Outlook of Expedited Rotator Cuff Surgery in Injured Workers

Determinants of Successful Recovery

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Background: Work-related rotator cuff injuries are a common cause of disability and employee time loss. In the case of persisting symptoms and unsuccessful response to nonoperative treatment, surgery may be indicated to reduce symptoms and improve rotator cuff function. While minor pathologies such as tendinitis or partial-thickness tears of the rotator cuff associated with subacromial bony impingement benefit from rotator cuff decompression, more significant pathologies such as full-thickness tears are usually managed through repair of the tendon(s).

Work-related rotator cuff injuries are a common cause of disability and employee time loss. In the case of persisting symptoms and unsuccessful response to nonoperative treatment, surgery may be indicated to reduce symptoms and improve rotator cuff function. While minor pathologies such as tendinitis or partial-thickness tears of the rotator cuff associated with subacromial bony impingement benefit from rotator cuff decompression, more significant pathologies such as full-thickness tears are usually managed through repair of the tendon(s).

Secondary to fiscal constraints on the Canadian health care system, delays for scheduled shoulder surgery can span...
several months and can often be over a year for many providers. Canadian Workers’ Compensation Boards have the responsibility of facilitating timely access to care for injured workers to reduce financial cost to both employees and employers by decreasing chronicity of disability. In Canada, some Provincial Workers’ Compensation Boards, including the Workplace Safety and Insurance Board (WSIB), act as a parallel pay insurance to finance preferred access to specialist assessment and expedited surgeries. One strategy to create a preferred access and expedite surgical care of injured workers involves establishing specialty clinics and contracting for additional capacity in the operating theaters of the public system. The WSIB covers the facility fee and funds the surgeons and the required support personnel.

Apart from the general belief that longer time off work is associated with more chronic disability, we are not aware of any literature on the results of expedited surgery for injured workers with shoulder conditions. Therefore, as a first step to examine the effectiveness of this initiative, the objectives of this study were to report on the results of expedited surgery in injured workers who had failed nonoperative treatment and then undergone rotator cuff–related surgery. A second objective was to explore the relationship between demographics and clinical and psychosocial factors in predicting the outcome of surgery. We hypothesized that (1) injured workers with rotator cuff pathology would improve in their perceived disability, (2) certain factors associated with more chronic disability, and presence of psychosocial factors would have a negative impact on patient recovery.

METHODS

Patient Population

This was a prospective longitudinal study of injured workers who were seen at a shoulder specialty program and who underwent an expedited arthroscopic rotator cuff decompression or repair financed by the WSIB. At the time of the study (May 2013 to May 2015), the expedited shoulder surgery for patients who did not delay surgery for personal reasons took place within an average of 65 business days from approval by the WSIB.

The inclusion criteria included an active work-related shoulder injury; age ≥18 years; failure of nonoperative treatment measures, including a structured physical therapy program; and diagnosis of tendinitis or partial- or full-thickness rotator cuff tear confirmed by magnetic resonance imaging or ultrasound. Patients unable to speak or read English and those with evidence of advanced osteoarthritis of the glenohumeral joint, inflammatory arthropathy, or concurrent pathology of superior labral anterior and posterior (SLAP) lesions or Bankart lesions that required a repair were excluded. Informed consent was obtained and the rights of the subjects were protected. Approval for use of human participants was obtained from the research ethics board of the Sunnybrook Health Sciences Centre.

Demographics and Clinical Data

Demographics such as age, sex, affected side, surgery on dominant side, smoking, job demands, level of education, family support, access to care, comorbidity, symptom duration, and mechanism of injury were documented at 2 to 3 weeks prior to surgery. The level of comorbidity was calculated by the Cumulative Illness Rating Scale, which examines overall health. The scale ranges from 0 to 52, with higher numbers representing a higher level of impairment.

Clinical examination included active ROM prior to surgery and at the time of discharge at 6 months or 1 year after surgery, depending on type of surgery and the patient’s recovery (i.e., patients who had reached full recovery at 6 months were discharged at 6 months and others were discharged at 1 year).

