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Association between carpal tunnel syndrome and trigger finger: a clinical and electrophysiological study

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Abstract

Background: Carpal tunnel syndrome is a prevalent mononeuropathy. Trigger finger is a flexor stenosing tenosynovitis. The aim of the study was to assess the concomitant occurrence of carpal tunnel syndrome and trigger finger in the same hand among patients presented with idiopathic carpal tunnel syndrome or idiopathic trigger finger. The study included 110 hands (75 patients) presented with carpal tunnel syndrome or trigger finger and 60 asymptomatic hands (46 apparently healthy individuals). Clinical assessment and neurophysiological evaluation were done.

Results: Regarding the presenting clinical complaints, there were 76 hands (69.1%) from 48 patients (64.0%) presented with idiopathic carpal tunnel syndrome. There 34 hands (30.9%) from 27 patients (36.0%) presented with idiopathic trigger finger. Classification of the patients into three groups depending on the final diagnosis: (I) carpal tunnel syndrome group, 57 hands (51.8%) with only carpal tunnel syndrome from 36 patients (48.0%); (II) trigger finger group, 25 hands (22.7%) with only trigger finger from 22 patients (29.3%); and (III) carpal tunnel syndrome with trigger finger group, 28 hands (25.5%) with both conditions from 24 patients (32.0%); and among them, seven patients had contralateral hand carpal tunnel syndrome only. The duration of complaints among the carpal tunnel syndrome with trigger finger group was significantly shorter than that in the other two groups. There were statistically significantly higher values of patient global assessment of hand symptoms and effect of hand symptoms on function and quality of life among the carpal tunnel syndrome with trigger finger group versus the other two groups. There was no statistically significant difference between the carpal tunnel syndrome with trigger finger group versus the carpal tunnel syndrome group regarding different classes of the Padua neurophysiological classification scale. The most common digit to have trigger finger was the middle finger in 19 hands (35.8%).

Conclusions: The concurrent presentation of idiopathic carpal tunnel syndrome and idiopathic trigger finger in the same hand is common. Each of them could be associated with the other one. The symptoms of one of them usually predominate the patient's complaints. The identification of this association is essential for proper diagnosis and comprehensive management of patients presented with these conditions.

Keywords: Carpal tunnel syndrome, Median neuropathy, Trigger finger, Flexor stenosing tenosynovitis, Entrapment neuropathy

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Background

Carpal tunnel syndrome (CTS) is a prevalent mono-neuropathy. It is a median nerve entrapment neuropathy at the wrist. It produces pain, paresthesia, and numbness in the fingers with nocturnal exacerbation of the symptoms. It is occasionally associated with weakness of the median innervated thenar muscles [1–4].

Trigger finger (TF) is a flexor stenosing tenosynovitis. It is characterized by catching, clicking, or locking of one or more digits in the hand with pain and tenderness over the first annular (A1) pulley at the metacarpal heads on the palmar aspect of the hand [5, 6].

There were reports stated that TF could develop following CTS [7]. It was reported that CTS and TF could coexist together and any one of them could have the upper hand in the clinical presentation of the patient [8–12]. However, there are few researches that evaluated the association between idiopathic CTS and idiopathic TF [7, 9, 12]. The aim of the study was to assess the concomitant occurrence of CTS and TF in the same hand among patients presented with idiopathic CTS or idiopathic TF.

Methods

The study included 110 hands presented with idiopathic CTS or idiopathic TF that were obtained from 75 patients who were recruited in a random way from the clinic of the investigator's department. A control group was included (60 hands from 46 apparently healthy volunteers). The examiner explained the purpose and steps of the research to all participants, and everyone

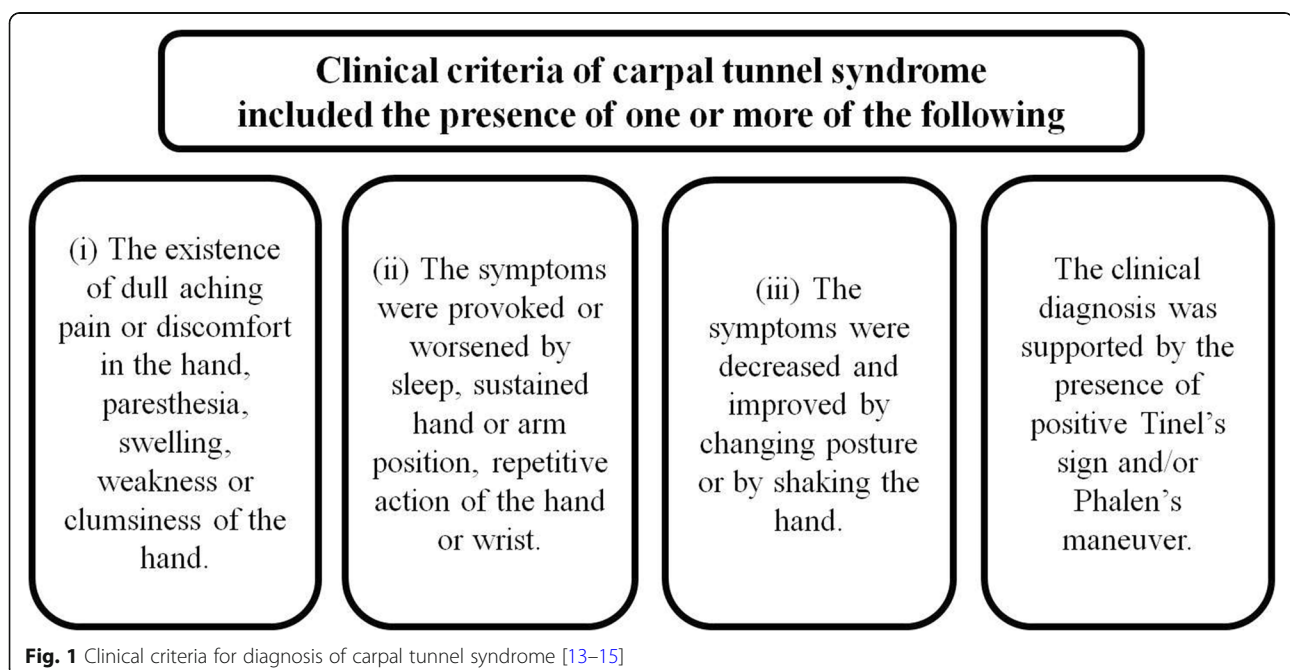
gave an informed consent. The research was accepted by the Institutional Ethics Committee.

