Comparison of Local-Only Anesthesia Versus Sedation in Patients Undergoing Staged Bilateral Carpal Tunnel Release: A Randomized Trial

HAND
2020, Vol. 15(6) 785–792
© The Author(s) 2019
Article reuse guidelines:
sagepub.com/journals-permissions
DOI: 10.1177/1558944719836237
journals.sagepub.com/home/HAN

Garrhett G. Via¹, Andrew R. Esterle², Hisham M. Awan¹, Sonu A. Jain¹, and Kanu S. Goyal¹

Abstract

Purpose: Carpal tunnel syndrome is a common disease treated operatively. During the operation, the patient may be wide-awake or sedated. The current literature has only compared separate cohorts. We sought to compare patient experience with both local-only anesthesia and sedation. **Methods:** Staged bilateral carpal tunnel release utilizing open or endoscopic technique was scheduled and followed through to completion of per-protocol analysis in 31 patients. Patients chose initial hand laterality and were randomized regarding initial anesthesia method: local-only or sedation. Data collection via questionnaires began at consent and continued to 6 weeks postoperatively from second procedure. Primary outcome measures included patient satisfaction and patient anesthesia preference. **Results:** At final follow-up, 6 weeks postoperatively, high satisfaction (30 of 31 patients per method) was reported with both types of anesthesia. Among these patients, 17 (54%) preferred local-only anesthesia, 10 (34%) preferred sedation, 2 had no preference, and 2 opted out of response. Although anesthesia fees were approximately \$390 lower with local-only anesthesia, total costs for carpal tunnel release were not significantly different with respect to the anesthesia cohorts. Total time in surgical facility was approximately 26 minutes quicker with local-only anesthesia, largely due to shorter time in the post-anesthesia care unit. Scaled comparison of worst postoperative pain following the 2 procedures revealed no difference between local-only anesthesia and sedation. **Conclusions:** Patients reported equal satisfaction scores with carpal tunnel release whether performed under local-only anesthesia or with sedation. In addition, local-only anesthesia was indicated as the preference of patients in 59% of cases.

Keywords: carpal tunnel release, WALANT, anesthesia, sedation, patient satisfaction

Introduction

Carpal tunnel syndrome is the most common compressive neuropathy of the upper extremity, with an estimated prevalence of 1.5% to 5% in the general population.¹⁻³ Accordingly, up to 700 000 procedures occur per year to surgically treat carpal tunnel syndrome, which makes carpal tunnel release—performed via open and endoscopic techniques—the most common elective hand surgery performed in the United States.⁴ Regardless of the chosen technique, the procedure is considered safe, effective, and is associated with a low complication rate.^{5,6} Relief of symptoms has been shown to correlate with high patient satisfaction.⁷

Recent trends in the literature include sedation-free carpal tunnel surgeries using the acronymic WALANT (wide-awake local anesthesia with no tourniquet) technique, which involves the injection of only a local anesthetic and epinephrine.⁸⁻¹⁰ This method combines the numbing properties of

the local anesthetic, the vasoconstrictive properties of epinephrine, and the tumescent effect of the injection itself. Benefits of WALANT include minimal preoperative testing, eating, and drinking on the day of surgery; freedom from sedation-induced nausea; and the ability to provide one's own transport to and from surgery in an ambulatory setting.

¹The Ohio State University Wexner Medical Center, Columbus, USA

²The Cleveland Clinic Akron General Orthopedic Institute, OH, USA

Supplemental material is available in the online version of the article.