Outcome Measures

Pre- and postoperative levels of disability were measured by the American Shoulder and Elbow Surgeons (ASES) Standardized Shoulder Assessment Form, which served as the primary patient-oriented outcome measure. The ASES is a valid and reliable outcome measure in patients with rotator cuff disease. The minimal clinically important difference (MCID), which is the smallest change in treatment outcome that a patient would identify as important, for the ASES is suggested at 17 points. Secondary outcomes collected pre- and postoperatively were ROM, medication consumption, and work status. Medication consumption was documented as binary data in 3 categories of analgesics, anti-inflammatories, and narcotics.

Work status was documented in 3 categories of regular duties, modified duties, and inability to work. Satisfaction with surgery, documented on the final follow-up visit, was rated on a 6-point Likert-type scale: very satisfied, somewhat satisfied, a little bit satisfied, a little bit dissatisfied, somewhat dissatisfied, and very dissatisfied.

Work-Related Psychological Factors

Participants were asked about 7 aspects of their job demands on a Likert-type scale: job support (from colleagues and supervisors), monotony/boringness, work pace, stressfulness, autonomy (ability to make own decisions), having the opportunity to learn new things, and overall job satisfaction. These questions were based on Karasek’s demand–support–control model and are shown to be associated with musculoskeletal pain.

Surgical Data

Three experienced surgeons with a subspecialty in shoulder surgery (R.H., S.G., P.H.) operated on the patients. The extent of rotator cuff and osseous pathology was documented at the time of surgery as tendinitis, partial- or full-thickness tear, subacromial osteophytes, and/or...
degenerative changes in the acromioclavicular joint. Patients with tendinitis or low-grade partial thickness tears of the rotator cuff associated with subacromial bony impingement or osteoarthritis of the acromioclavicular joint that had failed nonoperative treatment underwent rotator cuff decompression (acromioplasty and or resection of lateral clavicle). The full-thickness tears of the rotator cuff were managed through arthroscopic repair of the tendon(s). The size of rotator cuff tear (largest dimension) was categorized as small (<1 cm), moderate (1-3 cm), large (>3-5 cm), and massive (>5 cm). Surgeries overlapped in patients with multiple pathologies.

Rehabilitation

Patients received a standardized rehabilitation program based on the type of surgery. Patients with rotator cuff decompression were allowed to start active-assisted forward flexion and pendulum motions on postoperative day 1, progressing to active movements within a few days after surgery. Patients with rotator cuff repair wore a shoulder immobilizer for 4 to 6 weeks. Submaximal isometric exercises started at 6 weeks. Strengthening exercises against resistance commenced 10 to 12 weeks postsurgery.

Sample Size Justification

To detect a change of 12 points, noted as the lower end of MCID, and a power of 0.90, 48 patients were needed to answer the first question (change over time of ASES score). To answer the second question (identify predictors of disability based on ASES), using multiple regressions and the rule of thumb of 10 observations for each parameter in the model (one df [degree of freedom] for continuous data and one df – 1 for each category of categorical data), a minimum of 140 patients with complete data were required to examine up to 14 covariates together. To compensate for patients who were excluded at surgery or were lost to follow-up, this number was inflated by 10%. Therefore, a sample of 154 patients was considered sufficient to answer both questions.

Analytical Approach

Descriptive statistics were performed for all variables of interest. Change over time was documented in the ASES score and ROM by paired Student t tests and in work status and medication consumption by chi-square statistics as appropriate. Satisfaction with surgery was reported on a descriptive basis.

Patients were categorized into 2 groups: (1) those who exceeded the MCID of 17 points in the primary outcome measure and (2) those who did not. The relationship between disability as defined by the ASES (response variable) and individual predictors (independent variables) was examined in 2 different ways: Once with the postoperative ASES as continuous data through univariable ordinary least squares regressions and once with the ASES as categorical data (MCID >17 and MCID ≤17) through logistic regressions. The first analysis examined factors that affected the overall postoperative disability; the second analysis helped identify factors that affected making a certain level of improvement (eg, making an