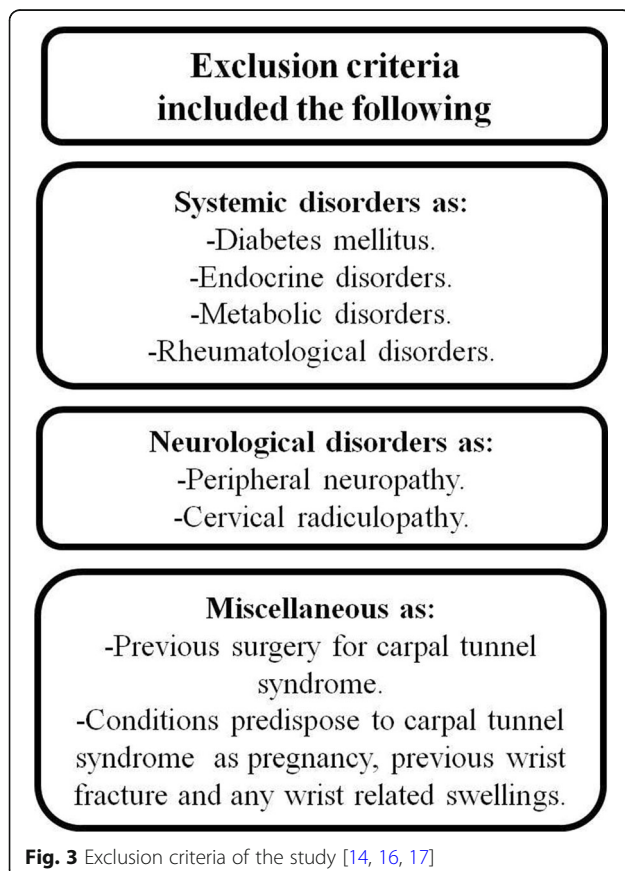
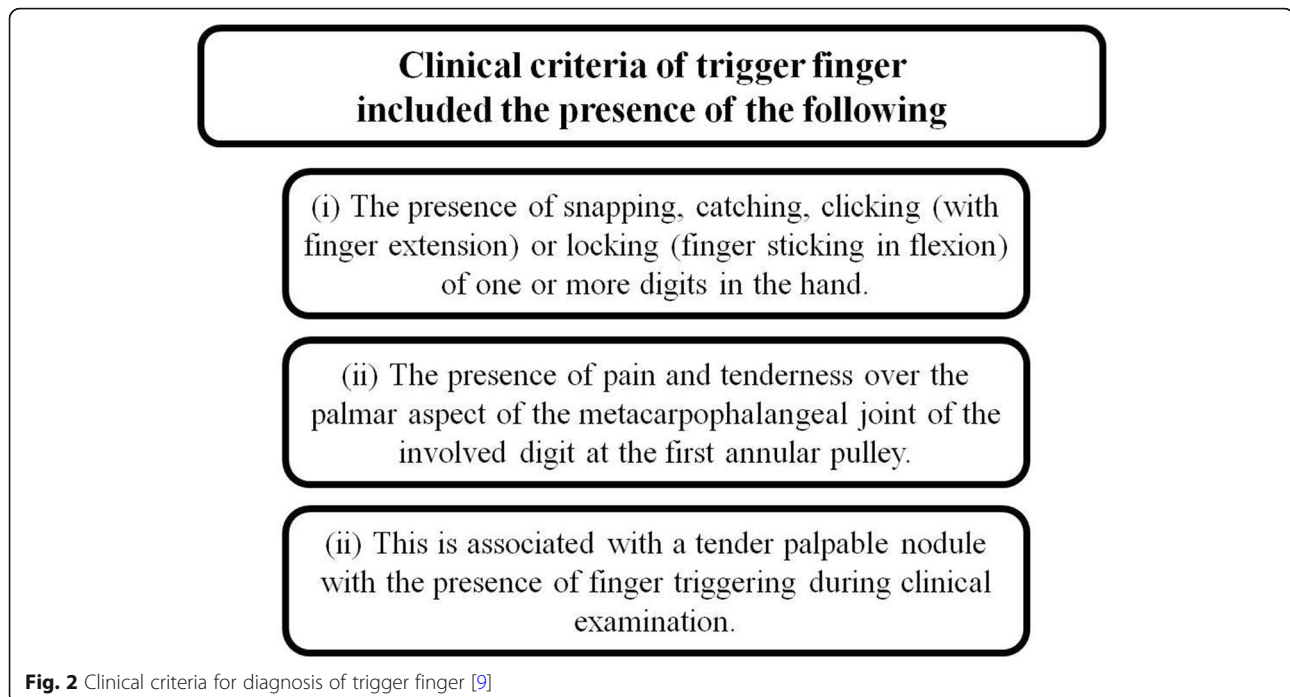
The clinical criteria for diagnosis of CTS are illustrated in Fig. 1 [13–15]. The clinical criteria of TF are illustrated in Fig. 2 [9]. The exclusion criteria are illustrated in Fig. 3 [14, 16, 17].

The demographic data and anthropometric measures (weight, height, and body mass index (BMI)) were documented [18]. History taking and neurological and musculoskeletal examination were done. Patient global assessment of hand symptoms was evaluated collectively by using visual analogue scale (VAS) (0 (no symptoms) to 10 (severe intolerable symptoms)) [19]. Patient global assessment of effect of hand symptoms on function and quality of life (QoL) was evaluated collectively by using VAS (0 (no influence on function and QoL) to 10 (severe influence on function and QoL)) [20]. These methods had good validity and excellent reliability [19, 20].

The patients were presented with one clinical problem (idiopathic CTS or idiopathic TF). They were asked and clinically examined, searching for the presence of the other condition (whether CTS or TF). The clinical diagnosis was based on the history taking and clinical examination for the detection of concurrent presence of CTS and TF in the same hand. The patients were classified into three groups as the following: (I) CTS group: patients with only CTS; (II) TF group: patients with only TF; and (III) CTS with TF group: patients with both CTS and TF.

The electrophysiological studies performed to the participants are illustrated in Fig. 4 [14, 16, 17, 21]. The classification of neurophysiological severity of median





neuropathy across the wrist was done depending on the Padua neurophysiological classification scale [22]. This scale consisted of six classes of neurophysiological severity (class one to class six) (Fig. 5) [22].

The data was assessed using SPSS version 17 (2007) software. Analytic measures included Mann–Whitney test, Kruskal–Wallis test, Pearson’s chi-squared test, and Fisher’s exact test. Significant difference was present whenever P value was less than 0.05.