Corresponding Author:

Kanu S. Goyal, Division of Hand and Upper Extremity Surgery, Department of Orthopaedics, The Ohio State University Wexner Medical Center, 915 Olentangy River Road, Suite #3200, Columbus, OH 43212, USA.
Email: kanu.goyal@osumc.edu

Table 1. Study Inclusion and Exclusion Criteria.**Inclusion criteria**

- Ability to provide consent
 - 18 y ≤ age ≤ 89 y
 - Presence of bilateral carpal tunnel (via clinical and/or electromyographic qualifications) syndrome requiring surgical release
 - Symptoms of numbness and tingling in the radial digits of the hand that may or may not occur during the day and night time
- AND/OR
- Signs on examination such as positive Tinel sign over the median nerve at the wrist or positive Phalen or Durkan compression test at the wrist or thenar atrophy
- AND/OR
- Nerve conduction studies showing conduction block of the median nerve across the wrist as evidenced by decreased velocity or delayed latency in the motor and sensory fibers, and/or electromyography showing abnormal activity in the abductor pollicis brevis
 - Willingness to participate in both methods of anesthesia
 - Ability to have both surgeries provided by the same surgeon, utilizing the same technique

Exclusion criteria

- Prior history of carpal tunnel release
- Allergy to local anesthetic
- Medical condition prohibiting sedation^a
- Any other contraindications to sedation
- Current imprisonment/incarceration

^aConditions include, but are not limited to, chronic obstructive pulmonary disease, lung cancer, sickle cell disease, liver disease, and kidney disease.

From a broader, systems-based standpoint, it has been demonstrated to be both more efficient and cost-effective.¹¹

Regardless of which anesthesia is used during a patient's carpal tunnel surgery, the general patient consensus tends toward high rates of satisfaction with the surgery and a proclivity to choose that treatment method again, if necessary.¹² This raises the question as to which method of anesthesia is truly preferred. To date, the current literature has only compared separate cohorts and has not addressed individual patients' experience with both types of anesthesia. Patients who will be undergoing staged bilateral carpal tunnel release present a unique opportunity to study this question in a prospective manner. It was hypothesized that after experiencing both types of anesthesia described, a greater proportion of patients would prefer wide-awake, local-only carpal tunnel release. As such, the primary outcome measures of this study included determinations of patient satisfaction with each procedure and patient anesthesia preferences.

Materials and Methods

Research Design

Patients who met diagnostic criteria for bilateral carpal tunnel syndrome and fit within inclusion and exclusion criteria were offered to participate in this institutional review board (IRB)-approved, prospective, randomized control trial with a paired-sampling design study (Table 1). Enrolled patients would have one hand operated on with local-only anesthesia, and the other hand with local anesthesia plus sedation. The patient was allowed to choose

which hand would be operated on first. Each patient was randomly assigned via the "RANDBETWEEN" function of Microsoft Excel to one of the 2 anesthesia methods for the first carpal tunnel release. The other method was then used for the second surgery. The 2 surgeries were completed by one of the 3 fellowship-trained hand surgeons. It was recommended that patients have the surgeries within 4 weeks of one another to limit recall bias. Open or endoscopic techniques were performed according to the surgeon's preference, but the same technique was used bilaterally. Advantages and disadvantages of each anesthesia method were discussed prior to enrollment to achieve a comprehensive informed consent.

Measurement/Instrumentation

Qualitative and quantitative measures were collected from study participants before and after both surgeries (Table 2).^{13,14} Baseline demographic and clinical information was collected (Table 3). After each surgery, the patient's operative report and medical chart were reviewed to collect patient time in the surgery center, preoperative suite, OR suite (including incision to closure), and recovery suite (post-anesthesia care unit [PACU]). In addition, objective information on direct costs of the procedure, which included breakdowns for total cost, anesthesia cost, facility/PACU fees, and surgeon fees, was collected. A postoperative questionnaire was given 2 weeks after each surgery and a final questionnaire was completed at 2 and 6 weeks postoperatively from second surgery (Supplemental Appendix I). If the patient decided to withdraw from the study, a

Table 2. Data Collection Protocol/Timeline for Enrolled Patients.

