

# Virtual Reality Improves Patient Experience and Anxiety During In-office Carpal Tunnel Release

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**Background:** This study examined how wide-awake local anesthesia no tourniquet (WALANT) surgery in the office versus the standard operating room (OR) impacts patient experience, and the effect wide awake virtual reality (WAVR) has in conjunction with WALANT on patient experience.

**Methods:** This is a patient-reported outcome study of patients undergoing carpal tunnel release by a single surgeon between August 2017 and March 2021. Patients were classified by location; traditional OR versus WALANT in-office. In-office patients were further classified by whether they chose to use WAVR or not. Patients rated overall experience, enjoyability, and anxiety using a Likert scale (1–7).

**Results:** The online survey had a 44.8% response rate. OR patients were twice as likely to report a neutral or negative experience (23% versus 11%,  $P = 0.03$ ), significantly lower enjoyment scores (44% versus 20%,  $P = 0.0007$ ), and higher anxiety (42% versus 26%,  $P = 0.04$ ) compared with office-based WALANT patients. With the addition of WAVR, office patients reported higher enjoyment than those who did not use WAVR (85% versus 73%,  $P = 0.05$ ). Patients reporting an anxiety disorder were more likely to choose WAVR when compared with patients without anxiety disorder (73.8% versus 56.4%). When they chose WAVR, they had greater anxiolysis (79% versus 47%,  $P = 0.01$ ), and increased enjoyment (90% versus 59%,  $P = 0.005$ ).

**Conclusions:** This study demonstrates improved patient experience in the office setting, further amplified by WAVR. Preexisting anxiety disorder is a positive predictive variable toward the patients' choice to use WAVR. (*Plast Reconstr Surg Glob Open* 2022;10:e4426; doi: [10.1097/GOX.0000000000004426](https://doi.org/10.1097/GOX.0000000000004426); Published online 13 July 2022.)

## INTRODUCTION

Our study explored an innovative alternative to traditional operating room (OR) carpal tunnel release (CTR) surgery. We offered an immersive experience to patients undergoing wide awake local anesthesia with no tourniquet (WALANT) in the office environment for CTR, which we have called wide awake virtual reality (WAVR). In our community, patients who undergo CTR in the main OR receive monitored anesthesia care (MAC) or general anesthetic (GA). We performed an outcome survey to study how these two groups of patients compare in terms of satisfaction, enjoyment, and anxiety reduction.

WAVR is derived from virtual reality (VR) technology that is becoming more commonplace in this decade.

Although true VR may be defined as an interactive reality, during this study, we offered a VR that is applied to the individual in an immersive, but noninteractive setting using similar technology. Our office patients had a choice whether to use this technology or spend time talking with the surgical team, which we believe empowers our more nervous patients to choose an office setting as opposed to MAC and GA in the main OR. This assumption is based on our previously published randomized single-blind prospective controlled trial, which demonstrated that the use of this technology is effective in reducing anxiety and increasing joy during WALANT procedures.<sup>1</sup> In the same study, patients with an anxiety disorder reported reduced pain during the administration of injected local anesthesia while in an immersive experience.

Office-based surgery has been popularized for hand surgery by Dr. Lalonde for over 15 years, and uptake of this method has become a worldwide phenomenon.<sup>2–4</sup> Within

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the United States, WALANT has had less penetration than internationally, with “business as usual” still driving patients into surgery centers and hospital ORs for MAC and GA. Rapid innovation and change are stimulated by wars and pandemics.<sup>5-7</sup> It is, therefore, notable that during the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) pandemic, there has been a shift away from the main OR and toward the office setting as a location of hand surgical care within the United States.<sup>8</sup> For the past 5 years, our team has been pursuing technological methods to enhance patient acceptance of WALANT in the US population by offering an immersive experience. We present survey data describing patient experiences in the main OR and compare them to the experiences of our patients who chose office-based surgeries, both WAVR and non-WAVR.

## METHODS

This study was approved by the Michigan State University (MSU) Biomedical and Health Institutional Review Board (Study 0006013). Patients were identified in the electronic medical record using the CPT code 64721 for having received a CTR in either the office setting or in the main OR.