Results

The research included 110 hands presented with idiopathic CTS or idiopathic TF that were obtained from 75 patients (61 women (81.3%)). Their mean age was 43.26 ± 13.42 years (ranged from 20 to 90 years). The control group consisted of 60 asymptomatic hands that were obtained from 46 apparently healthy individuals (34 women (73.9%)). Their mean age was 41.50 ± 12.18 years (ranged from 22 to 68 years). No statistically significant differences were detected between both groups regarding sex ($X^2 = 0.931$, $P = 0.367$), age ($Z = -0.625$, $P = 0.532$) and different anthropometric measures ($P > 0.05$).

Regarding the presenting clinical complaints of the participated patients, there were 76 hands (69.1%) obtained from 48 patients (64.0%) presented with idiopathic CTS. There were 34 hands (30.9%) obtained from 27 patients (36.0%) presented with idiopathic TF. Comparison between these two groups of patients and control group are summarized in Table 1.

Electrophysiological studies performed to the participants

I- Sensory nerve conduction studies (using antidromic technique):

- 1- Median nerve: Stimulation at wrist and recording at index finger.
- 2- Ulnar nerve: Stimulation at wrist and recording at little finger.

Conduction velocity and amplitude were the measurements of the sensory nerve action potential taken for analysis.

II- Motor nerve conduction studies:

- 1- Median nerve: Stimulation at wrist and recording at abductor pollicis brevis muscle.
- 2- Ulnar nerve: Stimulation at wrist and recording at abductor digiti minimi muscle.

Distal latency and amplitude were the measurements of the compound muscle action potential taken for analysis.

III- Median versus ulnar comparative studies:

- 1- Median versus ulnar ring finger sensory latency comparative study.
- 2- Median (recording the second lumbrical muscle) versus ulnar (recording the first palmar interosseous muscle) motor latency comparative study.

They were done if there was no electrophysiological abnormality in the median sensory conduction study.

The neurophysiological studies were conducted on a Nihon Kohden Neuropack S1 MEB-9400 unit with a two-channel measuring system (Nihon Kohden Corporation, Tokyo, Japan).

Note: Surface skin temperature of the hand and fingers was maintained around 32-34°C using an infrared lamp.

Fig. 4 Illustration of the electrophysiological studies performed to the participants [14, 16, 17, 21]

Padua neurophysiological classification scale (It is a classification of neurophysiological severity of median neuropathy across the wrist)

Class 1 (negative CTS)	There is normal median sensory conduction velocity with normal comparative studies.
Class 2 (minimal CTS)	There is normal median sensory conduction velocity with abnormal comparative studies.
Class 3 (mild CTS)	There are slowing of median sensory conduction velocity and normal median distal latency.
Class 4 (moderate CTS)	There are slowing of median sensory conduction velocity and abnormal median distal latency.
Class 5 (severe CTS)	There are unobtainable median sensory nerve action potential and abnormal median distal latency.
Class 6 (extreme CTS)	There are unobtainable median sensory nerve action potential and median compound muscle action potential.

Fig. 5 Illustration of the Padua neurophysiological classification scale [22]. CTS carpal tunnel syndrome

Table 1 Comparison between the two patients' groups and the control group regarding demographic data and anthropometric measurements

Demographic data and anthropometric measurements	CTS group (n = 76 hands from 48 patients)	TF group (n = 34 hands from 27 patients)	Control group (n = 60 hands from 46 apparently healthy volunteers)	Test of significance	P
Demographic data					
Women ^a	37 (77.1)	24 (88.9)	34 (73.9)	(X ²) 2.358	0.308
Age (years) ^b	41.97 ± 11.06	45.55 ± 16.81	41.50 ± 12.18	(K) 0.492	0.782
Side (right/left) ^c	43 (56.6) / 33 (43.4)	21 (61.8) / 13 (38.2)	34 (56.7) / 26 (43.3)	(X ²) 0.295	0.863
Dominant hand ^c	44 (57.9)	23 (67.6)	37 (61.7)	(X ²) 0.950	0.622
Anthropometric measurements					
Weight (kg) ^b	81.49 ± 12.06	76.48 ± 11.65	79.64 ± 12.52	(K) 2.461	0.292
Height (cm) ^b	162.39 ± 7.78	163.14 ± 6.58	163.82 ± 7.14	(K) 1.597	0.450
BMI (kg/m ²) ^b	31.05 ± 4.99	28.71 ± 4.04	29.78 ± 5.11	(K) 4.630	0.099
BMI category					
Underweight ^a	0 (0)	1 (3.7)	2 (4.3)	(X ²) 8.730	0.366
Normal weight ^a	6 (12.5)	2 (7.4)	5 (10.9)		
Overweight ^a	15 (31.2)	16 (59.3)	18 (39.1)		
Obese ^a	26 (54.2)	8 (29.6)	20 (43.5)		
Morbid obese ^a	1 (2.1)	0 (0)	1 (2.2)		

kg, kilogram; cm, centimeter; BMI, body mass index; m, meter; CTS, carpal tunnel syndrome; n, number of hands; TF, trigger finger; K, value of Kruskal–Wallis test; X², value of Pearson's chi-squared test.

*P is significant at < 0.05.

^aData are presented as (number (percentage)) of individuals.

^bData are presented as (mean ± standard deviation).

^cData are presented as ((number (percentage)) of hands.

