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Original article

Sleep disturbance and response to surgical decompression in patients with carpal tunnel syndrome: a prospective randomized pilot comparison of open versus endoscopic release

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Summary. *Background:* Sleep disturbance is a common complaint of patients with carpal tunnel syndrome (CTS). While carpal tunnel release (CTR) surgery has been shown to relieve subjective sleep-related complaints, data is lacking on the global effect on sleep using validated sleep measures. Additionally, it is not known if open (OCTR) or endoscopic release (ECTR) produce differing degrees of sleep-symptom relief. *Methods:* Sixty patients were randomly allocated to undergo either OCTR (n=30) or ECTR (n=30) surgery. Forty-three (71.7%) of the patients were female, and mean age of all patients was 49.4 years (range, 35-78). Prior to surgery, patients were administered three baseline self-reported outcome measures: the Pittsburgh Sleep Quality Index (PQSI), the Insomnia Severity Scale (ISI) and the Quick Disabilities of the Arm, Shoulder and Hand (QuickDASH) survey, which were subsequently administered at three postoperative time points: 1-2 weeks, 4-6 weeks and 6-12 months. *Results:* All 60 patients experienced significant improvements in the three outcome scores by their first postoperative visit compared to preoperatively. ECTR provided superior improvement to OCTR at the first postoperative visit for ISI (P=0.006) and PSQI (P=0.016), and at the second visit for PSQI (P=0.0038). There were no significant differences between the two groups for the QuickDASH at any time points, or for the ISI/PSQI at the final follow-up. *Conclusion:* Endoscopic and open CTR both improve sleep symptoms postoperatively in the short-term which is sustained for 6-12 months, although endoscopic CTR does so more rapidly. (www.actabiomedica.it)

Key words: insomnia, carpal tunnel syndrome, PQSI, Insomnia Severity Index, open surgical release, endoscopic surgery, sleep disturbance

Introduction

Carpal tunnel syndrome (CTS) is the most common entrapment neuropathy of the upper extremity, and often necessitates decompression via carpal tunnel release (CTR) when conservative management fails (1-3). CTS typically manifests with characteristic symptoms of numbness, tingling and pain in the median nerve distribution, which often hinder patients' ability to sleep, and in turn may profoundly affect their quality of life (4, 5). While CTR surgery is thought to result in subjective improvement in sleep symptoms, there is little data to quantify this improvement using validated sleep-quality or insomnia measures (5).

Both open (OCTR) and endoscopic carpal tunnel release (ECTR) effectively relieve nerve symptoms in the majority of CTS patients, although the superiority of one option over the other is debated (6, 7). Furthermore, it is not known if either surgical method is superior in treating secondary sleep symptoms. This is

potentially valuable information, as sleep disturbance is often the primary motivating factor towards seeking medical care for CTS. The purpose of this pilot trial was to test the null hypotheses that OCTR and ECTR would result in similar postoperative improvements in patients with CTS, as measured using validated patient-reported sleep-quality and insomnia outcome measures.

Methods

Patients

This study was approved by our Institutional Review (Ethics) Board. Patients were eligible for study enrollment if they were confirmed to have CTS warranting CTR surgery on the basis of clinical history, physical exam findings and electrodiagnostic (EDX) testing. Patients younger than 18 years of age, those with existing preoperative diagnoses of sleep disorders and/or taking sleep aid medications preoperatively, patients with prior history of surgery or trauma at the operative wrist, and patients with bilateral disease were excluded from participation. After obtaining study consent, patients were randomized either to the OCTR or ECTR groups using a custom random-number generator created with the Minitab statistical software package (Version 17.3.1 for Windows; State College, PA, USA).

Electrodiagnostic testing

All preoperative EDX testing was performed at our institution by one of two licensed clinical neuroelectrophysiologists using standardized techniques. For study of median nerve distal motor latency, the median nerve was stimulated at a position 3 cm proximal to the level the distal wrist crease between the flexor carpi radialis (FCR) and palmaris longus (PL) tendons. Recording was done from the abductor pollicis brevis muscle as the median nerve was stimulated, maintaining a 5 cm distance between the stimulating and the recording electrodes. To study median nerve sensory latency, a recording ring electrode was placed on the second digit and the median nerve was stimulated near the proximal crease with the cathode placed at a distance of 14 cm proximal to the ring electrode (8). Per our institutional standards, median nerve motor and sensory onset latencies greater than 4.2 and 3.5 msec, respectively are considered abnormal.

