

# Utilization of Diagnostic Testing for Carpal Tunnel Syndrome: A Survey of the American Society for Surgery of the Hand

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**Purpose** In 2016, the American Academy of Orthopaedic Surgeons (AAOS) changed the clinical practice guidelines (CPGs) for the diagnosis of carpal tunnel syndrome, relaxing the recommendation for electrodiagnostic studies (EDS) prior to offering surgery. However, it is unknown how the updated guidelines changed the practice patterns of hand surgeons.

**Methods** A web-based multiple-choice survey was sent to the members of the American Society for Surgery of the Hand. We assessed the current diagnostic practice patterns of hand surgeons. The survey was pretested using expert review with content and survey methodology experts and cognitively tested to ensure readability and understandability.

**Results** The final cohort consisted of 770 hand surgeons. Approximately 26% of respondents required EDS prior to seeing a patient in consultation, and 56% of members routinely ordered EDS after evaluating a patient with carpal tunnel syndrome if testing was not performed prior to evaluation. The top reasons for obtaining EDS were to provide additional information for unclear diagnoses (97% selected), for patients with worker's compensation (82% selected), for grading the severity (73% selected), and to provide a baseline examination in the event of persistent symptoms (72% selected). However, only 38% of respondents believed that the current AAOS CPGs were appropriate, and 43% of respondents did not know what the guidelines recommended.

**Conclusions** Despite the change in AAOS CPGs, EDS continues to be ubiquitously used for the diagnosis of carpal tunnel syndrome. Nevertheless, a substantial proportion of hand surgeons are unaware of the recommendations for EDS within the AAOS CPGs.

**Clinical relevance** These findings highlight the importance of explicitly defining which patients and which clinical scenarios would benefit from additional diagnostic testing and identifying strategies for more widespread dissemination of guidelines. (*J Hand Surg Am.* 2022;47(1):11–18. Copyright © 2022 by the American Society for Surgery of the Hand. All rights reserved.)

**Key words** Carpal tunnel syndrome, electrodiagnostic testing.



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**C**ARPAL TUNNEL SYNDROME (CTS) is a clinical diagnosis, encompassing classic symptoms and physical examination findings. Diagnosis may be aided with electrodiagnostic studies (EDS) in select cases where the history and examination are equivocal. The need for routine diagnostic testing to confirm the diagnosis of CTS is a long-standing topic of debate. In 2016, the American Academy of Orthopaedic Surgeons (AAOS) changed its stance on EDS through updated clinical practice guidelines (CPGs). A prior AAOS CPG recommended using EDS for patients in whom surgery was being considered.<sup>1</sup> However, the 2016 AAOS CPGs no longer recommend that EDS be considered for all patients undergoing carpal tunnel release (CTR) but rather support that CTS can be diagnosed through history and physical examination. This change has supported a more nuanced approach to the diagnosis of CTS, stating that EDS could be useful to aid in the diagnosis of CTS.<sup>2</sup> For other diagnostic imaging modalities, there is even more limited evidence. According to the guidelines, there is “moderate evidence supporting not routinely using MRI,” and for ultrasonography, there is “limited evidence in not routinely using ultrasound.”<sup>2</sup> There are conflicting results regarding the utility of ultrasound as a screening tool for the diagnosis of CTS, thus contributing to the debate regarding the optimal diagnostic tools for the confirmation of this diagnosis.<sup>3–8</sup>

The current practice patterns of hand surgeons are largely unknown after the change in the AAOS CPGs. In a 2014 study by the American Society for Surgery of the Hand (ASSH) members, approximately 90% of members used EDS for the diagnosis of CTS.<sup>9</sup> Despite the routine use of EDS, it does not have an impact on the final treatment decision in most cases. In a study by Becker et al,<sup>10</sup> EDS results only changed 19% of the cases from surgical management to nonsurgical treatment, questioning the use of EDS as a screening tool. Moreover, Graham<sup>11</sup> found that adding EDS to routine history and physician examination rarely changed the probability of CTS in patients with a high pretest probability of the diagnosis, questioning the utility of EDS in patients with classic CTS symptoms and physical examination findings. Therefore, the current practice patterns of hand surgeons can shed light on the translation of evidence-based guidelines into real-world clinical practice.

