0000000000003823; Published online 22 September 2021.)
experience and reduce postoperative dissatisfaction related to unmet expectations. Given that the relationship between preoperative patient expectations, satisfaction, and outcome score improvement is nuanced yet important, our primary purpose was to describe patient preoperative expectations before CTR. Secondly, we aimed to identify factors associated with expecting a high level of relief or improvement among patients undergoing CTR.

**METHODS**

With institutional review board (IRB #00071740) approval, adult patients (≥18 y) who underwent isolated unilateral or bilateral CTR surgery performed by five fellowship-trained hand surgeons at a single tertiary academic medical center were identified between April 2015 and April 2017. We included patients undergoing open (oCTR) and endoscopic (eCTR) CTR. Patient expectations were queried within 3 months before undergoing CTR. Specifically, a question designed to ascertain patient expectations regarding their surgical outcome was asked at preoperative clinic visits within three months of CTR: “how much relief and/or improvement seems realistic to you as a result of the treatment you will be receiving?” Likert scale responses included “great relief/improvement,” “some relief/improvement,” “little relief/improvement,” “no relief/improvement,” and “I do not have any expectations.” All patients received the same version of this question on an iPad (Apple Inc., Cupertino, Calif.). Preoperative patient counseling before surgery was delivered by the treating surgeon in a standardized fashion. Manual chart review was performed to collect potential predictor variables, verify coded procedures and surgical setting (operating room versus procedure room), and to ensure the anchor question was answered within 3 months preoperatively at a visit pertaining to the upcoming CTR surgery. Patients with a response to the improvement question only at visits unrelated to the preoperative CTR discussion, as were those lacking a response within 3 months preoperatively, were excluded. Patients undergoing revision CTR, and those with additional simultaneous surgical procedures performed in conjunction with the index CTR, were also excluded.

Demographic data were obtained through a combination of electronic data acquisition and manual chart review. Other preoperative factors known to limit postoperative improvement following CTR were collected via manual chart review, including age,23,24 presence of constant numbness or weakness/atrophy,25 and duration of symptoms.23,26 Preoperative composite upper extremity disability, as measured by the QuickDASH, was extracted electronically at our institution; this outcome score is queried at each clinic visit as part of routine clinical care via a tablet computer. Social deprivation was also included as a potential predictor variable given its impact on healthcare access and outcomes in general.27 To do so, we utilized the 2015 area deprivation index (ADI) to determine the level of social deprivation on a national percentile basis for each patient (lower ADI indicates lower levels of social deprivation).28 Recently, ADI has been studied in several upper extremity and general orthopedic studies that have demonstrated that higher levels of social deprivation are associated with worse PROs27,28,31 and decreased satisfaction with care.32 The ADI evaluates 17 factors that influence socioeconomic status. These factors include education level, income, and housing type for a given 9-digit zip code,33 which is granular to the level of 10 to 20 homes on average.35 These data, originally collected from census records based on the Health Resources and Services Administration, are updated regularly to include the most recent American Community Survey data.35

Continuous variables were summarized as mean (SD), median (interquartile range [IQR]) and range. Categorical variables were summarized as counts (percentages). Univariable and multivariable logistic regressions were used to identify factors associated with expectations. Specifically, we investigated which preoperative factors were associated with patients expecting great relief/improvement, versus lower levels of expectations (binning of patients with no expectations and those expecting some, little, and no relief/improvement). The multivariable model included all variables with a $P$ value less than 0.1 in the univariable analysis. Variance inflation factors were calculated to examine potential multicollinearity of the multivariable model. Variance inflation factors of less than 5 were deemed acceptable.34–36 Odds ratios, 95% confidence intervals (CIs) and $P$ values were reported from the models. Statistical significance was assessed at the 0.05 level and all tests were two-tailed.

**RESULTS**

**Demographics and Surgical Details**

The recruitment process and reasons for exclusion are illustrated in Figure 1. A total of 307 patients were included. Of those included, mean age was 54 ± 16 years and 63% were female. The mean preoperative QuickDASH was 46.0 ± 18.8 and the majority of patients fell within the lowest two quartiles of ADI. A notable proportion of patients were experiencing constant numbness (32%) or weakness/atrophy (17%) within 3 months preoperatively. A summary of the demographic factors and baseline patient characteristics is provided in Table 1. Patients underwent both eCTR (41%) and oCTR (59%), and most underwent unilateral CTR (62%). Additional surgical factors are described in Table 2.