### Equipment

During this study, two different VR headsets were used. Between 2017 and 2020, we used an Oculus Rift CV1 headset, and after January 2020, we used the Oculus Quest 2. Because the Oculus Virtual Reality system used between these dates did not permit alteration of the axis of gaze, it was necessary to operate on all the office patients in a seated position. This was consistently applied whether they received WAVR or not. The patients were offered 360 YouTube videos. These were chosen for their engaging qualities and avoided too much spatial motion. The rest of the room can follow what the patient is viewing on a laptop or tablet. The office WAVR + VR setup is demonstrated in [Figure 1](#). If the patient was needle-phobic, they were offered WAVR during the injection phase, but the standard approach was to use VR during the surgery alone.

### Participants

This is a retrospective review of patient experience with CTR surgery. A list was generated by MSU Clinical Information Systems of patients over the age of 18 who underwent a CTR by Dr. James Clarkson at MSU Department of Surgery Hand Clinic, McLaren Great Lansing, or Sparrow Hospital from August 1, 2017, to March 31, 2021 (n = 404). Multiple patients had bilateral CTR performed on different days (n = 134); therefore, the total number of CTR procedures performed by the principal investigator was 538.

Patients who had CTR done in the hospital setting underwent either conscious sedation with MAC, or GA, whereas patients who had CTR in the office received WALANT. Patients in the office were given the choice of using a WAVR headset for their comfort and enjoyment during the procedure. Demographic information is presented in [Table 1](#). All three groups (hospital, office

## Takeaways

**Question:** Can immersive virtual reality (VR) make the WALANT experience more acceptable for a patient population that expects general anesthesia? Which patients benefit most from this option?

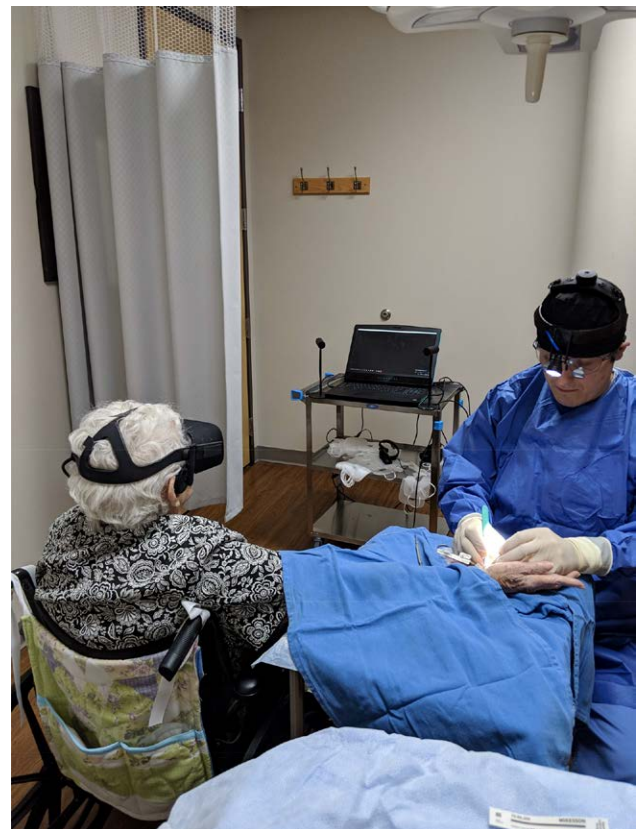
**Findings:** A patient-reported outcome study for patients undergoing carpal tunnel release either in the hospital with general anesthesia or in the office as a WALANT procedure. By offering VR immersive experiences to patients who report anxiety disorder, their anxiety levels fall and they have more joy.

**Meaning:** WALANT with VR helps anxiety-prone populations tolerate and enjoy awake procedures. VR also improves the WALANT experience for less anxiety-prone patients because it is fun.

WAVR, and office non-VR) had similar demographics regarding age, race, sex, etc.

### Surgical Technique

The carpal tunnel was released with an open approach along the ulnar border of the fourth ray, like that described by Ariyan and Watson<sup>9</sup> in 1977.



