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Original Article

Clinical Features of Course of Different Types of Carpal Tunnel Syndrome

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ABSTRACT

Objective: This article aims to study clinical features of the courses of different types of CTS to improve diagnostics and substantiate tactics of treatment.
Materials and methods: An analysis of a total of 172 patients (comprising 242 extremities) was conducted displaying clinical symptoms of carpal tunnel syndrome (CTS). These patients were examined and treated at the SI "ITO NAMS of Ukraine". All individuals were grouped together for the purpose of our study.
Results: This article analyzes the results of examining 172 patients with clinical signs of carpal tunnel syndrome of different types: idiopathic, posttraumatic, and the one associated with orthopedic pathology, specifies clinical features in the progression of posttraumatic carpal tunnel syndrome, and the one on the background of an orthopedic pathology, additional methods of medical imaging to confirm a median nerve neuropathy in the carpal canal, objectivize its severity, and establishes the etiology of carpal tunnel syndrome, essential to decide on further treatment tactics.
Conclusion: The recognized clinical characteristics present an opportunity to support the selection of an additional diagnostic procedure to validate the presence of compression-ischemic neuropathy in the median nerve, ascertain its severity, and identify the underlying causes.

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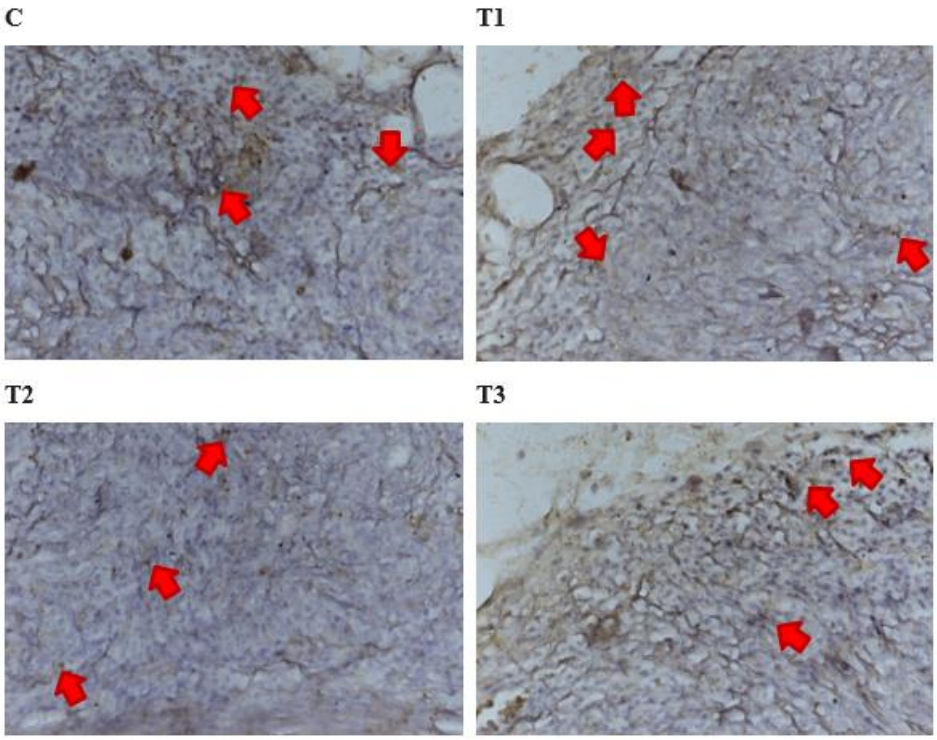
GRAPHICALABSTRACT



Introduction

Carpal tunnel syndrome (CTS) is an entrapment neuropathy caused by compression of the median nerve in the wrist's carpal tunnel (CT). CTS is the most widespread and studied tunnel syndrome of the upper limb [1, 2]. Classical clinical symptoms of CTS include sensory, motor, and autonomic symptoms in the zone of innervation of the median nerve on the hand. Decrease sensitivity in the form of a progressive feeling of tingling and numbness primarily in the thumb, index, middle fingers, and pain more often occur at night and in the morning. Aggravation of these symptoms at night leads to frequent awakening patients. Impairment of sensitivity is reduced by at least one of the factors: changing the position of the hands, self-massage, rubbing, and shaking the hand. The pain is mainly localized in the wrist, may radiate distally and proximally, and often has neuropathic character. In the chronic course of the disease, motor disorders may occur: clumsiness and weakness of the hand, which leads to decrease in grip strength and makes it difficult to hold objects in the hand. Autonomic disorders are manifested in the form of swelling of fingers and hand, changes skin color, and sweating disorders [3].

