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SURGERY ARTICLES

Treatment of carpal tunnel syndrome by members of the American Association for Hand Surgery

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Abstract
Background Carpal tunnel syndrome (CTS) is the most common compressive neuropathy affecting the upper extremity, yet evidence-based guidelines for its diagnosis and treatment are lacking. We set out to expose any potential discrepancies in CTS practice attitudes based on surgeon's academic background, residency training, clinical experience, and other factors.
Methods This was an online survey-based study. Members of the American Association for Hand Surgery (AAHS) were sent an electronic mail request (n=817). The online questionnaire consisted of 12 questions that queried surgeons' approaches to the diagnosis as well as operative and non-operative management of carpal tunnel syndrome.
Results One hundred twenty-three surgeons responded to the survey (15.1 %). The locations of surgical practices varied within the United States and beyond. Most respondents were either orthopedic or plastic surgeons. With respect to practice duration, 15.4 % had been in practice for 5 years or less, 30.9 % of the respondents had been in practice between 6 and 15 years, 30.9 % had been in practice between 16 and 25 years, and 26.8 % had been in practice for more than 25 years. The most notable interspecialty differences were related to the use of operative antibiotics and the surgical approach. Plastic surgeons were less likely to recommend antibiotic use during surgery and more likely to utilize an open extensile approach during surgical release. Younger surgeons were more likely to employ a mini-open approach for carpal tunnel release.
Conclusions We conclude that background training and generational differences contribute to the varied approaches observed in the diagnosis and management of CTS.

Keywords Carpal tunnel syndrome · Surgeon attitudes · Questionnaire · Survey

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Introduction

Carpal tunnel syndrome (CTS) is the most common compressive neuropathy affecting the upper extremity. Defined as median nerve compression at the level of the wrist, CTS causes numbness and tingling in the hand and fingers. George Phalen is credited for popularizing the diagnosis and treatment of CTS in the 1950s [6–8]. Since then, there has been continued debate over the optimal management of this disease. Surgeon attitudes have consistently varied both within the United States and globally [1–4]. Numerous factors such as the surgeon's academic background, residency training, and clinical experience may affect the decision making for the evaluation and treatment of patients with carpal tunnel syndrome. Furthermore, evidence-based guidelines are lacking, which allows dogmatic views to flourish.

In this study, we set out to investigate the attitudes of hand surgeons toward the management of carpal tunnel syndrome. In addition, we set out to identify factors that can influence surgeons' approaches toward the treatment of carpal tunnel syndrome, such as the type of surgical residency completed and the years in clinical practice.

Materials and Methods

This was an online survey-based study. Active members, candidate members, and international members of the