**Fig. 1.** A patient undergoing a wide-awake carpal tunnel release in the office using the immersive VR headset.

**Table 1. Patient Demographics. Data Are Presented with Number of Responses, and Percentage in Parentheses: n (%)**

Characteristics	Total	Hospital	Office WAVR	Office Non-WAVR
No. Participants	176	36	81	59
No. Surgeries	241	43	123	75
Multiple CTRs	65	7	42	16
Age				
Age range, y	22–88	22–78	32–81	29–88
Mean	57	55	58	58
Sex				
Woman	111 (65)	22 (61)	53 (65)	36 (61)
Man	65 (37)	14 (39)	28 (35)	23 (39)
Ethnicity				
White	146 (83)	30 (83)	66 (81)	50 (85)
Black	9 (5)	1 (3)	4 (5)	4 (5)
Asian	2 (1)	0 (0)	1 (1)	1 (1)
Hispanic	10 (6)	3 (8)	5 (6)	2 (3)
American Indian or Alaska Native	2 (1)	0 (0)	1 (1)	1 (1)
Other/prefer not to answer	17 (10)	5 (14)	9 (11)	3 (4)
Comorbidities				
Anxiety	54 (31)	10 (28)	31 (38)	13 (22)
Asthma	28 (16)	5 (14)	14 (17)	9 (15)
Depression	51 (29)	10 (28)	27 (33)	14 (24)
Diabetes	41 (23)	7 (19)	17 (21)	17 (29)
Heart disease	24 (14)	3 (8)	13 (16)	8 (14)
Kidney disease	11 (6)	3 (8)	6 (7)	2 (3)
Other	31 (18)	8 (22)	10 (12)	13 (22)
Stroke/CVA	3 (2)	0 (0)	3 (4)	0 (0)
Thyroid disease	22 (13)	5 (14)	10 (12)	7 (12)

CVA, cerebrovascular accident.

### Data Collection

A study-specific MSU mailbox was created to send the online consent and survey link to eligible patients. The patient outcome survey was completed on a Health Insurance Portability and Accountability Act (HIPAA) compliant online platform. If no response to the email was received within 2 weeks, a second email was sent along with a follow-up telephone call. The patient indicated voluntary agreement to participate in the research study by submitting the survey. Patients who underwent more than one CTR were asked to complete a survey for each procedure.

If there was no email address ( $n = 77$ ), a member of the research team (excluding Dr. Clarkson) telephoned the patient. The telephone consent was read over the phone. If the patient agreed to proceed with the survey and answer the questions, this served as their verbal consent. The telephone call to complete the survey took place in a private office. The completed survey data were stored in a password-protected Excel file that only members of the research team had access to.

The survey included a Likert scale of 1–7. Subjects were asked to rank several variables on the Likert scale, including overall experience (very dissatisfied to very satisfied), enjoyability (not enjoyable to very enjoyable), and anxiety (extreme anxiety to no anxiety).

### Data Analysis

The categorical data collected using the Likert scale were then categorized as a neutral/negative response (1/2/3/4) or positive response (5/6/7) and analyzed with the nonparametric categorical tool chi-square test using Microsoft Excel.

The data were analyzed by patient episode, given that some patients had more than one episode of care. Patients who elected to use WAVR were asked to further evaluate their experience with VR, including whether VR helped

reduce their anxiety, whether they would use it again, and whether they would recommend it to a friend.

## RESULTS

There were 404 patients contacted about their 538 surgical episodes, and 241 surveys were completed (44.8% response rate). Of the CTR surveys completed, 44 were evaluating traditional in-operating room surgery (18%), and 198 were WALANT in-office procedures (82%). Of the WALANT patients, 62% chose to use WAVR (Table 2).

### OR versus Office

To determine whether in-office, WALANT procedures improve the patient experience, the patients in our study were split into two groups: in-hospital versus in-office CTR. Our data (Table 3) showed that while patients overall had a positive experience in both the hospital and office (77% versus 89% respectively), patients were twice as likely to report a neutral or negative experience (23% versus 11%) in the hospital setting. Patient responses also showed improvements in both enjoyment and anxiety reduction in the office setting.