Etiologically carpal tunnel syndrome splits into an idiopathic and secondary CTS. Any condition that modifies the CT walls may cause compression of the median nerve. The secondary forms of CTS causes are divided into abnormalities of the container, such as dislocation fractures of distal radius or content, such as tenosynovitis. In their routine activities, orthopedic and trauma surgeons mostly encounter secondary CTS, conditioned by different pathologies in the wrist area structures-consequences of trauma injuries: after fractures and dislocation-fractures (radial bone distal epymetaphysis fractures (RBDEF), perilunate dislocations, and dislocation-fractures) and frequent orthopedic diseases (deforming osteoarthritis of a wrist (DOW) or a wrist inflammation (arthritis and synovitis), and/or tenosynovitis of different origin, tumor-like formations [4].

Most scientific papers consider idiopathic forms of CTS, and only some of them contain general information, without clinical features of the courses, on its secondary forms like posttraumatic and associated with an orthopedic

pathology [5]. Despite long-term CTS studies, its diagnostics and treatment, the impact of different factors on the occurrence and progression of syndrome, the choice of treatment methods and their efficiency still cause acute discussions at dedicated European and International congresses [6, 7]. Obviously, studying the secondary CTS's diagnostics and treatment, one should consider its etiological grounds and progression [8].

Objectives

This article aims to study clinical features of the courses of different types of CTS to improve diagnostics and substantiate tactics of treatment.

Martials and Methods

There were analyzed results of 172 patients (242 extremities) with clinical signs of CTS, examined, and treated at the Institute of Traumatology and Orthopedics of the NAMS of Ukraine (Kyiv), who made a common group.

All examined patients split into three groups depending on an etiologic factor: the first group gathered the patients with an idiopathic form-idiopathic CTS (CTSi); the second-patients after fractures and dislocation-fractures (radial bone distal epymetaphysis fractures (RBDEF), perilunate dislocations, and dislocation-fractures) – posttraumatic CTS (CTSt); the third included the patients with different orthopedic pathologies (deforming osteoarthritis of a wrist (DOW) or a wrist inflammation (arthritis and synovitis), and/or tenosynovitis of different origin, except for system diseases, tumour-like formations) – CTS on the backgrounds of an orthopedic pathology (CTSo). In the second group, patients with RBDEF prevailed (59.2%). The third group included mostly patients with synovitis and tenosynovitis (63.1%). After a thorough collection of the anamnesis of a patient's disease and life, we carried out the examination of their neurologic and orthopedic status according to the standard schedules using specific provocative tests: Phalen's, Tinel's, and Durkan's. The CTS-6 [9] diagnostic scale served to determine the extent of CTS probability for a patient. The visual-analog scale (VAS) served to assess the pain syndrome intensity. To define the stage of the disease, we applied the Hi-Ob scale for the intensity of symptoms [10]. We used the Boston Questionnaire BCTQ [8] to assess the severity of the CTS and DASH questionnaire [11] for the upper limb's function impairment.

To confirm the CTS diagnosis and to define the level and severity of a median nerve's (MN) compression-ischemic neuropathy (CIN), the patients underwent electromyography (EMG) according to the recommendations and the protocol by the American Board of Electrodiagnostic Medicine (ABEM) [3]. The ultrasonography study of a median nerve with adjacent structures was extremely useful to reveal any concomitant pathology. For the US examination, we applied Esaote MyLab 20 Plus and PHILIPS HD 11XE with a multi-frequency detector of 7-12 MHz. To study the MN, we used a standard method [12]. In cases of traumas and other accidents in the anamnesis, we used an X-Ray of the hand to disclose disorders of bone structures.

For the statistical analysis, we used statistics of variation with the calculation of frequency values for the qualitative parameters (in %), an arithmetic mean (M), and the root mean square (standard) deviation (SD, σ) for quantitative one with the assessment of normality of distribution according to Shapiro-Wilk criterion. Assessment of the difference between groups took place according to the Chi-square criterion (qualitative values) and using a two-sample t-test (quantitative values), the threshold level of statistical significance was $p<0.05$.

Results and Discussion

Based on the study's data, there were no significant differences in the age and gender of the patients across all groups. However, patients with CTSt (Carpal Tunnel Syndrome) had a significantly shorter average duration of the disease. This observation could be attributed to their tendency to seek medical attention earlier, likely due to the subacute nature of the disease. Table 1 provides a representation of the patient distribution across the study groups based on age, gender, and disease duration.