Surgical technique and postoperative course

OCTR was performed using a standard mini-open technique using a 2-cm longitudinal incision created in line with the fourth ray, with care taken to avoid extending the incision proximally past the distal wrist crease (9). ECTR was performed with the two-incision technique as described by Agee (10). Postoperatively, patients were seen for their first visit at 1-2 weeks for standard follow-up examination including wound inspection and suture removal. A second and final in-person evaluation was performed at 4-6 weeks.

Data collection and statistical analysis

Standard demographic information including age, gender and handedness, and EDX testing values were recorded for each study patient. To establish a baseline prior to surgery, patients were administered three validated self-reported outcome measures: the Pittsburgh Sleep Quality Index (PQSI) (11), the Insomnia Severity Scale (ISI) (12) and the Quick Disabilities of the Arm, Shoulder and Hand (QuickDASH) (13) functional survey. The three outcome measures were re-administered at both follow-up visits and again during a final follow-up telephone call made at 6-12 months postoperatively. Statistical analysis was performed using Minitab software. Paired t-testing was used to compare the preoperative and postoperative scores for consecutive visits, while independent t-testing was used to compare the two treatment groups at each visit.

Results

Baseline demographics

A total of 60 patients who underwent open (n=30) or endoscopic (n=30) CTR satisfied study inclusion. The mean patient age was 49.4±8.0 years, and 43 pa-

tients (71.7%) were female. There were no significant differences in age, sex, hand dominance, preoperative nerve testing values and baseline preoperative QuickDASH, ISI and PSQI scores between the OCTR and ECTR treatment groups (Table 1). Distal sensory latencies were absent in 6 patients (2 OCTR, 4 ECTR).

Patient-reported outcome measures

At the first postoperative visit (12.4±2.4 days from surgery), all three outcomes were significantly improved compared to preoperatively, although there was no significant difference between the OCTR and ECTR groups for the QuickDASH (P=0.539). Contrarily, the ISI and PSQI had both improved to a significantly greater degree in the endoscopic group as compared to the open CTR group. At the second postoperative visit (31.4±12.4 days), all three outcomes were again significantly improved compared to the previous visit. At this visit however, only the PSQI was significantly different between the two treatment groups. By the final telephone follow-up (234±51 days), all three outcomes again demonstrated statistically significant improvements compared to their most recent prior visit. There were no significant differences between the open and endoscopic CTR groups for the any of the three outcome measures at this final telephone follow-up. These values are presented in Table 2, and depicted graphically in Figure 1.

Discussion

Although sleep disturbance due to nighttime symptoms is a highly prevalent component of CTS, the response or improvement of these symptoms to CTR surgery has not been adequately explored, as outcome measures specific to CTS or upper extremity conditions tend to address secondary sleep disturbance in a single item related to nocturnal pain (4, 14). In addition, while the relative efficacy of OCTR versus ECTR in alleviating general CTS-related symptoma-

Table 1. Comparison of baseline data between the open and endoscopic carpal tunnel release groups

Variable	Open (n=30)	Endoscopic (n=30)	P-value
Age, mean ± SD, years	49.1±7.1	49.7±9.0	0.78
Final follow-up duration, mean ± SD, months	7.5±1.5	8.1±1.9	0.17
Female sex, n (%)	21 (70%)	22 (73%)	0.77
Dominant side, n (%)	18 (60%)	18 (60%)	1.0
Type II Diabetic, n (%)	9 (30%)	8 (27%)	0.77
Motor nerve onset latency, mean ± SD, ms	6.0±1.7	6.2±2.0	0.74
*Sensory nerve onset latency, mean ± SD, ms	5.0±1.2	4.8±1.0	0.51
QuickDASH score	43±19	43±18	0.70
ISI score	12.8±7.1	14.1±6.7	0.46
PSQI score	10.9±3.1	11.3±2.7	0.51

*Note: sensory latency values were non-recordable in 2 and 4 patients who in the open and endoscopic groups, respectively

Table 2. Mean values of outcome measures for entire patient cohort compared over treatment course

	Postoperative Visit 1			Postoperative Visit 2			Final Phone Follow-Up		
Measure	Open	Endoscopic	P-value	Open	Endoscopic	P-value	Open	Endoscopic	P-value
Time interval (days)	12.3±2.0	12.5±2.1	0.708	31.6±12.0	31.0±13.2	0.863	225±44.2	243±56.1	0.172
QuickDASH	26±12	24±12	0.539	13±8	13±8	0.918	12±7	11±7	0.491
ISI	7.5±4.9	4.4±3.7	0.006*	4.3±3.1	3.8±3.4	0.567	3.5±3.4	3.4±3.4	0.941
PSQI	6.1±2.8	4.4±2.7	0.016*	4.6±2.6	3.3±2.2	0.038*	3.3±2.4	3.2±2.2	0.904