| Patient Demographics (N = 146) |
|---------------------------------|
| Sex, n (%)                      |
| Female                          | 43 (29) |
| Male                            | 103 (71) |
| Age, y, mean (SD), range        | 52 (8), 27-75 |
| Age group, y                    |
| <65                             | 142 (97) |
| >65                             | 4 (3) |
| Comorbidity, mean (SD), range   | 3 (2), 1-10 |
| Marital status, n (%)           |
| Single                          | 16 (11) |
| Common law/married              | 100 (70) |
| Separated                       | 11 (8) |
| Divorced                        | 13 (9) |
| Widowed                         | 6 (4) |
| Education, n (%)                |
| No formal education             | 1 (<1) |
| Grade 8-11                      | 31 (21) |
| High school degree              | 43 (30) |
| College degree                  | 53 (37) |
| Bachelor degree                 | 15 (10) |
| Professional degree             | 9 (2) |
| Smoking, n (%)                  |
| Yes                             | 34 (23) |
| No                              | 112 (77) |
| Job demands, n (%)              |
| Heavy labor                     | 63 (43) |
| Light                           | 66 (45) |
| Sedentary                       | 17 (12) |
| Mechanism of injury, n (%)      |
| Insidious                       | 4 (2) |
| Repetitive                      | 24 (16) |
| Fall                            | 49 (34) |
| Traumatic                       | 60 (41) |
| Direct blow                     | 2 (1) |
| Traction injuries               | 4 (4) |
| Access to care, n (%)           |
| Not difficult                   | 89 (61) |
| A little bit difficult          | 33 (23) |
| Somewhat difficult              | 19 (13) |
| Very difficult                  | 5 (3) |
| Affected side                   |
| Left                            | 67 (46) |
| Right                           | 79 (54) |
| Surgery on dominant side, n (%) |
| Yes                             | 79 (54) |
| No                              | 67 (46) |
| Wait time (WT), mean (SD), range|
| WT1: Date of injury to date of surgery, mo | 16 (16), 2-124 |
| WT2: Date of consent to date of surgery, d | 82 (44), 12-261 |
| Type of surgery, n (%)          |
| Distal clavicle resection       | 33 (23) |
| Acromioplasty                   | 133 (91) |
| Rotator cuff repair             | 67 (46) |
| Small                           | 9 (20) |
| Moderate                        | 35 (76) |
| Large                           | 15 (33) |
| Massive                         | 8 (17) |
improvement that was considered clinically meaningful). The predictors for both models were the following: age, sex (female vs male), surgery on dominant side (yes vs no), access to care (not difficult/a little bit difficult vs somewhat difficult/very difficult), job demands (heavy vs light vs sedentary), preoperative work status (unable to work vs modified duties vs regular duties), and work-related psychosocial factors (7 categories). The final analyses involved 2 multivariable analyses (multiple ordinary least squares regression and multiple logistic regression) to assess the value of all predictors together. Only variables that were significant at $P < .05$ in the univariable analyses were entered into multivariable regressions.

**RESULTS**

One hundred fifty-four patients met the inclusion criteria and entered into the study over a period of 2 years (May 2013 to May 2015). Five patients were excluded at the time of surgery (1 patient had an isolated subscapularis repair, 2 patients required a SLAP repair, and 2 underwent an associated glenohumeral stabilization procedure). Of 149 patients, 2 patients did not attend their follow-up visits and 1 patient declined to complete the follow-up questionnaires. Therefore, 146 patients (43 women [29%], 103 men [71%]; mean age, 52 years; SD, 8 years) were included in data analysis (response rate of 98%). Sixty-seven (46%) patients had a repair of the rotator cuff. Forty patients were