Clinical details, symptoms, results of an objective examination, and statistical comparison of values related to patients from the first and the second group are displayed in Figures 1 and 2.

Clinical details, symptoms, results of an objective examination, and the statistical comparison of values related to patients from the first and the second group are depicted in Figures 1 and 2. The CTSt was specific with an earlier appearance of vegetative disorders changed and their severity, especially essential was the difference in cases of wrist swelling, more significant for patients from the second group, not only by the frequency of occurrence, but also by severity and incidence; more expressed there were: pain syndrome severity by VAS, sensor, and motor deficiency, functional activity impairments of the upper limb (Figures 1 and 2). In patients with the CTSt, mean values of DASH, severity of symptoms (BCTQ s.s.), and functional impairment (BCTQ f.i.) were significantly higher that the respective values of CTSi patients (Figure 2). Among the three provocative tests, the Tinel's showed the highest sensitivity, significantly more frequently demonstrated by the second group of patients. Mean values of CTS-6 were statistically significantly higher in CTSt patients.

Table 1: Distribution of patients by age, gender, and duration of the disease

	General occurrence (frequency, %)	The 1st group (frequency, %)	The 2nd group (frequency, %)	The 3rd group (frequency, %)
	n-242	n-109	n-49	n-84
Age of the patients	57.6±11.6	57.9±12.6	58.6±13.9	56.6±8.5
Female	201(83.1%)	86(78.9%)	37(75.5%)	78(92.9%)
Male	41(16.9%)	23(21.1%)	12(24.5%)	6(7.1%)
Duration of the disease (months)	25.0±49.5	23.0±38.5	10.8±16.0	35.9±69.2