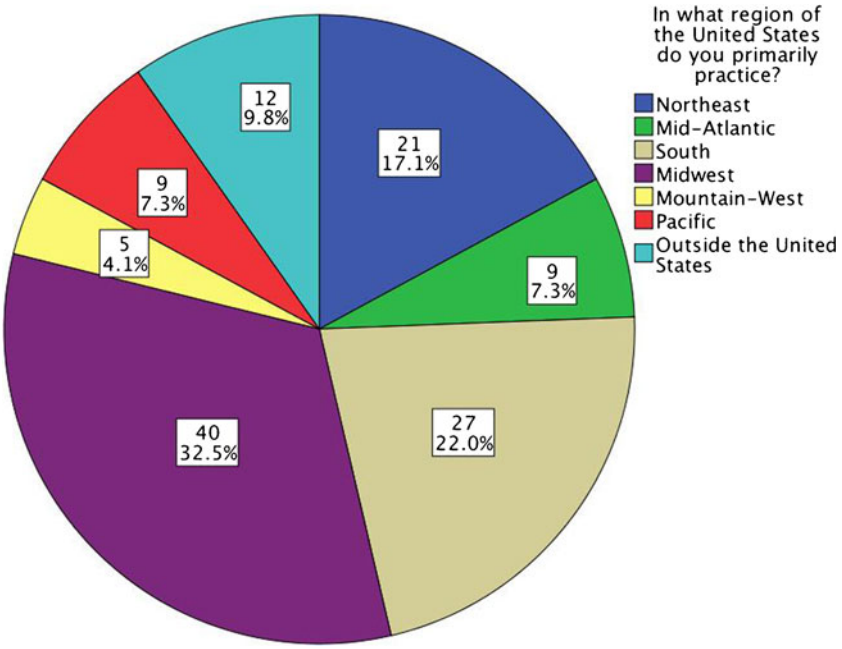

Fig. 1 Geographic distribution of respondents

American Association for Hand Surgery (AAHS) were sent an electronic mail request (n=817) by the AAHS administration on behalf of the authors. An electronic link within the mailing granted access to an online survey (Survey Gizmo software, surveygizmo.com). The survey questions were aimed at gauging surgeon attitudes toward the diagnosis and treatment of CTS. Therefore, only surgeons were included. Hand therapists were excluded from the mailing list (n=115).

The online questionnaire consisted of 12 questions that queried surgeons' approaches to the diagnosis as well as operative and non-operative management of carpal tunnel syndrome. A response was required for all questions. Surgeon demographics were also requested