Baseline (initial consultation visit)

- Informed consent
- HIPAA
- QuickDASH (0-100, 100 is high disability)
- Beck Anxiety Index (0-63, 63 is high anxiety)
- Demographics
- Prediction of preferred anesthesia method (1-10 scale to quantify preference, 10 is high)

Pre-op 1 (immediately prior to first surgery)

- Beck Anxiety Index (0-63, 63 is high anxiety)
- Prediction of satisfaction (1-10 scale, 10 is high satisfaction)

Post-op 1 (2 weeks after first surgery)

- Post-op questionnaire
- Surgeon comfort (1-5 scale, 5 is high comfort)

Pre-op 2 (immediately prior to second surgery)

- Beck Anxiety Index (0-63, 63 is high anxiety)
- Prediction of satisfaction (1-10 scale, 10 is high satisfaction)

Post-op 2 (2 weeks after second surgery)

- Post-op questionnaire
- Surgeon comfort (1-5, 5 is high comfort)

Final follow-up (6 weeks after second surgery)

- QuickDASH (0-100, 100 is high disability)
- Final Patient Questionnaire

Note. HIPAA = Health Insurance Portability and Accountability Act; QuickDASH = the shortened version of the Disabilities of the Arm, Shoulder and Hand Questionnaire.

withdrawal questionnaire was requested to be completed (Supplemental Appendix II).

More specific study details are provided in Supplemental Appendix III.

Statistical Analysis

In the last 3 years of the senior author's practice, 24% of surgery-naïve patients chose local-only anesthesia and 76% chose sedation as an anesthesia preference for an isolated carpal tunnel release. It is expected that this study may reveal that the proportion preferring local-only anesthesia is at least double this baseline value, or 48%. With a sample size of 30 patients, a priori power analysis predicts approximately 80% power to detect such a 2-fold difference from baseline in anesthesia preference at a significance level of 0.05 based upon the 2-sided binominal test. To account for attrition of the study participants, a goal was established to enroll more than the minimum 30 patients. Due to limitations of the IRB, it is uncertain how many patients were truly eligible for study participation, but 53 patients ultimately agreed to participate.

The primary outcome measures of this investigation were to determine the level of patient satisfaction and to estimate the preference of using local-only anesthesia, along with its 95% confidence interval (CI), in this patient population undergoing bilateral carpal tunnel release. Secondary outcomes included the Beck Anxiety Inventory, the shortened version of the Disabilities of the Arm, Shoulder and Hand Questionnaire

(QuickDASH), surgical times and costs, postoperative pain assessment, and surgeon comfort. Paired *t* testing or other appropriate nonparametric procedures were implemented in a per-protocol ("on-treatment") analysis, meaning that only patients fulfilling all eligibility, intervention, and outcome assessment requirements were included for statistical comparisons. All statistical analyses were performed using R Studio (version 1.1.383) operating under R (version 3.4.2) with significance set at an α level of 0.05 ($P < .05$).

Results

Per-protocol analysis was performed on 31 patients due to the fact that 14 patients were lost to follow-up and 8 patients desired to have the same anesthesia method for the second surgery (Figure 1). Prior to surgery, patients predicted a satisfaction score of 6.8 ± 2.6 for local-only anesthesia, and this increased to a statistically significant actual satisfaction value of 9.3 ± 1.5 ($P < .01$) at 6 weeks postoperatively. For procedures under sedation, patients predicted a satisfaction of 6.8 ± 2.5 , and subsequently increased actual satisfaction to a statistically significant value of 9.5 ± 1.0 ($P < .01$) at 6 weeks postoperatively. No statistically significant difference was detected in satisfaction between local-only and sedation at 6 weeks postoperatively ($P = .42$, $1 - \beta = 0.10$).

Regarding preoperative patient anesthesia preferences, 9 (28%) of 31 patients predicted that they would prefer local-only, 11 (36%) of 31 predicted preferring sedation, and 11 (36%) of 31 predicted indifference. At the 6-week postop-

Table 3. Characteristics of Enrolled Patients.