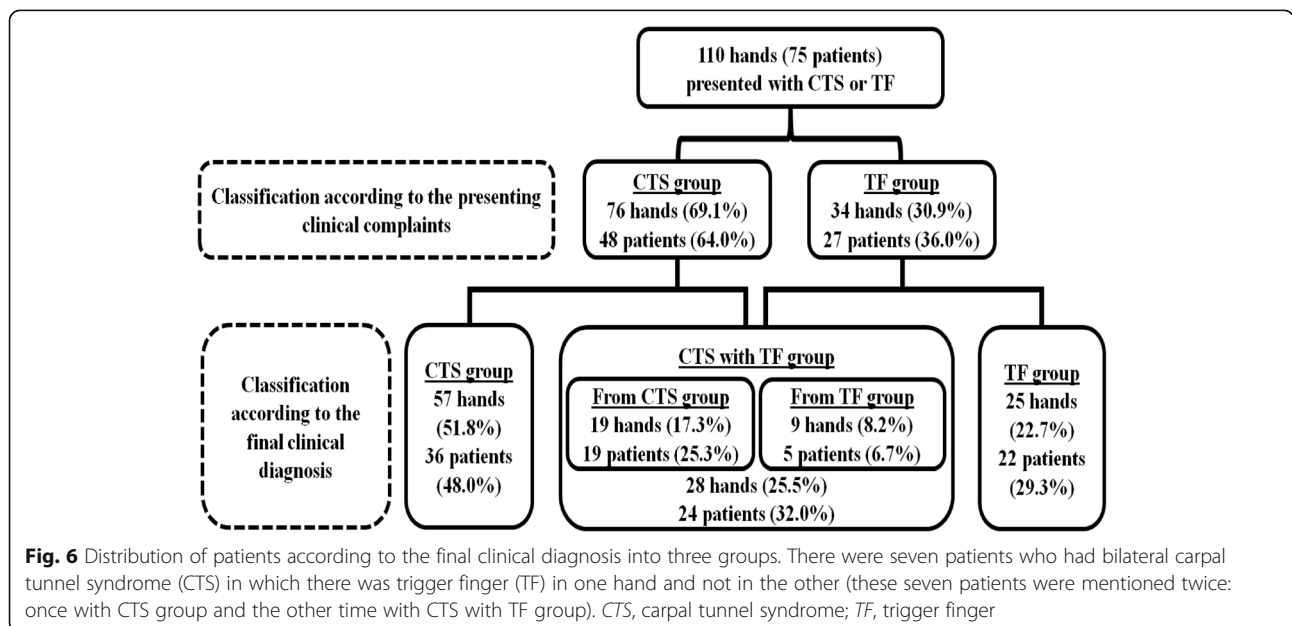


Fig. 6 Distribution of patients according to the final clinical diagnosis into three groups. There were seven patients who had bilateral carpal tunnel syndrome (CTS) in which there was trigger finger (TF) in one hand and not in the other (these seven patients were mentioned twice: once with CTS group and the other time with CTS with TF group). CTS, carpal tunnel syndrome; TF, trigger finger

After proper history taking, clinical examination, and electrophysiological assessment, the final diagnosis was obtained, and the patients were divided into three groups as the following (Fig. 6):

- I CTS group: it consisted of 57 hands (51.8%) with only CTS obtained from 36 patients (48.0%). It included 21 patients (58.3%) with bilateral CTS.
- II TF group: it consisted of 25 hands (22.7%) with only TF obtained from 22 patients (29.3%). It included three patients (13.6%) with bilateral TF as the following: a patient with right middle TF and left ring TF, a patient with right little TF and left middle TF, and a patient with bilateral middle TF. There were two different patients (9.1%) in whom each one had a hand with two TF as the following: a patient with thumb TF and middle TF in the same hand and another patient with middle TF and ring TF in the same hand.
- III CTS with TF group: it consisted of 28 hands (25.5%) with both CTS and TF obtained from 24 patients (32.0%). It included seven patients (29.2%) who had CTS with TF in one hand while the contralateral hand had CTS only. It included four patients (16.7%) who had CTS with TF in both hands bilaterally as the following: a patient with bilateral thumb TF, a patient with bilateral middle TF, a patient with right thumb TF and left ring TF, and a patient with right index TF and left

middle TF. There was a patient (4.2%) who had two fingers with TF (thumb TF and ring TF) in the same hand.

Among the group of patients presented with CTS, there were 19 hands (25.0%) obtained from 19 patients (39.6%) had associated clinical evidence of TF. Among these nineteen patients, there were seven patients who had bilateral CTS who had TF in one hand and not in the other. Subsequently, these seven patients were included in the CTS group regarding their hands which had CTS only and these seven patients were included another time in the CTS with TF group regarding their hands which had CTS with TF.

Among the group of patients presented with TF, there were nine hands (26.5%) obtained from five patients (18.5%) who had associated clinical and electrophysiological evidence of CTS.

Comparison between the three patients' groups and the control group are summarized in Table 2. The results of the nerve conduction studies of the median and ulnar nerves in the four groups are shown in Table 3. There was no statistically significant difference between the CTS with TF group and the CTS group regarding different classes of the Padua neurophysiological classification scale (Fig. 7).

Distribution of trigger fingers among different fingers in the hands of the TF group and the CTS with TF group is tabulated in Table 4 and illustrated in Figs. 8 and 9. The frequency of middle finger TF was

Table 2 Comparison between the three patients' groups and control group regarding different clinical characteristics

Different clinical characteristics	CTS group (n = 57 hands from 36 patients) ^b , mean ± SD	TF group (n = 25 hands from 22 patients), mean ± SD	CTS with TF group (n = 28 hands from 24 patients) ^b , mean ± SD	Control group (n = 60 hands from 46 apparently healthy volunteers), mean ± SD	Test of significance	P
Side (right/left) ^a	29 (50.9) / 28 (49.1)	16(64.0) /9(36.0)	19(67.9) /9(32.1)	34(56.7) /26(43.3)	(χ^2) 2.702	0.440
Dominant hand ^a	30 (52.6)	18 (72.0)	19 (67.9)	37 (61.7)	(χ^2) 3.518	0.318
Duration of complaint (months)	12.87 ± 9.93 ^{c d}	12.24 ± 8.58 ^{d e}	8.07 ± 6.07 ^{c e}	NA	(K) 7.411	0.025*
Patient global assessment of hand symptoms (VAS)	5.10 ± 2.86 ^{d f}	4.80 ± 2.10 ^{d g}	6.96 ± 1.64 ^{f g}	NA	(K) 12.903	0.002*
Patient global assessment of effect of hand symptoms on function and quality of life (VAS)	4.45 ± 2.82 ^{f d}	3.26 ± 2.24 ^{d g}	6.35 ± 2.16 ^{f g}	NA	(K) 19.268	≤0.0001*

VAS, visual analogue scale; CTS, carpal tunnel syndrome; n, number of hands; SD, standard deviation; TF, trigger finger; K, value of Kruskal–Wallis test; χ^2 , value of Pearson's chi-squared test

*P is significant at < 0.05.

^aData are presented as (number (percentage)) of hands.

^bThere were seven patients with bilateral CTS in which there was TF in one hand and not in the other. These seven patients were presented in the CTS group regarding their hands with only CTS and presented again in CTS with TF group regarding their hands with CTS and TF.

^cDuration of complaint was significantly longer in the CTS group versus the CTS with TF group ($P < 0.05$).

^dNo significant difference between the CTS group and the TF group ($P > 0.05$).