### OR versus Office WAVR

This study further compared the in-hospital group to only those patients who received WAVR in the office. Our data (Table 4) showed a similar significant improvement in all three categories to the total number of patients

**Table 2. Patient Choice of WAVR or Non-WAVR with Anxiety**

Characteristics	Total	WAVR	Non-WAVR
All office	198	123 (62%)	75 (38%)
General (no anxiety)	133	75 (56.4%)	58 (43.6%)
Anxiety	65	48 (73.8%)	17 (26.2%)

**Table 3. Hospital OR (n = 43) versus Office Procedures (Both WAVR and Non-WAVR) (n = 198)**

Characteristics	% Positive Response	% Neutral/Negative Response	P
Overall experience			
Hospital	77	23	P = 0.03
Office	89	11	
Enjoyment			
Hospital	56	44	P = 0.0007
Office	80	20	
Anxiety reduction			
Hospital	58	42	P = 0.04
Office	74	26	

managed in the office. Additionally, there was a trend toward higher positivity for the WAVR experience when comparing all office patients to only those who received WAVR (89% versus 90% in overall experience, 80% versus 85% in enjoyment, and 74% versus 78% in anxiety reduction) (Tables 3 and 4).

#### Office WAVR versus Non-WAVR

Seeing that the WAVR responses were trending more positively when compared to the hospital, we performed a subanalysis, comparing the WAVR responses to the non-WAVR office responses. Of all the office CTRs, 62% of the office patients chose to use WAVR, while 38% elected to not use WAVR. We found that there was no statistical difference between their results except for enjoyment, which was greater in the WAVR group (85%) versus the non-WAVR office group (73%) ( $P = 0.05$ ) (Table 5).

Additionally, 96% of WAVR users responded that they would recommend using WAVR during a surgery to a friend. 87% of WAVR users reported that the use of VR helped reduce anxiety during the surgery, and 91% responded that they would use WAVR during a surgery again if it was an option (Fig. 2).

Among WAVR patients, a third reported some sort of difficulty with the VR. Seven had an issue with their glasses, seven found the VR material not entertaining or distracting enough, six experienced technical issues, four became motion sick, and three reported that the device was ill-fitting or uncomfortable. Patient comments regarding the VR technology are recorded in Supplemental Digital Content 1. (See appendix, Supplemental Digital Content 1, which displays the patient comments about the VR experience, <http://links.lww.com/PRSGO/C92>.)

#### Anxiety

Patients who chose to use WAVR more frequently reported being treated for anxiety (38%) and depression

(33%), compared with those who chose not to use WAVR (22% and 24%) (Tables 1 and 2). There were 65 responses from patients who reported having an anxiety disorder. Of these 65 patients, 73.8% of them chose to use WAVR, compared with 56.4% of patients without an anxiety disorder. These patients were significantly more likely to report increased enjoyment (90% versus 59%,  $P = 0.005$ ) and reduced anxiety (79% versus 47%,  $P = 0.01$ ) while using WAVR when compared with patients who used WAVR and did not report an anxiety disorder (Table 6).

## DISCUSSION

The results demonstrate lower anxiety with increased enjoyment and satisfaction for patients undergoing procedures in the office either with or without WAVR when compared with the main OR. This reflects similar findings from Moscato et al<sup>10</sup> who compared the office to the hospital OR and the hospital procedure room. This effect is noted to be stronger when comparing the main OR to office patients who received WAVR. The data also support that WAVR enhances enjoyment independently from the location of care. This would suggest that we should encourage our office patients to accept the WAVR experience if they are unsure.

Patients with an anxiety disorder demonstrated a tendency to elect to use WAVR and when they did, it showed greater efficacy than for patients without an anxiety disorder. VR may be considered to enhance the patient experience primarily through an anxiolytic mechanism.