Given the evolving literature that questions the utility of EDS in all patients with CTS and recent guideline changes, the way hand surgeons currently practice warrants further investigation. Therefore, we

sought to identify the current rates of EDS utilization among the ASSH members and to determine the common reasons behind EDS use. Additionally, we aimed to assess if the ASSH members were aware of the recent AAOS CPG changes and if these changes affected EDS utilization. The findings from this study may help understand how the implementation of evidence-based guidelines in hand surgery corresponds to the practice patterns of surgeons.

## MATERIALS AND METHODS

### Study sample

We recruited independently practicing (nontrainee) active, candidate, and retired members of the ASSH. We sent a web-based questionnaire to the ASSH members via the research email list, with a note that the completion of the survey inferred consent to participate. If a participant selected that they were a current resident or fellow, the survey was then terminated, and their responses were not recorded. There were 3,369 ASSH members on the research email list. However, 80 emails were returned as undeliverable, thus resulting in a potential sample size of 3,289. A reminder email with an identical survey was sent 4 weeks after the initial email. Given the deidentified nature of the survey responses, this study received exempt status from the institutional review board of the University of Michigan.

### Survey instrument and data analysis

We developed the survey instrument with assistance from the Institute for Social Research, Survey Research Center at the University of Michigan. The survey assessed the practice patterns and reasons behind using specific diagnostic tests for CTS (Appendix E1, available online on the *Journal's* website at [www.jhandsurg.org](http://www.jhandsurg.org)). Demographic data were captured, and whether the participant had an active Subspecialty Certificate in Surgery of the Hand was noted. Additionally, we collected data regarding the average number of CTRs performed and operative location(s). The survey included questions regarding the timing for, and reasons behind, requesting additional diagnostic testing for CTS. Questions were directed at what diagnostic tests hand surgeons require prior to seeing a patient in consultation and after seeing a patient in consultation for CTS (if testing was not performed prior). A scenario was included describing a patient with “classic” history and physical examination findings consistent with CTS, and participants were asked how often they would require EDS prior to offering a CTR. Lastly,

**TABLE 1. Respondent Demographic Characteristics**

Characteristics	Number (%)
Age (y)	
<35	35 (4.6)
35–40	147 (19.1)
41–45	89 (11.6)
46–50	82 (10.7)
51–55	96 (12.5)
56–60	96 (12.5)
61–65	82 (10.7)
66–70	70 (9.1)
>70	73 (9.5)
Sex	
Male	668 (86.8)
Female	98 (12.7)
Other	4 (0.5)
Residency Training	
Orthopedic surgery	634 (79.9)
Plastic surgery	102 (12.9)
General surgery	58 (7.3)
Years in practice (y)	
<2	67 (8.7)
3–5	94 (12.2)
6–10	88 (11.4)
11–20	154 (20.0)
>20	366 (47.6)
ASSH member status	
Active	582 (76.0)
Candidate	137 (17.9)
Other*	47 (6.1)
Active Subspecialty Certificate in Surgery of the Hand	
Yes	574 (74.9)
No	143 (18.7)
Previously, but did no recertify	49 (6.4)
Surgical practice	
Private practice (nonacademic)	400 (52.2)

(Continued)

**TABLE 1. Respondent Demographic Characteristics (Continued)**

Characteristics	Number (%)
Academic (University)	188 (24.5)
Hospital-owned	94 (12.3)
Other <sup>†</sup>	84 (11.0)

\*Includes lifetime members and retired members.

<sup>†</sup>Includes hybrid private practice with academic affiliation, military, health maintenance organization, and a government practice.

CPGs for EDS were appropriate and if the guidelines changed their EDS requirements for CTR.

The survey was pretested using expert review with content and survey methodology experts. We also cognitively tested the survey with 5 physicians, including 2 hand surgeons, to ensure readability and understandability. We used descriptive statistics to analyze the survey results. We compared differences among groups requiring EDS prior to hand surgeon consultation and usually/always obtaining EDS after hand surgeon consultation using Fisher exact test for categorical variables. Cronbach  $\alpha$  was used to test the internal consistency of the survey items ( $\alpha \geq 0.70$  was considered good,  $\alpha \geq 0.80$  was considered better, and  $\alpha \geq 0.90$  was considered excellent).<sup>12</sup> Significance level was set at  $P$  value of  $<.05$  for all analyses.