Note that values are Mean ± SD.
* denotes statistical significance

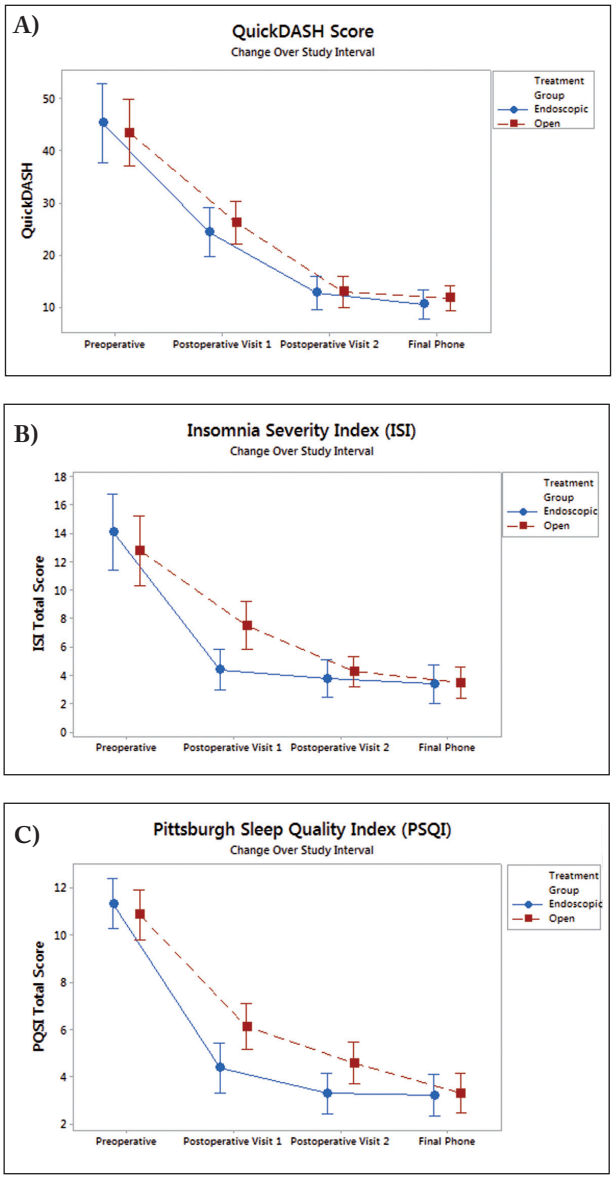

Figure 1. Interval plot of mean values of (A) the Quick Disabilities of the Arm, Shoulder and Hand (QuickDASH), (B) Insomnia Severity Scale (ISI), and (C) Pittsburgh Sleep Quality Index (PQSI) outcome measures plotted over the duration of study enrollment. Interval bars represent 95% confidence intervals

tology has been studied extensively, secondary sleep symptoms have not been evaluated using patient-reported measures specific to sleep (6, 7). For example, although Aslani et al. reported no difference in nocturnal pain between open and endoscopic techniques at similar postoperative intervals as our current study, nocturnal pain is only one component of sleep-disturbance that is addressed in validated outcome measures (11, 12, 15).

In the presented study, both ECTR and OCTR resulted in significant improvements in sleep symptoms as assessed by the ISI and PSQI, although ECTR resulted in a more rapid improvement in symptoms. Contrarily, while the QuickDASH scores improved for both groups through the second postoperative visit, the two groups remained similar. These findings suggest that the more-rapid resolution in sleep disturbance seen in patients undergoing ECTR would not necessarily be recognized without using sleep-specific instruments to assess global sleep symptomatology.

This study has several limitations. The relatively small sample size makes it difficult to use this data to draw conclusions to the general population of patients with CTS. Another limitation was that we used the QuickDASH as our outcome measure to account for symptoms not specific to sleep. We elected to use this measure as it relatively short and is given to all new patients at our center per institution standards. Although it is not specific to CTS, its longer version has been validated for CTS (16).

Despite these shortcomings, we feel the results of this study provide important information for both the clinician and the patient. For those patients who are notably burdened by their sleep symptoms, it may be in their best interest to perform an endoscopic CTR due to the quicker resolution of symptoms compared to open techniques. Surgeons may want to consider employing the PSQI or ISI to screen for these patients, and also to monitor relief of sleep symptoms postoperatively.

Ethics Approval: Thomas Jefferson University Institutional Review Board

Conflict of interest: None to declare

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