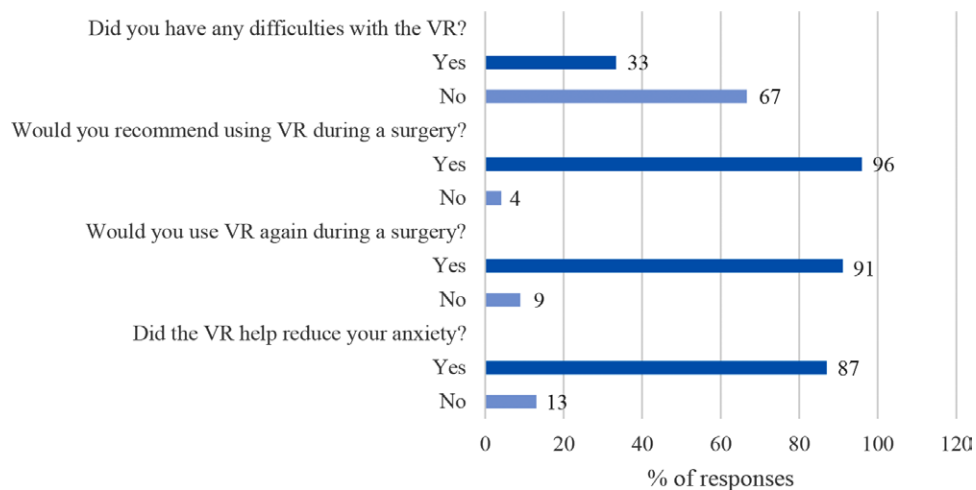
Limitations of this study include the use of a questionnaire that required recall by the patient after the events took place. Some patients may have had to recall for up to 3 years prior, some only a few months. More could have been learned if we had access to either prospective or retrospective clinical outcome data, which was not part of this study protocol.

**Table 4. Hospital OR (n = 43) versus Office Procedures Using WAVR (n = 123)**

Characteristics	% Positive Response	% Neutral/Negative Response	P
Overall experience			
Hospital	77	23	P = 0.02
Office WAVR	90	10	
Enjoyment			
Hospital	56	44	P = 0.0001
Office WAVR	85	15	
Anxiety reduction			
Hospital	58	42	P = 0.01
Office WAVR	78	22	

**Table 5. Office WAVR (n = 123) versus Non-WAVR (n = 75) for All Office Patients**

Characteristics	% Positive Response	% Neutral/Negative Response	P
Overall experience			
WAVR	90	10	P = 0.4
Non-WAVR	87	13	
Enjoyment			
WAVR	85	15	P = 0.05
Non-WAVR	73	27	
Anxiety reduction			
WAVR	78	22	P = 0.08
Non-WAVR	67	33	

**Fig. 2.** WAVR user responses (n = 123) are majority positive overall; however, around a third of users experienced difficulties with the technology.

## CONCLUSION

Multiple studies have demonstrated that office-based WALANT surgery is safer, more efficient, and less expensive than the main OR.<sup>11-14</sup> This study added to these findings that the patient experience (satisfaction, enjoyment, and anxiety) may be improved by having WALANT surgery in the office for CTR versus the OR and that this effect may be enhanced by offering them WAVR. Our data demonstrate that this improvement is compounded when the patient already has anxiety. These patients were more likely to choose WAVR and derived greater joy and reduced anxiety than nonanxiety diagnosed patients, thus identifying this patient population as particularly suitable for WAVR.

The technology available to offer WAVR is still in its infancy, and off-the-shelf solutions are difficult to apply in

the clinical setting, which is reflected by one-third of our patients having difficulties. Indeed, the senior author and his team spent considerable effort to support this process including having to physically wear the VR headset to set it up for the patient and maintain the patient in an upright posture. There is a need for a bespoke medical-grade device designed with WALANT and the clinical setting in mind.

WALANT may also be offered in ambulatory surgical centers and hospital ORs. This study provides a rationale to introduce WALANT into these environments, offering the patients WAVR for anxiolysis while increasing their enjoyment and satisfaction, and decreasing their exposure to anesthesia. Greater satisfaction scores may enhance the Center for Medicare and Medicaid Services payment in the hospital setting through the Hospital Value-Based Purchasing Program.<sup>15,16</sup>

**Table 6. Office WAVR (n = 48) versus Non-WAVR (n = 17) for Office Patients Reporting Anxiety Disorder**

Characteristics	% Positive Response	% Neutral/Negative Response	P
Overall experience			
WAVR	96	4	P = 0.07
Non-WAVR	82	18	
Enjoyment			
WAVR	90	10	P = 0.005
Non-WAVR	59	41	
Anxiety reduction			
WAVR	79	21	P = 0.01
Non-WAVR	47	53	

Most patients who reported anxiety and depression elected to use WAVR, enabling them to undergo WALANT office procedures. We find that the efficacy of WAVR is at its most potent in this population. We should encourage them to use WAVR if available, and we quote one of our patients who describes their decision to have surgery in the office:

“I was very skeptical at first, but knowing I was going to have a virtual reality experience for my second surgery made me much more relaxed pre-op.”

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