## RESULTS

A total of 770 ASSH members filled out the survey, with an overall response rate of 23.4%. The respondents were predominantly men (86.8%) with greater than 20 years of experience (47.5%) (Table 1). Most respondents (79.9%) completed an orthopedic surgery residency, 12.9% completed a plastic surgery residency, and 7.3% a general surgery residency. Approximately 52.2% of respondents ( $n = 400$ ) worked in a private practice (nonacademic setting), whereas 24.5% worked in an academic university setting ( $n = 188$ ). Seventy-five percent of respondents had an active Subspecialty Certificate in Surgery of the Hand. In a 1-month period, 253 (33.6%) respondents performed 6 to 10 CTRs. Nevertheless, there was a variation in the average number of CTRs performed monthly (Table 2).

For the diagnosis of CTS, 495 (61.1%) ASSH members reported that they did not require diagnostic studies before seeing a patient for consultation. However, 26.3% reported that they required EDS in

we inquired if the participants believed whether the 2016 American Academy of Orthopaedic Surgery

**TABLE 2. Respondent Surgical Practice**

Characteristic	Number (%)
Average no. of CTRs in 1 month	
0–5	95 (12.6)
6–10	253 (33.6)
11–15	184 (24.4)
16–20	119 (15.8)
>20	103 (13.7)
Operative setting*	
Office/clinic	96 (8.2)
Ambulatory surgery center	627 (53.3)
Hospital-based operating room	429 (36.5)
Other <sup>†</sup>	24 (2.0)

\*Respondents were permitted to select multiple choices.

<sup>†</sup>Includes minor procedure room in a hospital setting or an in office ambulatory surgery center/operating room.

at least half of their patients with CTS prior to evaluating them, and 10.4% required an x-ray (Table 3). Figure 1 illustrates how often the respondents ordered EDS after evaluating a patient with CTS. Most respondents reported that they always or usually obtained EDS for patients with CTS. This was reinforced by a clinical scenario of a patient with “classic signs and symptoms” (nocturnal symptoms, numbness in the median nerve distribution, thenar weakness, loss of 2-point discrimination, positive Phalen test, and positive Durkan test). In this scenario, 44.4% of respondents would require EDS prior to CTR in greater than 75% of the patients, and 10.4% would require EDS in 51% to 75% of the patients (Table 3). The most common reasons behind obtaining EDS included the need for additional information when the diagnosis is unclear (97.4% of respondents), workers’ compensation insurance (81.9%), to grade severity (73.0%), and to provide a baseline examination in the event of persistent symptoms (71.8%). Nearly half of the respondents (47.2%) selected malpractice concerns as a reason for obtaining EDS. A total of 14 respondents filled in “insurance requirement/authorization” as a reason for obtaining EDS.

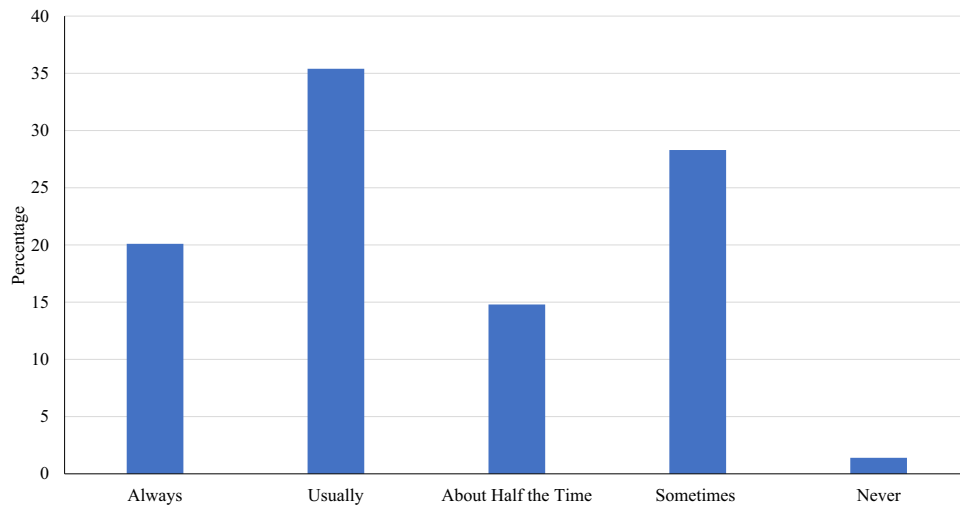
Among the ASSH members, 38.3% believed that the current AAOS guidelines were appropriate. However, 42.5% did not know if they were appropriate, were either unsure if they were appropriate, or did not know what the CPGs stated. Additionally, most respondents (89.4%) stated that the 2016 AAOS

