

Segmental Carpal Canal Pressure in Patients With Carpal Tunnel Syndrome

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Purpose: To clarify which part of the median nerve is the most compressed and to compare carpal canal pressure with the latency of the sensory nerve potential and the duration of symptoms.

Methods: Fifteen patients with idiopathic carpal tunnel syndrome were studied using a pressure guidewire system to record canal pressure. The wire was introduced from the distal end of the carpal canal to 2 cm proximal to the distal wrist crease (DWC) and then retracted in 5-mm increments using an image intensifier to guide the progress. A nerve conduction study was performed, and all patients were asked how long the symptoms lasted.

Results: Carpal canal pressure was significantly higher 5 to 15 mm distal to the DWC. The most compressed point was 10 mm distal to the DWC, with a pressure of 44.9 ± 26.4 mm Hg. The correlation coefficient between the highest canal pressure and the latency was 0.393 and between highest canal pressure and duration of symptoms was 0.402.

Conclusions: Our study showed that the most compressed part of the median nerve in the carpal canal is 10 mm distal to the DWC. The carpal canal pressure was related to the latency and to the duration of symptoms. (J Hand Surg 2006;31A:925–929. Copyright © 2006 by the American Society for Surgery of the Hand.)

Key words: Carpal canal pressure, carpal tunnel syndrome, carpal tunnel release.

High carpal canal pressure in patients with carpal tunnel syndrome (CTS) has been reported by many investigators.^{1–5} The normal carpal canal pressure was reported as 14.3 ± 9.73 mm Hg,³ and we used this value as the normal upper limit in this study. In previous studies, the carpal canal pressure at the neutral wrist position in CTS patients was about 32 mm Hg,¹ 43 mm Hg,³ and 34 mm Hg.⁴ Although this is well known, there have been few studies that measured pressure distribution in the carpal canal. This is because the technique used for measuring segmental carpal canal pressure is difficult. Previous studies^{1,2} that used the constant infusion technique measured carpal canal pressure at only 1 site in the carpal tunnel. In our study, however, we could measure segmental carpal canal pressure using a precise sensor with a pressure guidewire system. The purpose of this study was to clarify which part of the median nerve is the most compressed and to compare the carpal canal pressure with the latency of the sensory nerve potential and symptom duration.

Materials and Methods

We studied 15 idiopathic CTS patients (13 women, 2 men) ranging from 29 to 78 years (mean, 57 y) with an 11-month average duration of symptoms (range, 2–36 mo) (Table 1). We asked the patients at the outpatient clinic when the numbness or pain of the affected hand began and calculated the period from the beginning of the symptom to the surgery date. We used this time period as the symptom duration. In each patient, CTS was diagnosed by clinical signs and nerve conduction potentials. If the patient had 3 of 5 parameters (Phalen's test, Tinel-like sign, numbness on the median nerve area, sensory nerve latency of ≥ 3.5 ms, motor latency of ≥ 4.5 ms), we diagnosed CTS. The sensory potential latency was measured at the appearance of the initial negative wave. An axillary block was applied before making 1 short incision on the palm. The carpal canal pressure was measured using a pressure guidewire system. This device usually is reserved for measuring coronary-artery pressures (WaveWire; Volcano Therapeutic Inc., Rancho Cordova, CA) and consists of a 0.3-mm–

Table 1. Data for Patients With Carpal Tunnel Syndrome

Patient	Age, y, and Gender	Segmental Intracarpal Canal Pressure, mm Hg					Latency of Sensory Nerve Potentials, ms		Duration of Symptoms, mo
		20 mm	15 mm	10 mm	5 mm	DWC	–10 mm	–20 mm	
1	52 F	2	60	68	62	5	7	3	12
2	72 F	2	35	26	15	5	4	9	7
3	72 F	0	20	42	21	2	4	5	36
4	56 F	0	30	48	10	5	0	2	7
5	67 M	6	27	45	16	13	4	2	3
6	29 F	2	3	10	14	1	0	3	3
7	56 F	6	36	59	47	27	35	8	2
8	73 F	0	13	18	35	18	7	6	9
9	54 F	20	21	16	61	30	5	4	12
10	48 F	7	8	38	15	5	0	0	12
11	49 M	0	42	44	32	8	3	2	4
12	51 F	10	33	15	10	10	0	7	6
13	43 F	18	82	58	43	30	9	5	24
14	78 F	18	44	97	17	9	7	4	12
15	51 F	30	72	90	75	55	6	2	24
Mean	57 ± 13	8.0 ± 9.2	35.0 ± 22.5	44.9 ± 26.4	31.5 ± 21.4	14.9 ± 14.8	6.1 ± 8.5	4.1 ± 2.5	

20 mm, 20 mm distal to the DWC; –20 mm, 20 mm proximal to the DWC.

Bold numbers indicate the highest pressure for each patient.

diameter wire connected to a pressure monitor. We performed a “limited access” open carpal tunnel release with a 2-cm palmar incision with special equipment (KI-001~003; Koshiya Co Ltd, Kanazawa, Japan). Because we released the carpal tunnel from a distal to proximal direction, data gathering always was started 20 mm distal to the distal wrist crease (DWC). We opened the distal end of the flexor retinaculum to 22 mm distal to the DWC and inserted the elevator to prepare the introduction of the catheter. An 18-gauge elastic catheter was introduced into the carpal canal under the distal end of the flexor retinaculum. The catheter was inserted along the ulnar wall of the carpal canal to avoid injuring the thenar muscle branch. Then the wire was introduced through the elastic catheter. By using an image intensifier to guide the progress, the wire was inserted to 2 cm proximal to the DWC and then retracted in 5-mm increments to record canal pressure. Then the sensor finally was drawn to 2 cm distal to the DWC, almost to the distal end of the flexor retinaculum. We measured 7 points on the carpal canal: 20, 15, 10, and 5 mm distal to the DWC and 10 and 20 mm proximal to the DWC (Fig. 1). The hand was held in a neutral position (forearm was supinated fully, wrist and metacarpophalangeal [MCP] joint were in 0° flexion/extension) the entire time. All data were expressed as the mean ± SD. The Tukey-Kramer multiple comparison analysis was used to evaluate the differences between each group, which were considered significant at a probability level of 95% ($p < .05$). We compared both latency and duration of the symptoms with carpal canal pressure, which was represented by the highest pressure in each patient. The Pearson correlation coefficient was applied to this analysis. Values of 0.0 to 0.199 indicated no relationship, 0.20 to 0.399 indicated a slight relationship, 0.40 to 0.699 indicated a moderate relationship, 0.70 to 0.899 indicated a strong relationship, and 0.90 to 1.0 indicated an extremely strong relationship.

Results

The average latency of the sensory nerve potentials was 5.2 ms (range, 2.4–7.0 ms) (Table 1). The highest pressure of the carpal canal was at 10 mm distal to the DWC (44.9 ± 26.4 mm Hg) (Table 1, Fig. 2). Carpal canal pressure was significantly higher at 5 to 15 mm distal to the DWC than at any other point ($p < .01$). As noted in the Introduction section the average reported normal carpal canal pressure was about 14 mm Hg³; there were some pressures higher than the reported

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