Factor	Patients (N = 31)	P value ^a
Sex ^b		.21
Male	12 (39)	
Female	19 (61)	
Age ^c	55 (55 [51-59])	
Dominant hand ^b		<.01
Left	3 (10)	
Right	28 (90)	
Employment status ^b		<.01
Full-time	16 (52)	
Part-time	4 (13)	
Unable to work, CTS ^d	3 (10)	
Unable to work, other	3 (10)	
Retired	5 (15)	
Insurance status ^b		<.01
Medicare	4 (13)	
Medicaid	7 (22)	
Private	17 (55)	
Other ^e	3 (10)	
Location of surgery		<.01
Hospital	3 (10)	
Surgery center	28 (90)	
Initial surgery anesthesia ^b		.86
Local-only	15 (48)	
Sedation	16 (52)	
Initial surgery hand ^b		.37
Left	18 (58)	
Right	13 (42)	
Surgical technique		<.01
Open	23 (74)	
Endoscopic	8 (26)	
Initial Beck score ^c	10 (6 [7-13])	
Initial QuickDASH score ^c	47 (41 [39-55])	
Electrodiagnostic, left		.12
Mild	3 (10)	
Moderate	7 (22)	
Moderate-severe	3 (10)	
Severe	11 (36)	
NA	7 (22)	
Electrodiagnostic, right		.36
Mild	3 (10)	
Moderate	7 (22)	
Moderate-severe	5 (16)	
Severe	10 (32)	
NA	6 (20)	

Note. CTS = carpal tunnel syndrome; DASH = Disabilities of the Arm, Shoulder and Hand.

^a χ^2 test, $\alpha = 0.05$.

^bValues expressed as number (% of study cohort).

^cValues expressed as mean (median [95% confidence interval]).

^dPatient unable to work due to symptoms of CTS.

^eOther government payer, Medicare with supplemental insurance, and so on.

erative follow-up, 17 (59% [95% CI = 41%-77%]) of 29 patients preferred the local-only anesthesia, 10 (34% [95% CI = 17%-52%]) of 29 preferred sedation, and 2 (8%) of 29 were indifferent (Figure 2a). When controlling for hand dominance and the location of the surgeries, no statistical significance was found between the proportions of patients preferring local-only anesthesia ($P = .25$ and $.79$, respectively; $1 - \beta = 0.77$ and 0.14 , respectively). Similarly, patients receiving local-only first were not demonstrated to have a stronger final preference for local-only ($P = .051$, $1 - \beta = 0.58$). The same is true for patients experiencing sedation initially ($P = .17$, $1 - \beta = 0.35$). Furthermore, when grouped by initial anesthesia method, the distribution of final anesthesia preferences does not indicate any statistical significance regarding which method was used in the first procedure ($P = .60$, $1 - \beta = 0.13$). Compared with the institution-established theoretical baseline preference value of 24%, the sample population mean of 59% is found to be statistically significant ($P < .01$). The preferences and comments of both the patients and the surgeons were transformed to more fully display outcomes (Table 4).

The mean total costs for surgery with local-only anesthesia (\$7696) and sedation (\$7976) were not significantly different ($P = .30$, $1 - \beta = 0.13$). However, anesthesia cost was different—\$44 for local-only and \$435 for sedation ($P < .01$). Of note, total surgical costs were not statistically significant for local-only or sedation when controlling for the variable of surgery location ($P = .61$ and $.92$, respectively; $1 - \beta = 0.05$ and 0.05 , respectively). Total times in the facility with local-only (137 ± 27 minutes) and sedation (164 ± 37 minutes) were significantly different ($P < .01$). This time difference was attributed to a shorter time spent in the PACU (local-only = 33 ± 12 minutes vs sedation: 55 ± 23 minutes, $P < .01$). No statistical difference was detected in the time of incision to closure (local-only: 17 ± 5 minutes vs sedation = 16 ± 6 minutes; $P = .60$; $1 - \beta = 0.60$).

There was no difference in worst postoperative pain between anesthesia methods (local-only = 5 ± 3 , sedation = 5 ± 3 ; $P = .57$; $1 - \beta = 0.07$). In addition, 18 of 31 patients during local-only and 21 of 31 patients during sedation felt the postoperative pain was less than a common dental procedure such as a cavity filling or tooth extraction (Figure 2b). Beck scores prior to surgery with local-only anesthesia (9 ± 9) and sedation (7 ± 7) were statistically different ($P = .03$, 95% CI = 0.2-5.0). The QuickDASH score showed statistically significant improvement ($P < .01$) at the 6-week follow-up (20 ± 19) compared with preoperatively (47 ± 22). Beck Anxiety Index, sex, QuickDASH, and age at the time of consent were graphically demonstrated to have no considerable effect on anesthesia preference.