**TABLE 3. Diagnostic Testing for CTS**

Question	Number (%)
Diagnostic testing required prior to evaluating a patient with CTS symptoms	
Electrodiagnostic testing	213 (26.3)
Ultrasound	9 (1.1)
X-ray	84 (10.4)
Magnetic resonance imaging	1 (0.1)
None	495 (61.1)
Other*	8 (1.0)
Require EDS in a patient with classic CTS symptoms	
>75% of the time	329 (44.4)
51%–75% of the time	77 (10.4)
25%–50% of the time	54 (7.3)
<25% of the time	281 (37.9)
Reasons for obtaining EDS <sup>†</sup>	
Confirmation of diagnosis	471 (66)
Grading severity	523 (73.0)
Predicting response to treatment	357 (51.2)
Baseline examination in the event of persistent or recurrent symptoms	517 (71.8)
Malpractice concerns	324 (47.2)
Patients with worker’s compensation insurance	584 (81.9)
Patients with a diagnosis of chronic pain	453 (64.6)
Additional information when the diagnosis is unclear	708 (97.4)

\*Includes diagnostic steroid injection or CTS-6 scores.

<sup>†</sup>Respondents were permitted to select multiple choices.



**FIGURE 1:** How often ASSH members obtain EDS after the evaluation of patients with CTS.

guidelines did not change their EDS requirements. For respondents where the guidelines changed their EDS requirements, 80.3% now order fewer tests and 19.7% order more tests.

Table 4 illustrates the comparison of surgeon demographics and the use of EDS prior to evaluating a patient for CTS and always/usually obtaining EDS after evaluating a patient with CTS. Surgeon demographic characteristics, years in practice, practice setting, and CTR volume were not significantly associated with obtaining EDS prior to consultation. Moreover, there were no significant differences in surgeon characteristics among respondents who usually/always obtain EDS after evaluating a patient with CTS (Table 4). Cronbach  $\alpha$  for the survey test items was 0.70, indicating good internal consistency.

## DISCUSSION

In this survey of ASSH members, we found that 26% of hand surgeons obtained EDS and 10% obtained an x-ray prior to evaluating patients referred for CTS. Most respondents requested EDS for a patient with CTS if it was not obtained prior to the initial consultation, even for patients with “classic symptoms,” citing an array of reasons for ordering these tests. Only 38% of hand surgeons believed that the AAOS guidelines were appropriate, with 43% of respondents not knowing what the guidelines recommended or not knowing whether the guidelines were appropriate. The ASSH members’ practice patterns for the diagnosis of CTS are quite diverse despite the existence of evidence-based CPG. These findings highlight the importance of widely disseminated guidelines that emphasize the clinical scenarios in

which additional testing is most beneficial for the diagnosis of CTS and the need for clinicians to stay abreast of and follow the evidence-based guidelines.