^eDuration of complaint was significantly longer in the TF group versus the CTS with TF group ($P < 0.05$).

^fPatient global assessment of hand symptoms (VAS) and patient global assessment of effect of hand symptoms on function and quality of life (VAS) were significantly higher in the CTS with TF group versus the CTS group ($P < 0.05$).

^gPatient global assessment of hand symptoms (VAS) and patient global assessment of effect of hand symptoms on function and quality of life (VAS) were significantly higher in the CTS with TF group versus the TF group ($P < 0.05$).

Table 3 Comparison of different nerve conduction study parameters between the three patients' groups and the control group

Nerve conduction study parameters	CTS group (<i>n</i> = 57 hands from 36 patients) ^b , mean ± SD	TF group (<i>n</i> = 25 hands from 22 patients), mean ± SD	CTS with TF group (<i>n</i> = 28 hands from 24 patients) ^b , mean ± SD	Control group (<i>n</i> = 60 hands from 46 apparently healthy volunteers), mean ± SD	Test of significance	<i>P</i>
Median SNAP CV (m/s)	43.37 ± 7.21 ^{c, d}	54.44 ± 4.28	44.84 ± 9.74 ^{c, g}	54.80 ± 4.77 ^{d, g}	(<i>K</i>) 62.904	≤ 0.0001*
Median SNAP amp (μV)	19.87 ± 11.18 ^{c, e}	28.66 ± 17.55	20.44 ± 8.60 ^{c, h}	29.43 ± 10.81 ^{e, h}	(<i>K</i>) 22.003	≤ 0.0001*
Ulnar SNAP CV (m/s)	54.60 ± 5.08	56.98 ± 4.44	54.97 ± 4.07	55.34 ± 4.62	(<i>K</i>) 4.997	0.172
Ulnar SNAP amp (μV)	24.23 ± 11.27	30.04 ± 13.22	22.81 ± 9.29	25.55 ± 7.43	(<i>K</i>) 4.240	0.237
Median DL (ms)	4.52 ± 1.09 ^{c, f}	3.50 ± 0.35	4.24 ± 0.87 ^{c, i}	3.45 ± 0.38 ^{f, i}	(<i>K</i>) 62.318	≤ 0.0001*
Median CMAP amp (mV)	9.22 ± 3.03	10.12 ± 3.67	10.29 ± 4.13	9.80 ± 3.21	(<i>K</i>) 2.042	0.564
Ulnar DL (ms)	3.01 ± 0.35	2.96 ± 0.37	3.00 ± 0.36	3.02 ± 0.31	(<i>K</i>) 0.887	0.828
Ulnar CMAP amp (mV)	8.45 ± 2.61	9.45 ± 3.33	9.10 ± 2.76	8.23 ± 2.19	(<i>K</i>) 3.613	0.306
Padua neurophysiological classification scale						
Class 1 (negative CTS) ^a	9 (15.8)	NA	8 (28.6)	NA	(χ^2) 3.956	0.556
Class 2 (minimal CTS) ^a	5 (8.8)	NA	3 (10.7)	NA		
Class 3 (mild CTS) ^a	20 (35.1)	NA	7 (25.0)	NA		
Class 4 (moderate CTS) ^a	19 (33.3)	NA	9 (32.1)	NA		
Class 5 (severe CTS) ^a	3 (5.3)	NA	0 (0)	NA		
Class 6 (extreme CTS) ^a	1 (1.8)	NA	1 (3.6)	NA		

SNAP, sensory nerve action potential; CV, conduction velocity; *m*, meter; *s*, second; *amp*, amplitude; μ V, microvolt; DL, distal latency; CMAP, compound muscle action potentials; mV, millivolt; CTS, carpal tunnel syndrome; *n*, number of hands; SD, standard deviation; TF, trigger finger; NA, not applicable; *K*, value of Kruskal-Wallis test; χ^2 , value of Pearson's chi-squared test.

**P* is significant at < 0.05.

^aData are presented as number (percentage) of hands.

^bThere were seven patients with bilateral CTS in which there was TF in one hand and not in the other. These seven patients were presented in the CTS group regarding their hands with only CTS and presented again in the CTS with TF group regarding their hands with CTS and TF.

^cNo significant difference between the CTS group and the CTS with TF group (*P* > 0.05).

^dMedian SNAP CV was significantly slower in the CTS group versus the control group (*P* ≤ 0.0001).

^eMedian SNAP amplitude was significantly reduced in the CTS group versus the control group (*P* ≤ 0.0001).

^fMedian DL was significantly delayed in the CTS group versus the control group (*P* ≤ 0.0001).

^gMedian SNAP CV was significantly slower in the CTS with TF group versus the control group (*P* ≤ 0.0001).

^hMedian SNAP amplitude was significantly reduced in the CTS with TF group versus the control group (*P* ≤ 0.0001).

ⁱMedian DL was significantly delayed in the CTS with TF group versus the control group (*P* ≤ 0.0001).

statistically significantly higher among the TF group (Table 4). The most common digit to have TF was the middle finger in 19 hands (35.8%) among all participated patients with TF. There were three hands (5.7%) from three different patients (6.5%) who had multiple TF digits. From them, there were two hands which had two fingers with TF in each hand obtained from two different patients in the TF group, while there was one hand which had two fingers with TF which obtained from a patient in the CTS with TF group.

Discussion

Both CTS and TF are common musculoskeletal disorders. The concurrent presentation of CTS and TF is well-known to be associated with some systemic disorders as diabetes mellitus, hypothyroidism, and rheumatoid arthritis [23–25]. The relative risk of the occurrence of CTS among patients with multiple TF is threefold compared with those patients with a single TF [11]. However, there are scanty studies that evaluated the concurrent presentation and association of idiopathic

