SCIENTIFIC ARTICLE

Prospective Evaluation of Sleep Improvement Following Carpal Tunnel Release Surgery

Jacob E. Tulipan, MD,* Nayoung Kim, BS,† Jack Abboudi, MD,† Christopher Jones, MD,† Frederic Liss, MD,† William Kirkpatrick, MD,† Jonas Matzon, MD,† Michael Rivlin, MD,† Mark L. Wang, MD, PhD,† Asif M. Ilyas, MD†

Purpose Sleep disturbance due to nighttime awakening is a well-documented symptom of carpal tunnel syndrome. While relief of nighttime waking following carpal tunnel release (CTR) has been demonstrated, the effect of CTR on overall sleep quality has not been fully investigated. We hypothesized that CTR would result in significant improvement in overall sleep quality as well as patients' overall satisfaction with their sleep habits.

Methods Cases of carpal tunnel syndrome with positive nerve studies, and treated with CTR, were prospectively enrolled. Demographic data, electromyography (EMG) severity, Quick Disabilities of the Arm, Shoulder, and Hand questionnaire, and Insomnia Severity Index (ISI) scale data were collected.

Results A total of 398 patients were enrolled, with 99% available at 2 weeks and 64% available at 3-month final follow-up. At final follow-up, average Quick Disabilities of the Arm, Shoulder, and Hand score improved significantly from the preoperative value. Average ISI score on all 7 sleep categories on the survey improved significantly from before surgery to the first postoperative visit. However, the total ISI score did not further improve significantly between the 2-week and the 3-month postoperative visits. The ISI score improvements did not correlate with EMG severity.

Conclusions Patients undergoing CTR demonstrated significant improvement in mean scores for 7 aspects of sleep quality. Sleep improvement was unrelated to preoperative EMG severity and was experienced within 2 weeks of surgery. *(J Hand Surg Am. 2017;■(■):1.e1-e6.*

Type of study/level of evidence Therapeutic II.

Key words Carpal tunnel release, electromyography, insomnia, carpal tunnel syndrome, sleep disturbance.

Online Exclusive

SLEEP DISTURBANCE IS A WELL KNOWN symptom of carpal tunnel syndrome (CTS), with as many as 80% of patients with CTS demonstrating a decrease in sleep quality.[1] A sleep study of 6 patients with CTS demonstrated improvements in nocturnal movements and nighttime awakenings following carpal tunnel release (CTR). A survey of 34 CTS patients performed by the same group demonstrated daytime somnolence worse than that of controls prior to any treatment.[2]

*From the *Department of Orthopaedic Surgery, †Rothman Institute, Thomas Jefferson University, Philadelphia, PA.*

Received for publication January 23, 2017; accepted in revised form February 9, 2017.

No benefits in any form have been received or will be received related directly or indirectly to the subject of this article.

Corresponding author: Jacob E. Tulipan, MD, Thomas Jefferson University, 1025 Walnut St. Suite 516 College, Philadelphia, PA 19107; e-mail: Jacob.tulipan@gmail.com.

0363-5023/17/■ ■-0001$36.00/0
http://dx.doi.org/10.1016/j.jhsa.2017.02.009

Sleep disturbance has been associated with increased risk for numerous medical morbidities, including obesity,[3] hypertension,[4] and diabetes.[5] Many studies of CTS utilize the Levine-Katz carpal tunnel questionnaire,[6] which specifically enquires about nighttime sleep disturbance. Information regarding the specific sleep changes that occur beyond improving nighttime awakening following CTR is lacking. These other sleep issues include difficulty falling asleep, waking from sleep, satisfaction with sleep, and the effect of sleep disturbances with daily activities.

This study was designed to evaluate the effect on the various aspects of sleep following CTR surgery. We hypothesized that all aspects of patients' sleep quality would improve following CTR surgery.

MATERIALS AND METHODS

With institutional review board approval, all patients undergoing CTR, with no concomitant procedures (ie, CTR along with a trigger finger release) were prospectively and consecutively solicited to participate. Inclusion criteria included electrodiagnostically verified CTS indicated for CTR (based on history, physical examination, failure of nonsurgical management and nerve conduction studies demonstrating motor or sensory evidence of median nerve neuropathy, or evidence of thenar muscle denervation). These criteria were weighed by the participating surgeons (J.A., C.J., F.L., W.K., J.M., M.R., M.L.W., and A.M.I.) in deciding to proceed with CTR as per the practice at our institution and not all were required to proceed with surgery. Electrodiagnostic tests, consisting of standard nerve conduction studies and electromyography (EMG) were graded as electrophysiologically mild, moderate, or severe based on the criteria of Werner and Andary.[7] Exclusion criteria included age younger than 18 years, prior history of CTR surgery to the operative hand, CTS presenting acutely following trauma or surgery to the area, or negative electrodiagnostic findings.

Demographic data were obtained at the time of enrollment. The subjects were evaluated using the 11-question Disabilities of the Arm, Shoulder, and Hand (*Quick*DASH) questionnaire and the validated Insomnia Severity Index (ISI)[8] scale at the time of enrollment. The ISI scale rates 7 categories: (1) difficulty falling asleep, (2) difficulty staying asleep, (3) problems waking early, (4) overall sleep satisfaction, (5) how noticeable sleep disturbance is to others, (6) sleep distress, and (7) interference with daily functioning including fatigue, mood, concentration, memory, and performing daily chores. Each questions is rated on a scale of 1 (no symptoms) to 4 (severe symptoms), and a final score is obtained by summing each question's score.

TABLE 1. Demographic Characteristics of Included Patients

n	398
Mean age, y (range)	60.5 (27–98)
Female (%)	235 (59)
Male (%)	163 (41)
Mild NCS/EMG (%)*	33 (8§)
Moderate NCS/EMG (%)†	208 (52§)
Severe NCS/EMG (%)‡	157 (39§)

NCS/EMG, nerve conduction studies and electromyography.
*Mild NCS/EMG, number of patients for whom the preoperative electrodiagnostic study was read as "Mild CTS" according to the previously stated criteria.
†Moderate NCS/EMG, number of patients for whom the preoperative electrodiagnostic study was read as "Moderate CTS" by the electrophysiologist.
‡Severe NCS/EMG, number of patients for whom the preoperative electrodiagnostic study was read as "Severe CTS" by the electrophysiologist.
§Percentages add to 99% owing to rounding.

A decrease of 8 points in the ISI score has been previously determined to represent a moderate improvement in insomnia, a decrease of 6 points the minimal meaningful improvement,[9] and a total score of 10 points is considered a cutoff for a clinical diagnosis for insomnia.[10]

All surgeries were performed on an outpatient basis by a fellowship-trained orthopedic hand surgeon (J.A., C.J., F.L., W.K., J.M., M.R., M.L.W., and A.M.I.).

Patients underwent open or endoscopic CTR, according to the patient and surgeon's preference. After surgery, all patients were placed in a soft dressing and returned in 2 weeks for reevaluation and suture removal, at which time the subjects completed the outcome questionnaires. Repeat clinical evaluation was performed at 3 months and both questionnaires were repeated.

Patient scores on the *Quick*DASH and ISI were tabulated. Average changes in raw score were calculated, as well as average and SD of score subcategories. Pre- and postoperative scores were compared using a 2-tailed Student *t* test, with *P* less than .05 considered statistically significant.

RESULTS

A total of 398 patients were enrolled in the study. Open CTR was performed in 61% of patients, and endoscopic CTR was performed in 39%. At the 2-week postoperative visit, 397 patients (99%) were evaluated, and 253 (64%) responded at the final 3-month visit. Patient