**Expectations**

Regarding the primary outcome of the study, the vast majority of patients expected great (58%) or some (23%) improvement/relief of their CTS symptoms, whereas 13% did not have any expectations before surgery (Table 3). It was uncommon for patients to expect little to no relief (7%) after CTR.

**Univariable and Multivariable Analyses**

In the univariate analysis, older patients, White race, lower BMI, lower levels of social deprivation (lower ADI), commercial insurance or Medicare were associated with...
expecting great relief/improvement ($P < 0.05$ for each; Table 4). Surgical technique (oCTR versus eCTR), surgical setting (operating room versus procedure room), surgeon, preoperative presence of constant numbness, preoperative presence of atrophy/weakness, duration of symptoms, and QuickDASH were not associated with expectations ($P > 0.05$ for each).

In the multivariable analysis, only the following predictors were significantly associated with higher expectations: male sex, lower social deprivation, and lower BMI ($P < 0.05$ for each; Table 4). Specifically, men had 87% greater odds of expecting great improvement than women (odds ratio: 1.87, 95% CI: 1.10, 3.21; $P = 0.022$). Each one point increase in BMI and one percentile increase in ADI/social deprivation were associated with a 3% and 2% decreased odds in expecting great improvement, respectively.

**DISCUSSION**

The relationship between preoperative patient expectations, satisfaction, and outcome score improvement is nuanced.$^5,14$ Our primary purpose focused on describing patient preoperative expectations before CTR, revealing that the vast majority of patients anticipated some to
great improvement after surgical management of CTS. Additionally, we observed that the expectation of great improvement was associated with male sex, lower BMI, and lower levels of social deprivation. Of equal importance, we observed that factors leading to worse outcomes did not affect expectations, including the presence of preoperative constant numbness,26 presence of preoperative weakness/atrophy,25 age,23,24 and duration of symptoms.23,26

Table 1. Baseline Patient Characteristics and Demographics

| Variable                  | N*  |
|---------------------------|-----|
| **Descriptive Summary**   |     |
| Age at time of surgery    | 53.8 (±15.6) |
| Median (IQR)              | 53.1 (41.0, 65.8) |
| Range                     | (21.8, 92.0) |
| BMI                       | 31.5 (±8.6) |
| Mean (SD)                 | 30.0 (25.1, 36.0) |
| Median (IQR)              | (17.8, 70.9) |
| Sex                       |     |
| Male                      | 113 (36.8%) |
| Female                    | 194 (63.2%) |
| Race                      |     |
| White                     | 258 (85.1) |
| Other                     | 45 (14.9%) |
| Employment                |     |
| Working                   | 157 (51.6%) |
| Unemployed                | 47 (15.5%) |
| Retired                   | 83 (27.3%) |
| Disabled                  | 17 (5.6%) |
| ADI (national percentile) |     |
| Median (IQR)              | 36.0 (25.0, 46.0) |
| Tobacco use               |     |
| Current smoker            | 35 (14.3%) |
| Former smoker             | 57 (23.3%) |
| Never smoker              | 153 (62.4%) |
| Insurance type            |     |
| Commercial                | 169 (55%) |
| Medicare                  | 85 (27.7%) |
| Medicaid                  | 47 (13.5%) |
| Other                     | 6 (2%) |
| Clinical features of severity |     |
| Preop weakness/atrophy    | 72 (32%) |
| Mean (SD)                 | 46 (17.4%) |
| Preoperative testing and interventions |     |
| EMG                       | 111 (36.3%) |
| Injection                 | 22 (7.2%) |
| Duration of symptoms (mo) |     |
| Mean (SD)                 | 33.5 (46.3) |
| Median (IQR)              | 24.0 (7.0, 37.0) |
| Range                     | 1.0 (36.0) |
| Preoperative               |     |
| Mean (SD)                 | 46.0 (18.8) |
| Median (IQR)              | 45.0 (32.9, 59.0) |
| QuickDASH                  |     |
| Mean (SD)                 | 46.0 (18.8) |
| Median (IQR)              | 45.0 (32.9, 59.0) |
| Range                     | (2.0, 91.0) |

*N total of 370, with data missing for some specific demographic queries.