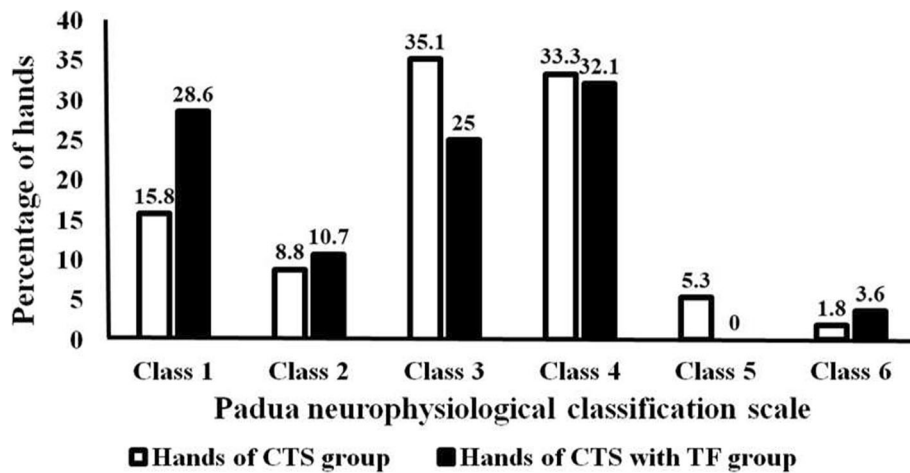


Fig. 7 Bar chart illustrates the lack of statistically significant difference between the carpal tunnel syndrome (CTS) with trigger finger (TF) group versus the CTS group regarding different classes of the Padua neurophysiological classification scale of CTS electrophysiological severity ($\chi^2 = 3.956, P = 0.556$). Hands of the CTS group are presented as white bars. Hands of the CTS with TF group are presented as black bars. The above bar number is the percentage of hands represented by the corresponding bar. CTS, carpal tunnel syndrome; TF, trigger finger

CTS with idiopathic TF in the same hand [7, 9, 12]. There are many reports which stated that surgical treatment of CTS (median nerve decompression surgery) was associated with the development of TF [8, 10, 26–30]. The CTS decompression surgery increased the risk of development of TF following surgery, and the mechanism of its occurrence is well established [10].

The obtained results were in accordance with Wessel et al. regarding the percentage of patients presented with concomitant CTS and TF [11]. Wessel et al. reported the percentage to be 28% of their patients presented with concomitant CTS and TF [11]. But, they were not in agreement with Rottgers et al., Garti et al., Kumar et al., and El-Hadidi [8, 9, 12, 31]. Rottgers et al. reported the percentage to be 60.2% of their patients who had CTS with TF, while Garti et al. reported it to be 63% [9, 31]. However, Kumar

et al. reported it to be 16.5%, and El-Hadidi reported it to be 13% [8, 12]. The differences between the present research and these studies could be due to differences in the inclusion criteria. They included patients with systemic diseases as diabetes mellitus which were excluded in the current study [8, 9, 31]. Also, they included patients who were older than those who participated in the present study [8, 9, 12, 31].

The study was in agreement with Kumar et al. regarding the percentage of patients with evidence of TF among patients presented with CTS [12]. Kumar et al. reported the percentage to be 21.1% of their patients [12]. However, Zhang et al. reported the percentage to be 10.6% of their assessed hands [32]. The differences between the present study and this study could be due to the inclusion of patients with systemic diseases as diabetes mellitus which were excluded in the current study

Table 4 Distribution of trigger fingers among different fingers of the hands of patients with trigger finger

Distribution of trigger fingers among different fingers of the hand	TF group (n = 25 hands from 22 patients) n (%) ^a	CTS with TF group (n = 28 hands from 24 patients) n (%) ^b	Test of significance (χ^2)	P
Thumb TF	5 (20.0) ^a	12 (42.9) ^b	3.167	0.088 ^c
Index TF	2 (8.0)	3 (10.7)	0.114	0.555 ^c
Middle TF	13 (52.0) ^a	6 (21.4)	5.368	0.025* ^c
Ring TF	6 (24.0) ^a	8 (28.6) ^b	0.142	0.763 ^c
Little TF	1 (4.0)	0 (0)	1.142	0.472 ^c

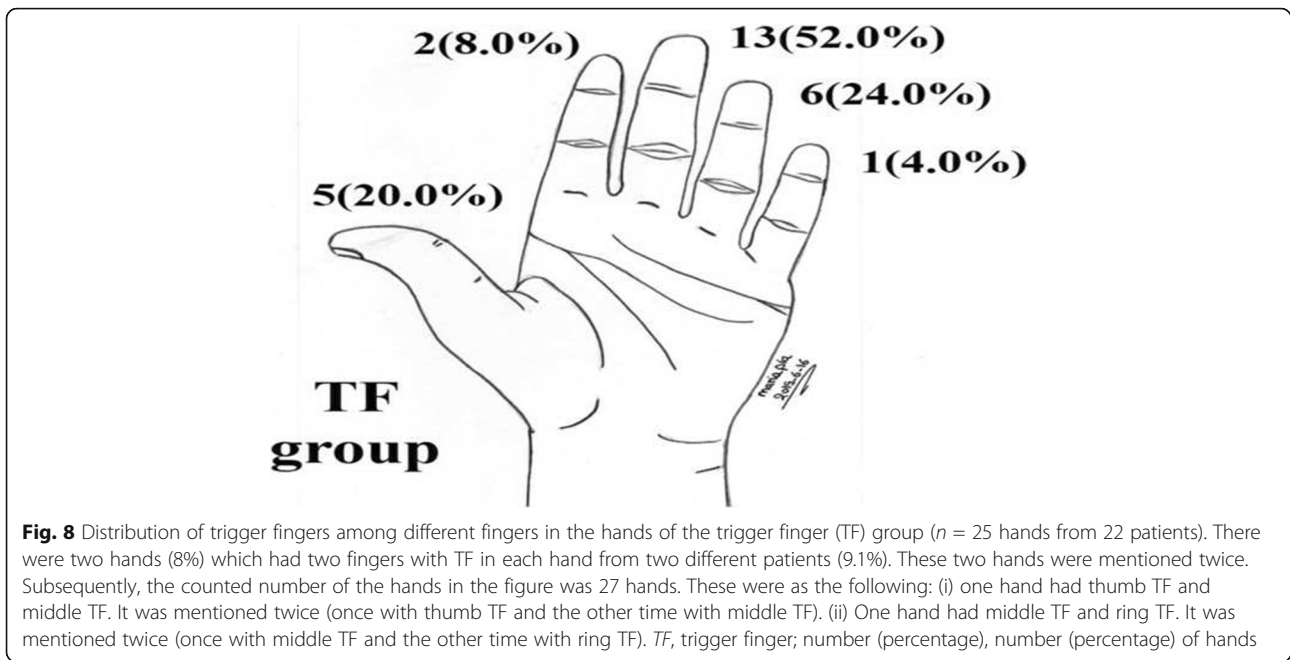
TF, trigger finger; CTS, carpal tunnel syndrome, n (%), number (percentage) of hands; χ^2 , value of Pearson’s chi-squared test.

*P is significant at < 0.05.