| Variable                      | Preoperative | Postoperative | Statistics for Change$^b$ |
|-------------------------------|--------------|---------------|--------------------------|
| ASES, mean (SD)               |              |               |                          |
| Full sample                   | 34 (15)      | 70 (20)       | Paired $t$ test = 21.62, $P < .0001$ |
|                               |              |               | MCID $>17$: 122 (84%)    |
|                               |              |               | MCID $\leq 17$: 24 (16%)|
| Rotator cuff repair subgroup  | 31 (14)      | 69 (19)       | Paired $t$ test = 16.69, $P < .0001$ |
|                               |              |               | MCID $>17$: 60 (90%)    |
|                               |              |               | MCID $\leq 17$: 7 (10%) |
| Rotator cuff decompression subgroup | 35 (16)  | 70 (20)       | Paired $t$ test = 14.34, $P < .0001$ |
|                               |              |               | MCID $>17$: 62 (78%)    |
|                               |              |               | MCID $\leq 17$: 17 (22%)|
| Range of motion, deg, mean (SD) |          |               |                          |
| Flexion                       | 118 (37)     | 149 (30)      | Paired $t$ test = 8.97, $P < .0001$ |
| Abduction                     | 108 (39)     | 144 (35)      | Paired $t$ test = 9.35, $P < .0001$ |
| External rotation             | 46 (16)      | 51 (17)       | Paired $t$ test = 2.88, $P = .0045$ |
| Medication consumption        |              |               |                          |
| Analgesics                    | 44           | 33            | $\chi^2 = 1.76, P = .1834$ |
| Anti-inflammatories           | 32           | 32            | $\chi^2 = 0.00, P = .1000$ |
| Narcotics                     | 14           | 8             | $\chi^2 = 1.76, P = .1834$ |
| Work status$^c$               |              |               |                          |
| Full-time                     | (n = 105)    | (n = 99)      | Fisher exact test < .0001 $P < .0001$ |
| Regular duties                | 20           | 48            |                          |
| Modified duties               | 85           | 51            |                          |
| Part-time                     | (n = 13)     | (n = 12)      |                          |
| Regular duties                | 0            | 4             |                          |
| Modified duties               | 13           | 8             |                          |
| Off work                      | (n = 28)     | (n = 29)      |                          |
| Medically restricted          | 14           | 3             |                          |
| Unsuitable tasks              | 10           | 15            |                          |
| Other (retraining)            | 4            | 11            |                          |
| Retired                       | 0            | 6             |                          |
| Postoperative satisfaction with surgery, n (%) |              |               |                          |
| Very satisfied                | 78 (53)      |               |                          |
| Somewhat satisfied            | 37 (25)      |               |                          |
| A little satisfied            | 9 (6)        |               |                          |
| A little dissatisfied         | 8 (6)        |               |                          |
| Somewhat dissatisfied         | 5 (4)        |               |                          |
| Very dissatisfied             | 2 (1)        |               |                          |
| Missing                       | 7 (5)        |               |                          |

$^a$ASES, American Shoulder and Elbow Surgeons; MCID, minimal clinically important difference.

$^b$Boldfaced values indicate statistical significance.

$^c$The number of patients doing regular duties increased from 8 (12%) to 19 (28%) in the repair group and from 12 (15%) to 33 (42%) in the decompression group at the time of discharge.
discharged at 6 months as they had achieved full recovery, and 106 patients who required a longer time to recover were discharged at 1 year. The demographics and characteristics of the sample studied are shown in Table 1.

**Wait Time**

The average time between the date patient consented to have surgery and date of actual surgery was 82 days (SD, 44 days; range, 12-261 days). Some surgeries were delayed or cancelled by patients for personal reasons. The symptom duration (date of original injury to date of surgery) varied from 2 to 124 months with an average of 16 months (SD, 16 months). There were a number of outliers with chronic symptoms or multiple injuries.

**Change Over Time (Recovery)**

There was a statistically significant improvement in the ASES. Eighty-four percent (n = 122) of the patients exceeded the MCID of 17 points. Table 2 shows the details of the ASES scores in subgroups of patients with rotator cuff repair and decompression procedures. ROM was improved in flexion, abduction, and external rotation (Table 2). Although the number of patients who took painkillers and narcotic medication was lower at follow-up, this was not statistically significant. The work status improved at a statistically significant level, changing from “unable to work” to “modified” or “modified” to “regular duties” in the full sample (P < .0001). The number of patients doing regular duties increased from 8 (12%) to 19 (28%) in the repair group and from 12 (15%) to 33 (42%) in the decompression group. The majority of patients (78; 53%) reported high satisfaction with surgery, with 37 (25%) reporting somewhat satisfied and a smaller percentage reporting dissatisfaction with surgery (Table 2).

**Impact of Predictor Variables on Postoperative ASES and MCID**

Demographics, surgery on dominant side, or job demands did not predict the postoperative ASES or the amount of recovery made as defined by the MCID. The postoperative ASES had a significant relationship with work status prior to surgery. Patients who worked regular duties had an average of 78 on ASES, versus 68 for patients who performed modified duties and 60 for those who were off work (Table 3) at the time of discharge.

The most consistent predictor of disability was the level of access to care as perceived by the injured workers. This predictor had a statistically significant relationship with both postoperative ASES (P = .01) and the MCID (P = .01) (Tables 3 and 4).