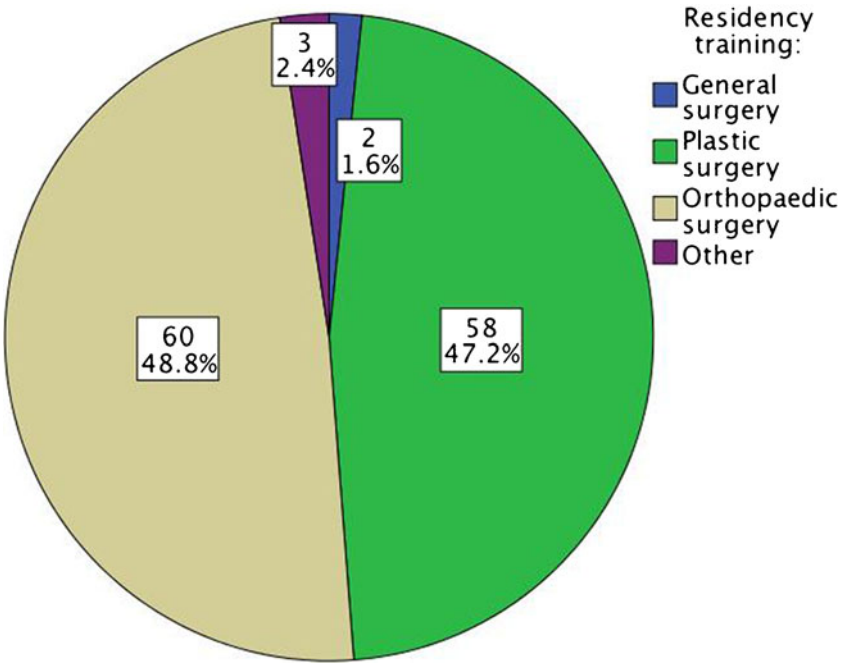

Fig. 2 Respondent distribution by residency training

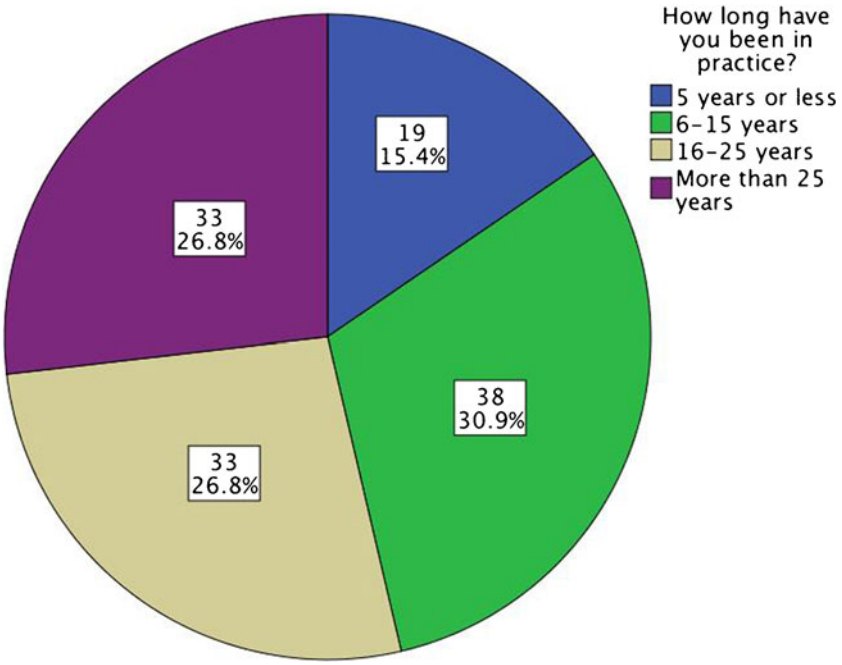

Fig. 3 Respondent distribution by years of clinical practice

as part of the questionnaire. The estimated time for survey completion was 3 min. All responses were kept confidential. In order to maintain an accurate representation of the data, respondents were asked not to repeat the questionnaire more than once and not to forward the survey link to other individuals. Furthermore, any duplicate responses—as evidenced by the Internet Protocol (IP) address, city, and zip code—were removed from the final analysis ($n=1$).

Members were given 10 days to respond to the survey. No additional electronic mail queries were delivered. The submitted data was stratified by surgical residency type and by surgical practice duration to determine the effect of background training and generational differences on the approaches toward CTS.

Results

One hundred twenty-three surgeons responded to the survey, yielding a response rate of 15.1 %. All questions in all responses were complete. The locations of surgical practices varied within the United States and beyond (Fig. 1). Most respondents were either orthopedic or plastic surgeons in a nearly equal distribution. Two general surgeons and three surgeons in combined specialties responded to the survey (Fig. 2). According to the administrative board of AAHS, the surgeon membership is composed of 43 % plastic surgeons, 41 % orthopedic surgeons, 1 % general surgeons, and 15 % unknown surgeons (not defined).

With respect to practice duration, 15.4 % had been in practice for 5 years or less, 30.9 % of the respondents had

Table 1 In the conservative treatment of carpal tunnel syndrome, do you regularly offer corticosteroid injections for symptomatic relief

	Yes	No
Total	76 (61.8 %)	47 (38.2 %)
Residency training		
Orthopedic surgery	41 (33.3 %)	19 (15.4 %)
Plastics surgery	32 (26.0 %)	26 (21.1 %)
Other	3 (2.4 %)	2 (1.6 %)
Years in practice		
5 years or less	12 (9.8 %)	7 (5.7 %)
6 to 15 years	28 (22.8 %)	10 (8.1 %)
16 to 25 years	22 (17.9 %)	11 (8.9 %)
More than 25 years	14 (11.4 %)	19 (15.4 %)

Table 2 Prior to elective surgery for carpal tunnel syndrome, do you routinely order an EMG/NCS study

	Yes	No
Total	100 (81.3 %)	23 (18.7 %)
Residency training		
Orthopedic surgery	50 (40.7 %)	10 (8.1 %)
Plastics surgery	45 (36.6 %)	13 (10.6 %)
Other	5 (4.1 %)	0
Years in practice		
5 years or less	17 (13.8 %)	2 (1.6 %)
6 to 15 years	32 (26.0 %)	6 (4.9 %)
16 to 25 years	25 (20.3 %)	8 (6.5 %)
More than 25 years	26 (21.1 %)	7 (5.7 %)

Table 3 When performing carpal tunnel surgery, what sort of anesthesia do you typically employ