Our findings are corroborated by other surveys of hand surgeon practice patterns for the diagnosis of CTS. In a survey study of ASSH members by Lane et al,<sup>13</sup> the majority of respondents reported that EDS were important for the diagnosis of CTS if they were going to offer surgery. In another study by Munn and Awan,<sup>9</sup> approximately 90% of ASSH members used EDS for the diagnosis of CTS. Lastly, in a study of adherence to the AAOS upper extremity CPGs, it was found that 32% of the ASSH members always ordered EDS when considering surgical intervention.<sup>14</sup> However, these studies were conducted prior to the recent 2016 AAOS CPG changes, which have adjusted the recommendation for EDS prior to surgery. The previous guidelines recommended EDS in all patients with CTS who were considered for surgical intervention. Despite the AAOS CPG change, there has been little change in the practice patterns of hand surgeons. In our study, 26% of respondents reported that they routinely obtained EDS prior to evaluating a patient with CTS and 56% of respondents reported that they usually or always required EDS if they did not receive it prior to evaluation, underscoring the slow implementation of guideline changes. Additionally, 10% of the ASSH members obtain an x-ray before the evaluation of a patient with CTS, which has been shown to have limited utility in the diagnosis of CTS. The most common reasons behind obtaining EDS for hand surgeons were varied, including the confirmation of diagnosis, workers’ compensation insurance, grading severity, and obtaining a baseline examination in the

**TABLE 4. Comparison of Surgeon Demographics and the Use of Electrodiagnostic Testing Before Evaluating a Patient With CTS**

Characteristics	No. of ASSH Members Who Obtain EDS Before Consultation	<i>P</i> Value*	No. of ASSH Members Who Always/Usually Obtain EDS After Consultation <sup>†</sup>	<i>P</i> Value*
Age (y)		.06		.60
<40	37 (20.4)		99 (55.6)	
41–50	51 (29.8)		91 (55.5)	
51–65	78 (28.5)		157 (57.7)	
>65	47 (32.9)		64 (50.4)	
Sex		.64		.56
Male	181 (27.1)		355 (55.0)	
Female	31 (32.0)		55 (59.1)	
Other	1 (25.0)		1 (33.3)	
Years in practice (y)		.24		.38
<2	14 (20.9)		43 (65.2)	
3–5	22 (23.4)		46 (49.5)	
6–10	20 (22.7)		44 (53.0)	
11–20	50 (32.5)		86 (57.0)	
>20	107 (29.2)		192 (55.2)	
ASSH member status		.08		.15
Active	167 (28.7)		307 (54.3)	
Candidate	29 (21.2)		76 (55.9)	
Other	17 (36.2)		28 (70.0)	
Active Subspecialty Certificate in Surgery of the Hand		.17		.79
Yes	162 (28.2)		305 (54.8)	
No	33 (23.1)		80 (58.0)	
Previously, but did no recertify	18 (36.7)		26 (56.5)	
Surgical practice		.35		.70
Private practice (nonacademic)	99 (24.8)		216 (55.5)	
Academic (University)	60 (31.9)		99 (53.8)	
Hospital-owned	30 (31.9)		56 (60.9)	
Other	24 (28.6)		33 (55.0)	
Average monthly number of CTRs performed		.76		.83
0–10	103 (29.6)		187 (54.5)	
11–20	82 (27.1)		166 (55.7)	
>20	28 (27.2)		58 (58.0)	

\*Obtained using Fisher exact test for categorical variables.

<sup>†</sup>Testing performed after hand surgeon consultation if not received prior to consultation.



event of persistent symptoms. In the workers' compensation population, EDS is often required prior to surgical intervention. However, studies have shown that patients with workers' compensation have a greater number of clinic visits and diagnostic testing before undergoing surgical intervention for hand and wrist complaints.<sup>15</sup> Moreover, patients with workers' compensation have higher rates of postoperative pain after CTR with delayed return to work, which may contribute to specific insurance requirements of EDS prior to surgery.<sup>16</sup> Moreover, 14 respondents typed in that insurance authorization or requirement was a reason behind obtaining EDS. Additionally, 47% of respondents stated concerns regarding malpractice as a reason for obtaining EDS. More widespread dissemination of the guidelines with better implementation strategies and greater emphasis on scenarios that would benefit from EDS may lead to fewer tests as EDS is not necessary in all patients.