^aThere were two hands (8%) which had two fingers with TF in each hand obtained from two different patients (9.1%). These two hands were mentioned twice. Subsequently, the counted number of the hands in the table was 27 hands. These were as the following: (i) one hand had thumb TF and middle TF. It was mentioned twice (once with thumb TF and the other time with middle TF). (ii) One hand had middle TF and ring TF. It was mentioned twice (once with middle TF and the other time with ring TF).

^bThere was one hand (3.6%) of a patient (4.2%) which had two fingers with TF (thumb TF and ring TF). This hand was mentioned twice (once with thumb TF and the other time with ring TF). Subsequently, the counted number of the hands in the table was 29 hands.

^cP value of Fisher’s exact test.

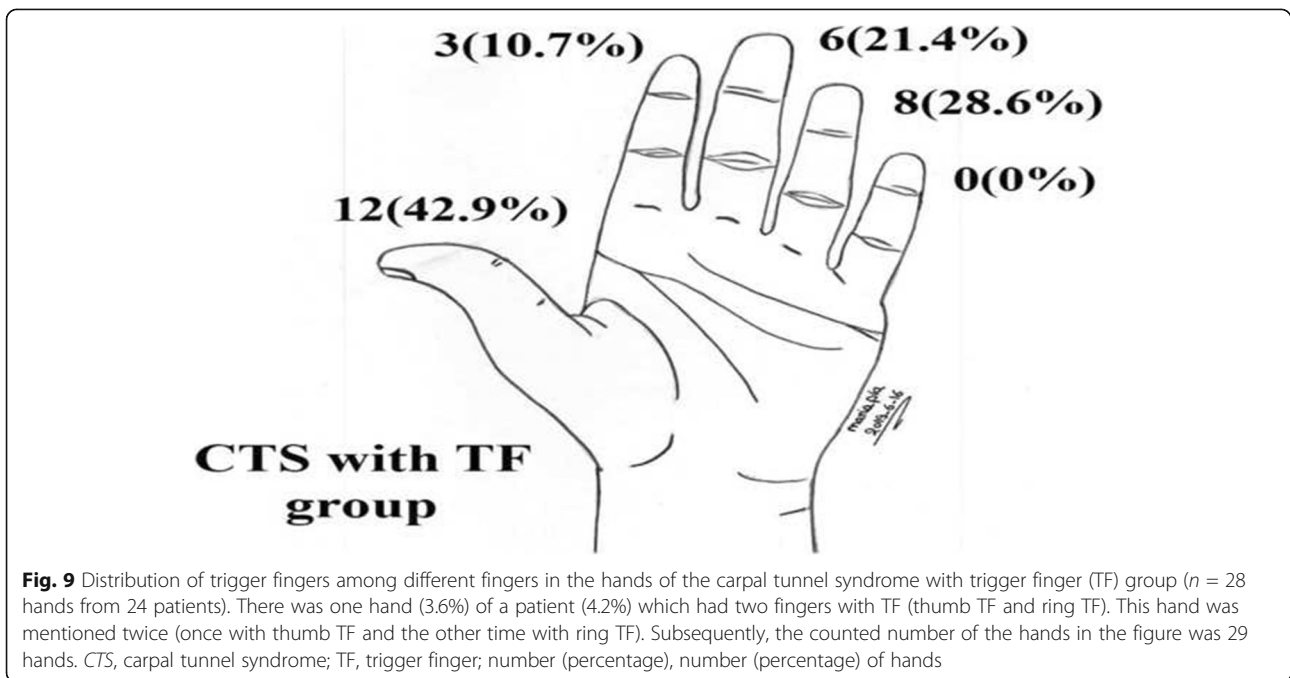


[32]. Also, they included patients who were older than those who participated in this study, and their patients included more males than those included in the present research [32].

The study did not agree with Rottgers et al. and Garti et al. regarding the percentage of patients with evidence of CTS among patients presented with TF [9, 31]. Rottgers et al. reported the percentage to be 56% of their TF patients, while Garti et al. reported it to be 63%. The

differences between the current study and these studies were mentioned previously [9, 31].

The duration of complaint among the CTS with TF group was significantly shorter than the duration of complaint of patients in the CTS group and TF group. This was associated with statistically significantly higher value of patient global assessment of hand symptoms and patient global assessment of effect of hand symptoms on function and QoL among the CTS with TF



group in comparison with the other two patients' groups. This could be explained by the existence of both CTS and TF in the hands of these patients making the symptoms more severe with more influence on the function and QoL. All these made those patients seek medical consultation earlier in their illness in comparison with those patients with only CTS or TF. These were not mentioned nor discussed previously in the scientific literature.

Among all participants, there were 28 hands (25.5%) with both CTS and TF obtained from 24 patients (32%). The association of both conditions in a high percentage in addition to the lack of significant difference between the CTS with TF group and the CTS group regarding different classes of the Padua neurophysiological classification scale indicated that there were some common predisposing factors or common local mechanisms affecting the initiation of both CTS and TF in the same hand [7, 9, 12].

The pathology of CTS is different from that of TF [3, 6]. The concomitant presence of CTS and TF in the same hand could not be explained by the effect of the pathological changes of one on the appearance of the other [10–12, 33]. However, it was reported that in chronic severe CTS, pathological changes in the flexor tendons and their synovial sheaths could lead to the development of TF [34]. But, there was still an underlying common predisposing factor or mechanism responsible for the occurrence of both of them. It was reported that the same predisposing factors responsible for the development of both conditions. They were due to overuse of the hand in manual activities, overuse injuries, and overload with occupational activities [1, 5, 34–39]. The mechanical predisposing risk factors could explain why there was no significant difference between both hands regarding the occurrence of both CTS and TF [9].

So, the presence of CTS and TF could be a coincidental condition without the presence of a main direct relationship between both of them except for the similar mechanical predisposing risk factors for both of them [1, 5, 34–36, 39]. This could be the explanation of the concurrent presentation and association between CTS and TF. However, why some patients developed only idiopathic CTS while other patients developed only idiopathic TF, this needs further studies to be done to explain it.

In chronic, severe CTS, fibrous hypertrophy takes place at the synovium of the flexor tendons at the carpal tunnel. The thickened synovium within the carpal tunnel was associated with increased fibroblast density, fibrosis, with decreased elastin content, vascular sclerosis, amyloid deposition, and edema with minimal inflammatory changes [40–42]. Within the carpal tunnel and with the presence of continued mechanical stress on the flexor

tendons, there is an increase in the proteoglycan content within the flexor tendon matrix with subsequent tendon hypertrophy [34]. These changes in the flexor tendons and their synovial sheaths could extend and lead to tendon entrapment at the A1 pulley [34]. Subsequently, these changes could result in TF development in patients with chronic severe idiopathic CTS [10, 34].