Among psychological factors, patients who reported more autonomy at work were less disabled at follow-up (P = .04) and were more likely to exceed the MCID of 17 ASES points (P = .01). Patients who reported less stress at work were more likely to exceed the MCID (P = .03). Patients who had a higher satisfaction with their job were more likely to exceed MCID (P = .04). The final multiple ordinary least squares regression that adjusted for all statistically significant variables showed that the most important predictors of overall disability at the time of discharge (postoperative ASES) were patient-perceived autonomy at work and level of disability prior to surgery (Table 5). The multiple logistic regressions that adjusted for all significant psychosocial factors showed that the most important predictors of exceeding a clinically meaningful change were patient perceived autonomy at work and access to care (Table 5).

**DISCUSSION**

**Wait Time**

At present, in Ontario, Canada, the target wait time from shoulder surgical assessment to surgery is 188 days or about 6 months. The WSIB has set the optimal wait time from day of approval for surgery to surgery at 10 business days, which at present is 23 days in our center. This timeframe varies based on the number of consultants (surgeons) and operating room availability. The patients who participated in the present study waited an average of 82 days from the day they consented to surgery and the day surgery was performed. Some surgeries were delayed or cancelled by patients for personal reasons, which made the wait time longer that desired. The symptom duration (injury to surgery) was longer, as some patients with chronic symptoms or multiple injuries were included.

The role of accelerated surgical procedures in improving care of patients with acute rotator cuff tears should not be
underestimated. Successful repair of acute traumatic tears, particularly in younger individuals, is reported to be affected by the surgical time frame. Delay in surgery may affect tissue quality and healing environment and increase tear retraction and fatty degeneration of the involved muscle. The threshold of the timing for "optimal" results of acute cuff tears is suggested to be anywhere from 3 weeks to 4 months. In a study by Bassett and

| Predictor Variable                        | Estimate | Odds Ratio (95% CI) | Wald $\chi^2$ | $P$ Value$^b$ |
|------------------------------------------|----------|---------------------|---------------|---------------|
| Age                                      | 0.03     | 1.03 (0.98-1.08)    | 1.01          | .31           |
| Sex (2 categories)                       |          |                     |               |               |
| Female vs male                           | -0.011   | 0.81 (0.31-2.95)    | 0.21          | .65           |
| Smoking (2 categories)                   |          |                     |               |               |
| Yes vs no                                | -0.08    | 0.84 (0.29-2.46)    | 0.10          | .76           |
| Access to care (2 categories)            | 0.072    | 4.28 (1.59-11.48)   | 8.3           | .01           |
| Surgery on dominant side                 | 0.017    | 0.71 (0.29-1.74)    | 0.54          | .46           |
| Job demands (3 categories)               |          |                     |               |               |
| Heavy vs sedentary                       | -0.48    | 0.26 (0.03-2.20)    | 1.29          | .26           |
| Light vs sedentary                      | -0.37    | 0.30 (0.4-2.47)     | 0.77          | .38           |
| Type of surgery (2 categories)           | -0.43    | 0.43 (0.17-1.10)    | 3.11          | .08           |
| Preoperative work status (3 categories)  |          |                     |               |               |
| Regular vs off work                      | 0.15     | 1.55 (0.34-7.09)    | 0.11          | .74           |
| Modified vs off work                     | 0.13     | 1.51 (0.52-4.34)    | 0.13          | .69           |
| Work-related psychosocial factors        |          |                     |               |               |
| Support from colleagues                  | 0.14     | 2.12 (0.64-7.00)    | 0.09          | .76           |
| Dissatisfied vs neither                  | 0.48     | 3.00 (0.30-29.94)   | 0.43          | .51           |
| Monotonous work                          | -0.18    | 0.70 (0.24-2.04)    | 0.42          | .52           |
| Work pace                                | -0.30    | 0.54 (0.19-1.54)    | 1.29          | .25           |
| Stressful work                           | 0.60     | 3.33 (1.10-10.01)   | 4.60          | .03           |
| Work autonomy                            |          |                     |               |               |
| Often/very often vs sometimes            | 0.93     | 5.91 (1.76-19.90)   | 6.11          | .01           |
| Seldom/very seldom vs sometimes          | -0.09    | 2.14 (0.44-10.34)   | 0.03          | .85           |
| Learn new things                         | 0.357    | 1.26 (0.37-4.32)    | 0.86          | .35           |
| Seldom/very seldom vs sometimes          | -0.48    | 0.54 (0.15-1.97)    | 1.44          | .22           |
| Overall satisfaction with job            | 0.82     | 3.63 (1.13-11.63)   | 4.12          | .04           |
| Satisfied vs neither                     | -0.36    | 1.10 (0.18-6.82)    | 0.39          | .53           |

$^a$MCID, minimal clinically important difference.