Table 2. Summary of Surgical Factors

| Variable            | N*  |
|---------------------|-----|
| **Descriptive Summary** |     |
| Surgical technique  |     |
| Endoscopic          | 125 (40.7%) |
| Open                | 182 (59.3%) |
| Unilateral          | 190 (61.9%) |
| Bilateral           | 117 (38.1%) |
| Surgical setting    |     |
| PR                  | 196 (63.8%) |
| OR                   | 111 (36.2%) |
| Anesthesia type     |     |
| General             | 29 (9.4%) |
| EMG                 | 112 (36.5%) |
| MAC                 | 133 (43.3%) |
| Regional            | 33 (10.7%) |
| Surgeon             |     |
| Provider A          | 74 (24.1%) |
| Provider B          | 81 (10.1%) |
| Provider C          | 7 (2.3%) |
| Provider D          | 122 (39.7%) |
| Provider E          | 75 (23.8%) |

*N total of 370, with data missing for some specific demographic queries. OR, operating room; PR, procedure room.

Although we are unaware of other literature for comparison specific to CTR, patient expectations have been studied in a variety of surgical fields and are important not only because of their impact on outcomes but because patients and their surgeons often have strikingly different expectations. In the setting of breast reconstruction after mastectomy, Tedesco and Loerzel demonstrated that women held unique expectations of surgical outcomes and that both these expectations and the information made available to them preoperatively influenced the overall satisfaction with breast reconstruction. Mancuso et al revealed that patients undergoing total knee arthroplasty had higher mean expectations of their joint replacement than the surgeons performing their operation. In a 2019 study, only 58% of surgeons performing periacetabular osteotomies for hip dysplasia felt that their expectations aligned with those of their patients. Patient expectations have been studied in the setting of orthopedic joint replacement surgeries, identifying younger age, male sex, and white race to result in higher patient expectations before total knee arthroplasty. In terms of other upper extremity surgeries, total shoulder replacement patients with higher preoperative function and no history of prior joint replacements had greater expectations of their surgical outcomes. This latter point is important, as the lack of knowledge of what it was like to undergo shoulder replacement correlated to higher patient expectations, which speaks to the role of the surgeon in helping the patient understand what their operation, outcome, and recovery may be like if they have never experienced it. Managing and fostering appropriate perioperative patient expectations has been found to influence successful and timely discharge after total hip replacement. Perhaps most importantly, small discrepancies between expectations and fulfillment of these expectations are intimately and significantly related to patient satisfaction, which was demonstrated by Kim et al in the setting of medial opening wedge high tibial osteotomies. We also found that male patients undergoing CTR had significantly higher expectations than their female counterparts. Female patients undergoing aesthetic rhinoplasty were found to have higher levels of preoperative anxiety, depression, obsessive-compulsive symptoms, and general psychopathologic symptoms, as well as higher visual analog scale (VAS) pain scores before the procedure, which may influence patient expectations. Sex is known to influence preoperative expectations before total joint replacement. Perez et al demonstrated that female patients had worse preoperative outcomes scores than male patients.

Table 3. Summary of Patient Expectations

| Preoperative Expectations | N* (%) |
|---------------------------|-------|
| Level of relief/improvement |       |
| Great                     | 177 (57.7%) |
| Some                      | 60 (22.9%) |
| Little                    | 8 (2.6%) |
| None                      | 12 (3.9%) |
| No expectations            | 41 (13.6%) |

*N total of 370, with data missing for some specific demographic queries.
before total knee arthroplasty without notable difference postoperatively. Additionally, female patients undergoing shoulder surgery reported higher VAS pain scores as well as lower Veterans RAND mental scores preoperatively, even though there was ultimately no sex-based differences in PROs at 1-year follow-up. To our knowledge, CTR outcomes do not differ by sex. Our finding that female patients have different expectations before CTR surgery than males highlights the role of the surgeon in providing preoperative counseling about surgical expectations and pertinent patient resources. This becomes particularly relevant in those patients that are male and present with constant numbness and/or weakness atrophy. These clinical findings are correlated with worse outcomes after CTR, and in the context of a particular type of patient (advanced age, male, high socioeconomic status, and low BMI), represent an important opportunity for counseling on the part of the surgeon.