Of the 31 patients undergoing bilateral carpal tunnel release, 8 were endoscopic and 23 were open. There was no

Figure 1. Patient flow diagram for enrolled participants.

statistically significant difference in postoperative pain between local-only and sedation when the variable of surgical technique was controlled ($P = .51$ and $.76$, respectively; $1 - \beta = 0.07$ and 0.07 , respectively). Similarly, no significance was found for anesthesia method preference ($P = .74$, $1 - \beta = 0.10$) when controlling for the variable of surgical technique.

Discussion

It was originally hypothesized that a greater proportion of patients would prefer carpal tunnel release with local-only anesthesia. We found that 17 (59%) of 29 patients preferred local-only anesthesia, 10 (34%) of 29 preferred sedation, and 2 (7%) of 29 were indifferent. Anesthesia preferences aside, nearly all patients were highly satisfied (30 of 31 rated 8 or higher). Despite a 30% excess of anxiety prior to local-only, patients still had favorable outcomes based upon overall satisfaction and anesthesia preferences. Postoperative pain was similar after both anesthesia methods in terms of worst pain and relative to common dental procedures (with approximately 2 of 3 thinking it was less painful). In addition, Miller et al¹⁵ did not detect a difference in postoperative pain pill utilization after minor procedures done under WALANT versus sedation.

Analysis of costs revealed that facility and PACU fees accounted for 74% of the total cost, while surgeon and anesthesia fees accounted for the remaining 21% and 5%, respectively. Although the current study does not indicate statistical significance in total cost savings, previous studies estimate the potential for anywhere from 30% to 80% in

total cost reduction by shifting appropriate procedures toward ambulatory surgery centers and in-office procedure rooms.¹⁶ The present study evidenced only \$390 in anesthesia cost savings; however, with an estimated 700 000 carpal tunnel releases occurring per year, this modest cost reduction would compound to nearly \$300 million in cost savings if WALANT-style procedures are more widely implemented.^{4,8,9} Van Demark Jr et al take this a step further by suggesting that the use of in-office procedure rooms offers many benefits: diversion of traffic away from the main operating rooms and added convenience for the physician and patient.¹⁶⁻¹⁸

The results of the present study do not definitively support the exclusive implementation of a WALANT technique for carpal tunnel release. However, with careful patient selection, the potential benefits of safety, efficacy, low complication rates, low costs, high patient satisfaction, and overall reasonable pain tolerance may be realized.^{5-7,10,18,19} In addition to the aforementioned potential for logistic benefits, the absence of inhaled and intravenous anesthetics in a WALANT technique allows for patients to experience reduced postoperative nausea, vomiting, and grogginess.²⁰ Recent Canadian studies conclude that patients approve of the WALANT technique and often recommend it to friends and family.^{12,21} Analogously, the current study demonstrated that surgeons at the investigating institution are amenable to learning and utilizing WALANT techniques. Despite this finding, a 2015 poll by the American Society for Surgery of the Hand shows that only 8% of US hand surgeons currently implement a WALANT technique in carpal tunnel release, indicating that it has yet to become common practice.²²

Figure 2. A vertical bar graph (a) representation of the anesthesia methods preferred at baseline and at 6 weeks follow-up. Predicted preference at baseline was calculated by tallying the frequencies of the scaled proportion factor (calculated as predicted satisfaction with sedation minus predicted satisfaction with local-only, such that positive integers represent a predicted preference for sedation and negative integers represent a predicted preference for local-only) that fell into each category. A vertical bar graph display (b) of patient comparisons of the postoperative pain following local-only anesthesia and sedation compared with a common dental procedure (ie, cavity filling) at the 6-week follow-up. Patients who never had any previous dental work were added to the cohort for the “same” level of pain as a dental procedure.