The optimal timing of EDS is controversial with potential efficiency advantages for the surgeon for obtaining EDS before surgical evaluation. However, EDS obtained before surgeon evaluation may lead to an overuse in diagnostic testing and contribute to health care waste. In a study by Hartzell et al,<sup>17</sup> 74% of patients received diagnostic testing prior to seeing a hand surgeon, but 70% of those tests were deemed unnecessary because they did not aid in obtaining the correct diagnosis or change the ultimate treatment recommendation. Although referring providers may use some of these tests in deciding whether hand surgeon evaluation is warranted, many hand surgeons commonly require testing prior to evaluating patients, thus contributing to potential testing overuse. In a secret shopper study in the state of Michigan, Sears et al<sup>18</sup> found that 57% of hand surgeons required diagnostic testing prior to patient evaluation. Our study found lower rates of required testing before consultation, with 26% of hand surgeons requiring EDS and 10% requiring an x-ray prior to evaluating a patient with CTS. However, 55% stated that they usually or always obtain EDS after an evaluation if patients did not receive it prior. Studies have shown that diagnostic testing obtained prior to hand surgeon evaluation has been associated with delays to definitive surgical treatment for patients with CTS.<sup>19–21</sup> Therefore, the use of pre-evaluation diagnostic testing in all patients is potentially one source of health care overuse.

In 2016, the AAOS CPG for CTS took a more neutral stance on the use of EDS for the diagnosis of CTS. The guideline states that "moderate evidence supports that ...electrodiagnostic studies and/or

diagnostic questionnaires could be used to aid the diagnosis of carpal tunnel syndrome."<sup>2</sup> However, the guideline further acknowledges that EDS cannot be the reference standard as the test has false positives and negatives. Currently, there is no consensus for the reference standard for the diagnosis of CTS. Nonetheless, evidence does not support using EDS as a screening test in all patients. Multiple studies have shown that the addition of EDS in patients with classic CTS symptoms and physical examination typically does not change the treatment plan.<sup>11,22</sup> In this study, most respondents reported that they would obtain EDS in a clinical scenario of a patient with "classic" CTS symptoms and physical examination findings despite evidence that EDS is unlikely to influence the treatment plan in these cases or to meaningfully change the probability of CTS diagnosis. In this study, 43% of the ASSH members did not know what the guidelines recommended with regard to the use of EDS in diagnosing CTS or did not know if they found the guidelines appropriate, and only 38% of the ASSH members believed that the guidelines were appropriate. Collectively, these findings highlight the slow uptake of evidence-based recommendations within the hand surgery community and the need for more widespread dissemination to promote the uptake of evidence into practice.

This study has several limitations. First, this is a survey of ASSH members, which may introduce selection bias. The ASSH members are not the only physicians who care for patients with CTS. Primary care, neurosurgical, physical medicine and rehabilitation physicians, and non-ASSH member surgeons also diagnose and treat patients with CTS, and these physicians were not surveyed. Nevertheless, we believe that this is a representative sample of surgeons who care for patients with CTS. Additionally, we only obtained a 23% response rate, thus raising the potential for some response bias. Nevertheless, this response rate is consistent with other online surveys distributed through a professional society. Additionally, our survey responses showed an internal consistency of 0.70, thus indicating the good reliability of the survey test items. Lastly, our survey demographics reflect the general ASSH membership; therefore, this sample is likely representative of the ASSH population.<sup>23,24</sup> Despite a response rate of 23%, we have practice patterns from 770 ASSH members, which we believe captures a representative sample of hand surgeons. We also did not probe into the reasons behind certain respondent answers, including why the respondents felt that the CPGs were appropriate or inappropriate and why hand

surgeons obtained specific diagnostic tests before consultation, although we inquired about reasons for ordering EDS after seeing a patient with suspected CTS. Additionally, a specific word choice in the survey questions could influence respondents' answers and create spurious findings. Future studies will need to survey all providers who care for patients with CTS, beyond surgeons, to capture a more comprehensive understanding of diagnostic testing patterns for patients with CTS.

Despite changes in the AAOS CPGs for CTS, most hand surgeons continue to use EDS for the diagnosis of CTS, including in patients with "classic" symptoms. Moreover, 1 in 4 hand surgeons require EDS prior to evaluating a patient with CTS, potentially contributing to testing overuse. More concerning, 43% of the ASSH members do not know the CPG recommendation for the use of EDS or do not know if they find the guidelines appropriate, thus highlighting the need for better dissemination strategies. To minimize potential over-testing for the diagnosis of CTS, future guidelines should emphasize the patients and clinical scenarios where the addition of EDS is least beneficial, such as patients with classic history and physical examination findings.

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