Additionally, our study identified that patients with greater social deprivation (higher ADI) had decreased preoperative expectations before CTR. Social deprivation describes the collective influence of a variety of external stressors—such as poverty, malnutrition, limited access to education, and violence—on an individual’s physical and emotional health. Furthermore, social deprivation has been shown to affect the health outcomes of patients in many contexts. Individuals in lower socioeconomic groups have worse outcomes in the setting of colorectal cancer and after liver and renal transplantation. Social deprivation in the context of upper extremity pathology has been studied to some degree, both in the adult and pediatric populations. Wall et al recently assessed social deprivation in patients with congenital upper extremity abnormalities, indicating that these patients report lower psychosocial well-being and could be at risk for negative outcomes. There is a documented relationship between socioeconomic deprivation and the incidence of hand injuries, with the odds of those in the most deprived category sustaining a hand injury being 1.6 times greater than those in the least deprived category. Social deprivation also influences fracture care. Those in the most deprived 10% of the population have an increased incidence of experiencing fractures. Davis et al found that patients in lower socioeconomic groups had worse pain and functional levels before undergoing total knee arthroplasty. Given that patients from a lower socioeconomic standing are more at risk for injuries and pathology, and also have worse expectations than their higher socioeconomic counterparts, it becomes important to recognize this as a potential barrier to optimal recovery before indicating an individual for surgery. In the context of CTR however, it remains unclear whether the socially deprived experience worse outcomes, and this may be an area warranting further investigation.

This study reinforced the connection between sex, increased BMI, and worse social deprivation with lower expectations before CTR. This is important not only because these factors are identifiable before surgery but given the evidence in the literature that higher preoperative expectations are associated with improved outcomes,

### Table 4. Association between Expectations and Patient Factors: Univariate and Multivariable Binary Logistic Regressions

| Variable                                              | Univariable Model | Multivariable Model |
|-------------------------------------------------------|-------------------|---------------------|
|                                                      | Odds Ratio (95% CI) | P       | Odds Ratio* (95% CI) | P* |
| Age at time of surgery†                               | 1.02 (1.00, 1.03)  | 0.016              | 1.01 (0.99, 1.03) | 0.47 |
| Male sex                                              | 1.58 (0.98, 2.56)  | 0.06               | 1.87 (1.10, 3.21) | 0.02 |
| Non-White race                                        | 0.46 (0.24, 0.88)  | 0.019              | 0.54 (0.27, 1.06) | 0.07 |
| BMI‡                                                  | 0.96 (0.93, 0.99)  | 0.004              | 0.97 (0.94, 1.00) | 0.02 |
| Employment                                            | 1.39 (0.80, 2.44)  | 0.25               |                      |     |
| Retired vs working                                    | 1.38 (0.65, 2.89)  | 0.39               |                      |     |
| Tobacco use                                           | 0.79 (0.46, 1.34)  | 0.38               |                      |     |
| Former smoker vs current                              | 0.87 (0.37, 2.03)  | 0.75               |                      |     |
| Alcohol use (yes vs no)                               | 0.79 (0.46, 1.34)  | 0.38               |                      |     |
| ADI (national percentile)§                            | 0.98 (0.97, 0.99)  | 0.004              | 0.98 (0.97, 1.00) | 0.02 |
| Laterality (unilateral vs bilateral CTR)              | 1.09 (0.68, 1.75)  | 0.71               |                      |     |
| Surgical setting (PR vs OR)                           | 1.00 (0.62, 1.61)  | 1.00               |                      |     |
| qDASH§                                                | 1.00 (0.99, 1.01)  | 0.65               |                      |     |
| Clinical features                                     | 1.40 (0.79, 2.49)  | 0.25               |                      |     |
| Constant numbness present                            | 1.24 (0.65, 2.40)  | 0.52               |                      |     |
| Duration of symptoms (mo)                             | 1.00 (1.00, 1.01)  | 0.49               |                      |     |
| Preoperative testing and interventions                |                   |                    |                      |     |
| EMG obtained                                          | 0.85 (0.53, 1.36)  | 0.49               |                      |     |
| Injection performed                                   | 0.48 (0.19, 1.15)  | 0.11               |                      |     |
| Insurance                                             |                   |                    |                      |     |
| Commercial vs Medicaid                                | 2.08 (1.09, 4.07)  | 0.029              | 1.44 (0.70, 3.00) | 0.32 |
| Medicare vs Medicaid                                  | 2.70 (1.31, 5.70)  | 0.008              | 1.57 (0.58, 4.27) | 0.37 |
| Other vs Medicaid                                     | 2.05 (0.52, 22.82) | 0.24               | 1.85 (0.26, 16.84) | 0.55 |