Table 4. Paraphrased Quotations from Both the Patients and the Surgeons Regarding Anesthesia Preferences at (6-Week) Final Follow-up Appointment, Organized by Final Preference.

Local-only

Patients

- Not groggy after surgery and could do things that day
- Not groggy after surgery and could remember things
- Instant relief, could eat right away, not sleepy
- Quicker recovery
- Did not like effects of anesthesia
- Better healing
- Did not like extra time for sedation, like eating afterward

Surgeons

- Patient movement (with sedation) can delay the procedure
-

Local anesthesia with sedation

Patients

- Numbness from local took longer to wear off
- Local-only was more traumatic, needed additional shots
- Local had more pain, took sedation procedure more seriously
- More anxiety with local, better healing after sedation
- Less swelling
- More comfortable
- Less anxiety
- Afraid of distracting surgeon while awake

Surgeons

- Bleeding obscuring field (without tourniquet) can be an issue
-

No preference

Patients

- Hate needles, do not care either way
-

Strengths and Limitations

There are associated limitations to acknowledge in the present study. Much of the data collected in the study is subjective in nature, although paired design and evidence-based metrics served to reduce this variability. Patients commonly experience symptoms differently by laterality of the carpal tunnel syndrome. This may have introduced bias regarding surgical experience and patient satisfaction, yet randomization of the first anesthesia method minimized this as much as possible. The present study was conducted at one of the 2 locations by 3 surgeons within a single university medical center in which study participants were required to comply with the facility's policies regardless of the anesthesia method (Table 5). Consequently, the data may have been affected by the mandatory policy compliance, and the results may not be widely generalizable.

Potential cofounders in this study are hand dominance (all 3 left-handed patients chose to operate on the dominant hand first), the location of surgery (3 patients were operated on in the hospital), and the surgical technique (8 patients had endoscopic carpal tunnel releases). An unfortunate consequence of the modest sample size is the associated concern for adequate study power in the secondary outcome

measures. Several of these measures were underpowered to detect any true differences (as reported previously), and *post hoc* analyses indicated that up to several hundred study participants would have been required. Other considerations include an unequal number of procedures between the 2 techniques and locations, an initial loss of 22 patients, and the subsequent loss to follow-up of 2 patients before the final questionnaires.

Future steps for this and other similar investigations may involve increasing patient numbers to better power secondary metrics, randomization of all major variables (surgery location, first anesthesia method, first hand, etc), and development of an in-office procedure room to compare against the hospital and/or ambulatory surgical center.

In summation, 96% of patients (95% CI = 91%-100%) are highly satisfied with carpal tunnel release regardless of which anesthesia method is used. Anesthesia costs were \$390 lower and total surgical times were 26 minutes quicker with local-only. The data further indicated that wide-awake carpal tunnel release with local-only anesthesia is preferred by 59% of patients (95% CI = 41%-77%). This is compared with 34% of patients preferring sedation (95% CI = 17%-52%), and the remainder of the patient population stating indifference.

Table 5. University Medical Center Surgical Policy.

- NPO status at least 6 h prior to surgery
- Arrive to location of surgery at least 1 h prior to surgery
- ASA III/IV patients receive intravenous access, regardless of the procedure
- ASA III/IV patients require monitoring by anesthesiology, regardless of the procedure
- Patients with local-only anesthesia may drive themselves to and from surgery

Note. NPO = nothing by mouth; ASA = American Society of Anesthesiologists.

Ethical Approval

This protocol was approved by the Biomedical Institutional Review Board of The Ohio State University, 2015H0148.

Statement of Human and Animal Rights

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008. This research protocol was approved by our Biomedical Institutional Review Board.

Statement of Informed Consent

Informed consent was obtained from all patients included in the study.