	Local only	Local with MAC	Regional	General	Other[a]
Total	23 (18.7 %)	58 (47.2 %)	28 (22.8 %)	11 (8.9 %)	3 (2.4 %)
Residency training					
Orthopedic surgery	8 (6.5 %)	33 (26.8 %)	11 (8.9 %)	7 (5.7 %)	1 (0.8 %)
Plastics surgery	13 (10.6 %)	23 (18.7 %)	16 (13.0 %)	4 (3.3 %)	2 (1.6 %)
Other	2 (1.6 %)	2 (1.6 %)	1 (0.8 %)	0	0
Years in practice					
5 years or less	3 (2.4 %)	13 (10.6 %)	2 (1.6 %)	1 (0.8 %)	0
6 to 15 years	7 (5.7 %)	18 (14.6 %)	11 (8.9 %)	1 (0.8 %)	1 (0.8 %)
16 to 25 years	5 (4.1 %)	18 (14.6 %)	8 (6.5 %)	2 (1.6 %)	0
More than 25 years	8 (6.5 %)	9 (7.3 %)	7 (5.7 %)	7 (5.7 %)	2 (1.6 %)

MAC monitored anesthesia care

[a]Other responses included: one regional or laryngeal mask airway, approximately 50:50; one retired surgeon that used to use regional anesthesia; one local or local with MAC

been in practice between 6 and 15 years, 30.9 % had been in practice between 16 and 25 years, and 26.8 % had been in practice for more than 25 years. One respondent indicated that he was retired (Fig. 3).

The results stratified by specialty training and years in clinical practice are presented in Tables 1, 2, 3, 4, 5, 6, 7, 8, and 9. The most notable interspecialty differences were related to the use of operative antibiotics and the surgical approach. Plastic surgeons were less likely to recommend antibiotic use during surgery (Table 4) and more likely to utilize an open extensile approach during surgical release (Tables 5 and 6). Younger surgeons were more likely to employ a mini-open approach for carpal tunnel release (Tables 5 and 6).

Discussion

Previous reports have studied surgeon practice attitudes towards CTS [1–4]. In 1987, Duncan et al. studied the treatment of CTS by members of the American Society for Surgery of the Hand (ASSH) [1]. Thirty-seven questions on the evaluation, conservative management, surgical technique, and postoperative care were submitted to 722 members, out of which 467 (64.7 %) responded. In many respects, the content of the survey conducted by Duncan et al. was similar to ours. At that time, Duncan et al. found that carpal tunnel release was frequently performed under regional anesthesia and that the preferred surgical approach was a longitudinal incision greater than 4 cm in 65.8 % of respondents, whereas 31.9 % favored a longitudinal incision less than 4 cm.

Twenty-five years later, we find that 65.9 % of respondents utilize local anesthesia (local anesthesia only or local anesthesia with MAC) and only 13.8 % of surgeons typically employ regional anesthesia. In addition, 33.3 % of our respondents favor a standard open incision, whereas 45.5 % favor a mini incision and 19.5 % favor an endoscopic release. When stratified by years of clinical practice, the preferred surgical approach is a "mini-open release" in 57.9 % of surgeons in clinical practice for 5 years or less and 60.5 % of surgeons in clinical practice for 6–15 years. Conversely, only 39.4 % of surgeons in practice for 16–25 years and 27.3 % of surgeons in practice more than

Table 4 Do you regularly use intravenous antibiotics during surgery

	Yes	No
Total	38 (30.9 %)	85 (69.1 %)
Residency training		
Orthopedic surgery	28 (22.8 %)	32 (26.0 %)
Plastics surgery	9 (7.3 %)	49 (39.8 %)
Other	1 (0.8 %)	4 (3.3 %)
Years in practice		
5 years or less	8 (6.5 %)	11 (8.9 %)
6 to 15 years	14 (11.4 %)	24 (19.5 %)
16 to 25 years	9 (7.3 %)	24 (19.5 %)
More than 25 years	7 (5.7 %)	26 (21.2 %)