*Multivariable model includes all variables with P value < 0.1 in the univariable models. Sample size for the multivariable model is N = 297.
†Refers to each additional 1 year in age.
‡Refers to each additional one point increase in BMI.
§Refers to each additional one percentile increase in ADI.
¶Refers to each additional 1 point difference in qDASH.
OR, operating room; PR, procedure room; qDASH, Quick Disabilities of Arm, Shoulder and Hand Score.
Rauck et al\textsuperscript{15} demonstrated that patients with higher expectations before reverse total shoulder arthroplasty experienced improved outcomes in terms of less nocturnal pain and return to overhead sports. Additionally, there is a documented positive correlation between patient expectations and their outcome after total joint arthroplasty.\textsuperscript{36} Jain et al\textsuperscript{38} demonstrated that higher preoperative expectations predicted greater PROs, satisfaction, and fulfillment of expectations. This is further convoluted by the fact that those from higher socioeconomic status have higher expectations of arthroplasty to begin with.\textsuperscript{31} Ultimately, the surgeon has the opportunity to identify the factors that make their patient more at risk—such as their socioeconomic background, BMI, and sex—and provide counseling or resources, intervene on unrealistic expectations, and allow that individual to reframe their expectations and support their individual postoperative recovery. Ultimately, helping patients set realistic expectations produces anticipations that are more likely to be met, which may improve overall patient satisfaction.\textsuperscript{57} Preoperative counseling as a result of unrealistic expectations can also lead to a more informed decision-making process for patients considering surgical treatment and can assist in identifying physician–patient communication barriers. This has been borne out in the literature surrounding breast reconstruction after mastectomy, where Tedesco and Loerzel\textsuperscript{62} demonstrated that provider counseling catered to patients based on their individual expectations before surgery—as determined by a preoperative questionnaire—resulted in patients feeling more prepared for both the surgery and what to anticipate in the postoperative recovery period.

Study limitations that warrant mention include the possibility of selection bias given that we did not have 100\% enrollment. Additionally, the generalizability of our study may be limited due to the homogeneity of our study population (mostly White) with the majority falling in the lower two quartiles in terms of social deprivation. Our study may be subject to recall bias, as aspects such as symptom duration are based on patient histories. As there is no gold standard anchor question, the use of different anchor questions, or alternate wording or answer choices may affect the results. Although ADI was associated with expectations, it remains unclear if ADI affects the outcome (satisfaction or dissatisfaction) or PROs following CTR. Further research is required to evaluate this.

In summary, the majority of patients expected great improvement after CTR. Preoperative expectations regarding improvement following CTR were independent of surgical technique and setting. Older age, constant numbness, and presence of weakness and/or atrophy were not found to influence patient expectations, which highlights an opportunity for patient counseling given that these factors lead to worse outcomes and a greater level of residual symptoms after CTR.\textsuperscript{23,26,36} Our finding that social deprivation is associated with lower expectations is consistent with a plethora of data demonstrating worse outcomes and decreased access to healthcare for the socioeconomically disadvantaged,\textsuperscript{35} and highlights the importance of evaluating health disparities among CTR patients.
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