Declaration of Conflicting Interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

References

1. Atroshi I, Gummesson C, Johnsson R, et al. Prevalence of carpal tunnel syndrome in a general population. *JAMA*. 1999;282:153-158.
2. Luckhaupt SE, Dahlhamer JM, Ward BW, et al. Prevalence and work-relatedness of carpal tunnel syndrome in the working population, United States, 2010 national health interview survey. *Am J Ind Med*. 2013;56(6):615-624.
3. Bickel KD. Carpal tunnel syndrome. *J Hand Surg Am*. 2010;35:147-152.
4. Jain NB, Higgins LD, Losina E, et al. Epidemiology of musculoskeletal upper extremity ambulatory surgery in the United States. *BMC Musculoskelet Disord*. 2014;15:4.
5. Benson LS, Bare AA, Nagle DJ, et al. Complications of endoscopic and open carpal tunnel release. *Arthroscopy*. 2006;22:919-924.
6. Agee JM, Peimer CA, Pyrek JD, et al. Endoscopic carpal tunnel release: a prospective study of complications and surgical experience. *J Hand Surg Am*. 1995;20(2):165-71; discussion 172.
7. Becker SJ, Makanji HS, Ring D. Expected and actual improvement of symptoms with carpal tunnel release. *J Hand Surg Am*. 2012;37(7):1324-1329.
8. Lalonde DH. "Hole-in-one" local anesthesia for wide-awake carpal tunnel surgery. *Plast Reconstr Surg*. 2010;126(5):1642-1644.
9. Lalonde D. Minimally invasive anesthesia in wide awake hand surgery. *Hand Clin*. 2014;30(1):1-6.
10. Lalonde D, Bell M, Benoit P, et al. A multicenter prospective study of 3,110 consecutive cases of elective epinephrine use in the fingers and hand: the Dalhousie Project clinical phase. *J Hand Surg Am*. 2005;30(5):1061-1067.
11. Chatterjee A, McCarthy JE, Montagne SA, et al. A cost, profit, and efficiency analysis of performing carpal tunnel surgery in the operating room versus the clinic setting in the United States. *Ann Plast Surg*. 2011;66(3):245-248.
12. Davison PG, Cobb T, Lalonde DH. The patient's perspective on carpal tunnel surgery related to the type of anesthesia: a prospective cohort study. *Hand*. 2013;8(1):47-53.
13. Sambandam SN, Priyanka P, Gul A, et al. Critical analysis of outcome measures used in the assessment of carpal tunnel syndrome. *Int Orthop*. 2008;32(4):497-504.
14. De Ayala RJ, Vonderharr-Carlson DJ, Kim D. Assessing the reliability of the Beck Anxiety Inventory scores. *Educ Psychol Meas*. 2005;65:742-756.
15. Miller A, Kim N, Ilyas AM. Prospective evaluation of opioid consumption following hand surgery performed wide awake versus with sedation. *Hand*. 2017;12(6):606-609.
16. Van Demark RE Jr, Becker HA, Anderson MC, et al. Wide-awake anesthesia in the in-office procedure room: lessons learned. *Hand*. 2017;13:481-485.
17. Codding JL, Bhat SB, Ilyas AM. An economic analysis of MAC versus WALANT: a trigger finger release surgery case study. *Hand*. 2017;12(4):348-351.
18. Lalonde D, Martin A. Epinephrine in local anesthesia in finger and hand surgery: the case for wide-awake anesthesia. *J Am Acad Orthop Surg*. 2013;21(8):443-447.
19. Teo I, Lam W, Muthayya P, et al. Patients' perspective of wide-awake hand surgery—100 consecutive cases. *J Hand Surg Eur Vol*. 2013;38(9):992-999.
20. Steiner MM, Calandruccio JH. Use of wide-awake local anesthesia no tourniquet in hand and wrist surgery. *Orthop Clin North Am*. 2018;49(1):63-68.
21. Leblanc MR, Lalonde J, Lalonde DH. A detailed cost and efficiency analysis of performing carpal tunnel surgery in the main operating room versus the ambulatory setting in Canada. *Hand*. 2007;2(4):173-178.
22. Munns JJ, Awan HM. Trends in carpal tunnel surgery: an online survey of members of the American Society for Surgery of the Hand. *J Hand Surg Am*. 2015;40:767-771.