In idiopathic TF, the pathogenesis of triggering is different from that in CTS [5, 10]. The repeated friction between the flexor tendon and the inner surface of A1 pulley leads to inflammatory changes and hypertrophy with evidence of thickening of the flexor tendon sheath. It is associated with flexor tendon inflammation and nodular changes with increased thickness. These result in narrowing of the diameter of the tendon sheath in relation to the diameter of the flexor tendon. This limits and restricts the normal gliding of the flexor tendon. This affects mainly the A1 pulley at the metacarpal heads [5]. The histopathological changes in the A1 pulley in idiopathic TF are the presence of varying sized areas of extracellular matrix loss with chondrocyte proliferation and production of small-sized collagen fibers. This fibrocartilagenous metaplasia occurs mainly in the inner surface of the A1 pulley [5, 43]. All these changes were suggested to be due to repetitive finger movements, overuse injury, local hand trauma, and constant gripping [5, 44, 45].

There was no statistically significant difference between right hands and left hands, as well as the dominant and nondominant hands regarding the concurrent occurrence of CTS with TF. This was in accordance with Kumar et al. [12]. This could suppose the presence of a common or a systemic predisposing factor for the development of CTS and TF. However, the exclusion of systemic disorders in the current study, made only idiopathic CTS and TF to be included. Subsequently, systemic etiology could not be taken into consideration. Excessive overuse and repetitive movement of the hands due to occupational tasks or household activities could be the sole accepted factor for the development of idiopathic CTS and idiopathic TF separately and concomitantly [1, 5, 34–36, 39].

There was not any statistical difference between the CTS group and the CTS with TF group regarding the Padua neurophysiological classification scale of CTS electrophysiological severity. There was no significant increase in the frequency of hands with TF with increasing severity of CTS measured by the Padua neurophysiological classification scale. These indicated that the occurrence of TF had no relation with the CTS severity and vice versa and, subsequently, no direct relation between CTS existence and development of TF. The concomitant association could be due to the similarity of the predisposing factors which could be summarized as mechanical factors in the form of overuse injuries [46]. These results were not mentioned nor discussed previously in different medical literature.

In the current study, the most common digit to have TF was the middle finger in all TF patients, as well as, in the patient's group with only TF. But, the thumb was the most common digit to have TF in the CTS with TF group. The study was in agreement with Hayashi et al. and Shafae-Khanghah et al. [10, 47]. Hayashi et al. reported that the thumb finger was the most common finger which developed TF in patients with CTS followed by the middle finger [10]. Shafae-Khanghah et al. reported that the thumb and ring fingers were the most common fingers which developed TF followed by the middle finger [47]. The study was in partial agreement with other researches. It was reported that the ring finger was considered the most common finger which developed TF followed by the thumb [5, 9, 12, 31]. The difference between the current study and these previous studies could be due to differences in the inclusion criteria. These studies included patients with systemic diseases as diabetes mellitus and other systemic disorders which were excluded in the current study [9, 31]. Also, these studies included patients who were older than the patients included in the present study [9, 12].

There were three hands (5.7%) from three patients (6.5%) with multiple TF digits. These were not in agreement with previous studies [5, 9, 12]. These studies reported that hands with multiple TF digits ranged from 30–41% [9, 12]. The differences between this study and these previous studies were mentioned previously.

There was high percentage of hands (25.0%) presented with CTS had TF and high percentage of hands (26.5%) presented with TF had CTS. Subsequently, when a patient presented with CTS seeking medical consultation, the physician should search for the presence of TF and vice versa. This is because at presentation the symptoms, of one of them is more evident and prominent [7, 9, 12]. The physicians should be aware during dealing with any patient presented with CTS or TF for the high percentage of patients with concomitant idiopathic CTS and idiopathic TF. They should evaluate the patient for both conditions. This could be essential for proper diagnosis and management of both conditions. This would lead to the proper improvement of the patient. It is recommended to assess the presence of TF in patients with CTS especially those patients with CTS with increased hand symptoms and increased effect of hand symptoms on function and QoL. Patients with TF especially if multiple digits are affected should be assessed for the presence of CTS. This is essential for the proper diagnosis and effective treatment of both conditions if they coexisted together. The patients with CTS should be informed for the increased risk of TF development after carpal tunnel decompression surgery especially if CTS was of mild degree [12, 33].

There were some limitations which could be summarized as the following: (i) the small percentage of participated men. This could be due to the higher prevalence of CTS and TF among women [2, 3, 48–50]. (ii) Musculoskeletal ultrasonography for the assessment of CTS and TF was not applied [51–53]. (iii) No long-term follow-up was done for patients with only CTS or only TF for the assessment of the rate of development of the other condition over time. Future studies are essential to be done to explore these issues. These could help in the proper understanding of these two clinical problems and proper management of both.

Conclusions

In conclusion, the concurrent presentation of idiopathic CTS and idiopathic TF in the same hand is common. Each of them could be associated with the other one. The symptoms of one of them usually predominate the patient's complaints. The identification of this association is essential for the proper diagnosis and comprehensive management of patients presented with idiopathic CTS or idiopathic TF. The concurrent occurrence of both conditions could not be related to the effect of one of them on the other one. It could be due to the presence of common predisposing factors for both. Overuse injuries could be the cause and explanation for the high percentage of the concurrent occurrence of both conditions.

Abbreviations

A1: First annular; BMI: Body mass index; CMAP: Compound muscle action potential; CTS: Carpal tunnel syndrome; CV: Conduction velocity; DL: Distal latency; QoL: Quality of life; TF: Trigger finger; SNAP: Sensory nerve action potential; VAS: Visual analogue scale

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Author's contributions

The author (EKAS) contributed in the concepts, design, definition of intellectual content, literature search, clinical studies, data acquisition and analysis, manuscript preparation, editing, and revision. The author read and approved the final manuscript.

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Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate:

The local Ethics Committee of Faculty of Medicine, Alexandria University, Egypt (IRB No: 00007555-FWA No: 00015712) approved the study (Date of approval: 25/2/2015; serial number: 0302525). A written informed consent was given by each participant.

Consent for publication

Not applicable

Competing interests

The authors declare that they have no competing interests.

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