$^b$Boldfaced values indicate statistical significance.

| Predictor Variable                        | Estimate | Odds Ratio (95% CI) | Wald $\chi^2$ | $P$ Value$^b$ |
|------------------------------------------|----------|---------------------|---------------|---------------|
| Preoperative ASES                        | 7.21     |                     |               | .01           |
| Work autonomy                            | 7.01     |                     |               | .01           |
| Access to care                           | 2.05     |                     |               | .15           |
| Preoperative work status                 | 0.85     |                     |               | .43           |

$^a$ASES, American Shoulder and Elbow Surgeons; MCID, minimal clinically important difference.

$^b$Boldfaced values indicate statistical significance.
Cofield, a group of patients who had undergone a rotator cuff repair within 3 months of injury were categorized into 3 groups: patients who had surgery within 3 weeks, those who had surgery between 3 and 6 weeks, and finally those who had surgery between 6 and 12 weeks. The authors reported that patients who underwent repair within 3 weeks had the best functional results. Providing capacity for the timely treatment of injured workers facilitates optimization of surgical wait time for injured workers. However, it is recommended that even patients with asymptomatic rotator cuff tears be monitored. Yamaguchi et al reported progression of tear size in 39% (9/23) of asymptomatic patients with rotator cuff tears. In their study, development of symptoms was associated with a significant increase in pain and decrease in the ability to perform activities of daily living. Similarly, in a study of 50 asymptomatic patients with rotator cuff tear, Moosmayer et al reported a significant increase in tear size, muscle atrophic changes, and fatty degeneration in the newly symptomatic group when compared with the still-asymptomatic group. The authors suggested that in light of progression of pathology, patients diagnosed with an asymptomatic rotator cuff tear should be informed about the natural history of the condition and stated that follow-up with repeated imaging may be indicated to monitor tear progression.

Recovery

Our study shows an overall successful response to expedited surgery in patients with work-related rotator cuff pathology. Patients improved on average in the report of disability, ROM, and work status.

Predictors of Recovery

Patients who reported better autonomy, less stress, and more satisfaction with their job were more likely to exceed the MCID. Preoperative disability, on the other hand, played an important role in the overall disability expressed by patients. Putting the results of both regression analyses into perspective, by creating an environment that ensures less stress and a sufficient level of autonomy, employers can help with lowering disability after rotator cuff surgery.

Access to Care

The role of Workers' Compensation Boards in Canada as a system of social insurance is to encourage workplace safety and to optimize care for workplace-related injuries and illness. It has been suggested that the preferential treatment of workers through expediting investigations, assessments, and surgery may create unequal access to care for patients with non-work-related injuries, who have to wait longer due to limited available resources. However, parallel insurance helps improve quality standards, accountability, and innovation for injured workers without taking away resources from the public health by using the excess underutilized capacity of the surgeons and operating theaters of the public system.

In the present study, perceived level of access to care was the most consistent predictor of overall postoperative disability and improvement beyond the MCID. Our results showed that despite the effort to improve access by the WSIB, suboptimal access to care explained poor results of some patients after rotator cuff surgery. This may indicate that there is the potential to optimize access to care for some individual patients. Future studies should explore the details on suboptimal access to care experienced by workers throughout the management pathway, such as delay in reporting the injury or delay in initial assessment, imaging services, or referral for specialized care.

Limitations

All 3 orthopaedic surgeons involved in this study were experienced and had subspecialty in shoulder surgery. However, minor differences in surgical techniques might have existed among surgeons.

CONCLUSION

Expedited rotator cuff surgery improved disability, ROM, and work status in injured workers. Successful recovery after work-related shoulder injuries may be further facilitated by optimizing access to care and improving the psychosocial work environment.

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