Table 5 For surgical treatment, what is your favored approach

	Open release	Mini open release	Endoscopic	Other[a]
Total	41 (33.3 %)	56 (45.5 %)	24 (19.5 %)	2 (1.6 %)
Residency training				
Orthopedic surgery	10 (8.1 %)	36 (29.3 %)	12 (9.8 %)	2 (1.6 %)
Plastics surgery	29 (23.6 %)	19 (15.4 %)	10 (8.1 %)	0
Other	2 (1.6 %)	1 (0.8 %)	2 (1.6 %)	0
Years in practice				
5 years or less	6 (4.9 %)	11 (8.9 %)	2 (1.6 %)	0
6 to 15 years	9 (7.3 %)	23 (18.7 %)	6 (4.9 %)	0
16 to 25 years	13 (10.6 %)	13 (10.6 %)	6 (4.9 %)	1 (0.8 %)
More than 25 years	13 (10.6 %)	9 (7.3 %)	10 (8.1 %)	1 (0.8 %)

[a] Other responses included: one open and endoscopic, one endoscopic carpal tunnel release with balloon access

Table 6 If you order EMG/NCS studies pre-operatively, what is your favored approach for electrically severe CTS

	Open release	Mini open release	Endoscopic	Other[a]
Total	54 (43.9 %)	52 (42.3 %)	16 (13.0 %)	1 (0.8 %)
Residency training				
Orthopedic surgery	16 (13.0 %)	34 (27.6 %)	10 (8.1 %)	0
Plastics surgery	35 (28.5 %)	17 (13.8 %)	5 (4.1 %)	1 (0.8 %)
Other	3 (2.4 %)	1 (0.8 %)	1 (0.8 %)	0
Years in practice				
5 years or less	9 (7.3 %)	9 (7.3 %)	1 (0.8 %)	0
6 to 15 years	9 (7.3 %)	24 (19.5 %)	5 (4.1 %)	0
16 to 25 years	17 (13.8 %)	12 (9.8 %)	3 (2.4 %)	1 (0.8 %)
More than 25 years	19 (15.4 %)	7 (5.7 %)	7 (5.7 %)	0

[a] Other response included: one synovectomy

Table 8 Approximately when do you remove sutures following surgery

	7 days	10 days	14 days	None (absorbable)
Total	15 (12.2 %)	44 (35.7 %)	44 (35.7 %)	20 (16.3 %)
Residency training				
Orthopedic surgery	8 (6.5 %)	26 (21.2 %)	18 (14.6 %)	8 (6.5 %)
Plastics surgery	6 (4.9 %)	16 (13.0 %)	25 (20.3 %)	11 (8.9 %)
Other	1 (0.8 %)	2 (1.6 %)	1 (0.8 %)	1 (0.8 %)
Years in practice				
5 years or less	4 (3.3 %)	11 (8.9 %)	4 (3.3 %)	0
6 to 15 years	3 (2.4 %)	8 (6.5 %)	18 (14.6 %)	9 (7.3 %)
16 to 25 years	1 (0.8 %)	15 (12.2 %)	10 (8.1 %)	7 (5.7 %)
More than 25 years	7 (5.7 %)	10 (8.1 %)	12 (9.8 %)	4 (3.3 %)

25 years favor the smaller incision of a mini-open release (Tables 5 and 6).

Steroid injection for the symptomatic relief of CTS is regularly used by 63.2 % of surgeons in clinical practice for 5 years or less, 73.7 % of surgeons in clinical practice for 6–15 years, and 66.7 % of surgeons in practice for 16–25 years. However, this is the case in only 42.4 % of surgeons who have been in practice more than 25 years (Table 1). Therefore, there have been gradual changes in practice trends that favor more use of local anesthesia and less invasive treatments and surgical techniques. These differences could be attributed to a better understanding of disease pathophysiology, more comprehensive clinical outcomes data, and technological advancements and improvements in surgical technique.

Differences in training background have also been known to affect practice attitudes. ElMaraghy and Devereauux conducted a survey of orthopedic and plastic surgeons in Ontario, Canada, to identify variations in the choice of surgical setting and anesthesia when treating CTS [3]. Surveys were delivered to 606 orthopedic and plastic surgeons; 75 % responded to the questionnaire. The authors found that orthopedic surgeons used the formal operating room for all CTR surgeries significantly more than plastic surgeons. Furthermore, significant differences in the selection of anesthesia were revealed between the two specialties, with regional or general anesthesia used more in orthopedists compared to plastic surgeons.

Similarly, we found a number of interesting trends when stratifying the data by specialty. When comparing responses based on training background, the following overt differences were noted: (1) 15.5 % of plastic surgeons use intravenous antibiotics during surgery, while 46.7 % of orthopedic surgeons use intravenous antibiotics (Table 4) and (2) the preferred surgical approach to carpal tunnel syndrome is a traditional "open release" in 50.0 % of plastic surgeons and 16.7 % of orthopedic surgeons. The smaller "mini-open release" is the favored approach in 32.8 % of

Table 7 What type of dressing do you apply

	Splint/cast	Soft bandage	Band-aid
Total	34 (27.6 %)	88 (71.5 %)	1 (0.8 %)
Residency training			
Orthopedic surgery	11 (8.9 %)	49 (39.8 %)	0
Plastics surgery	20 (16.3 %)	37 (30.1 %)	1 (0.8 %)
Other	3 (2.4 %)	2 (1.6 %)	0
Years in practice			
5 years or less	5 (4.1 %)	14 (11.4 %)	0
6 to 15 years	6 (4.9 %)	32 (26.0 %)	0
16 to 25 years	11 (8.9 %)	22 (17.9 %)	0
More than 25 years	12 (9.8 %)	20 (16.3 %)	1 (0.8 %)

Table 9 Are you fellowship trained in hand surgery

	Yes	No
Total	103 (83.7 %)	20 (16.3 %)
Residency training		
Orthopedic surgery	57 (46.3 %)	3 (2.4 %)
Plastics surgery	42 (34.1 %)	16 (13.0 %)
Other	4 (3.3 %)	1 (0.8 %)
Years in practice		
5 years or less	18 (14.6 %)	1 (0.8 %)
6 to 15 years	36 (29.3 %)	2 (1.6 %)
16 to 25 years	27 (22.0 %)	6 (4.9 %)
More than 25 years	22 (17.9 %)	11 (8.9 %)

plastic surgeons and 60.0 % of orthopedic surgeons. The questionnaire did not specify a cut-off with respect to the size of a "mini-open release." Endoscopic release is the favored surgical approach of 17.2 % of plastic surgeons and 20 % of orthopedic surgeons. These trends are very similar when considering electrically severe CTS (Tables 5 and 6). Because there were only five responses from general and combined specialty surgeons, we were not able to analyze the trends of these specialties in more detail.

There were a number of limitations in this study. First, the response rate was only 15.1 %. Previous online surveys with similar methodological designs have reported higher response rates in the range of 45 % [5] and 50 % [9]. Past questionnaires that were sent through regular mail to ASSH members have had impressive response rates of 64.7 % [1] and 48 % [4]. The reason for our relatively low response rate is open to speculation. Unlike previous studies, AAHS members were only contacted once for this survey. This could have impacted the response rate, but we also believe that the enthusiasm for replying to online surveys aimed at gauging surgeon attitudes has decreased due to a recent surge in the number of these studies. The administrative board of AAHS allowed only one such electronic mailing to be distributed to the membership.

Furthermore, although 817 surgeons were contacted, it is not clear whether all individuals received the intended electronic mailing. Some accounts may automatically redirect bulk mail to a "junk mail" folder or the like, and it is possible that some surgeons did not see the questionnaire. We attempted to increase the response by rate by limiting the number of questions to 12. Responder attrition and the number of incomplete surveys are likely to increase proportionally to the number of questions. Despite our small response rate, the geographic and demographic distributions of the members that replied represented a diversity of AAHS members.

Practice attitudes toward illnesses in general and carpal tunnel syndrome in particular are fluid, continuously changing, and developing over time. Based on the results of this survey, we conclude that background training and generational differences contribute to the varied approaches observed in the diagnosis and management of carpal tunnel syndrome.

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Conflicts of interest The authors declare that they have no conflicts of interests.

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