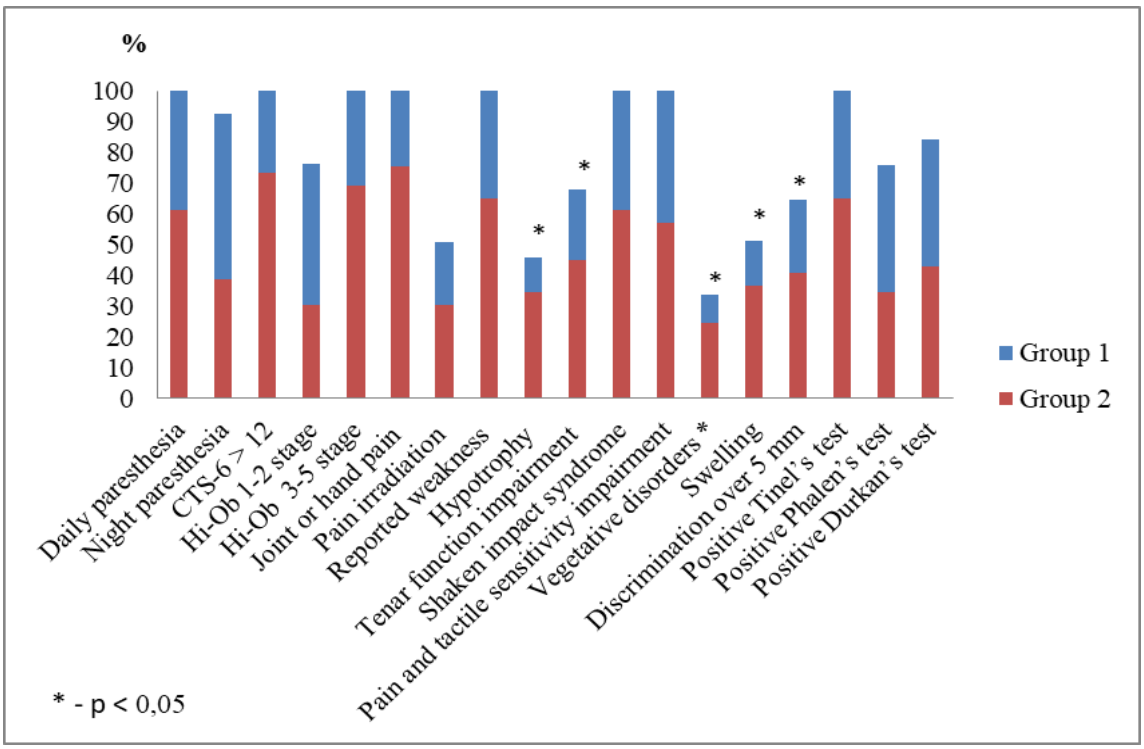


Figure 1: Comparison of values of clinical results of the patient groups 1 and 2

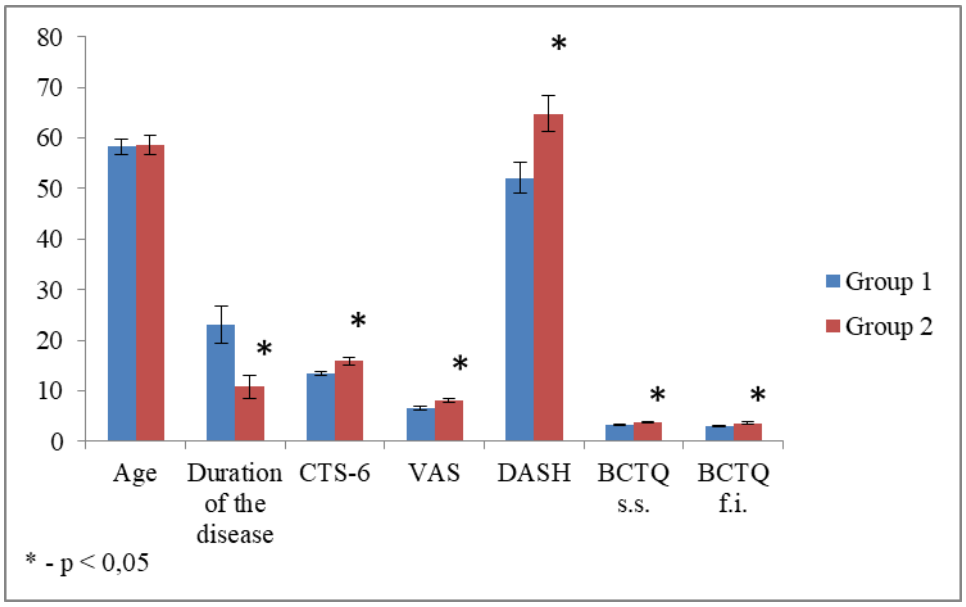


Figure 2: Comparison of values of clinical results of the patient groups 1 and 2

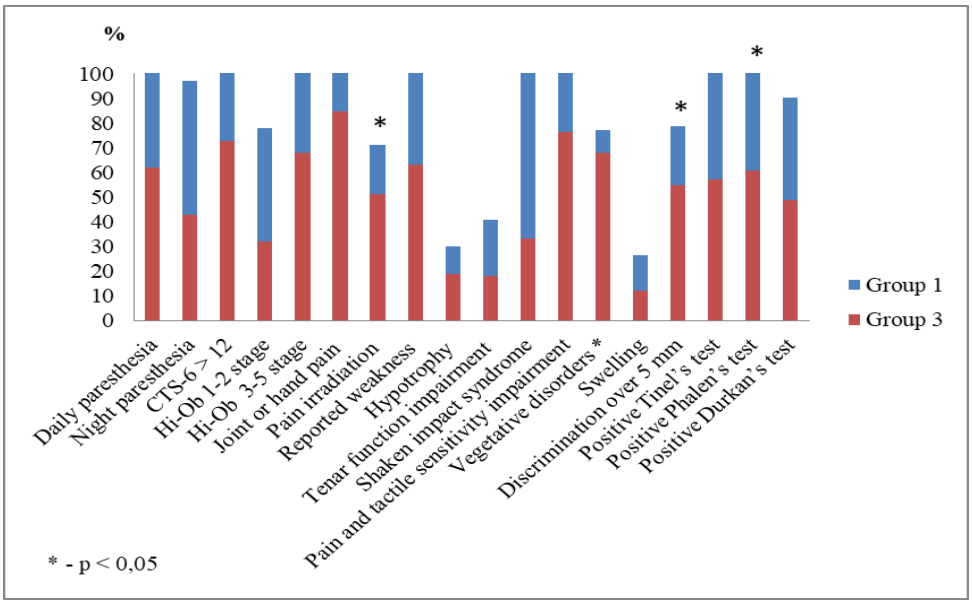


Figure 3. Comparison of values of clinical results of the patient groups 1 and 3

The majority of cases of the 3-5 clinical stage of the disease (with the existence of objective sensor and motor deficiencies) and vegetative disorders in the second group might be associated with the progression of a concomitant complex regional pain syndrome (CRPS) due to the limb's injury and immobilization. A sub-acute start and well-expressed clinical image in this group of patients made these patients seek medical aid early. In CTSt cases, the majority of patients appeared with previous diagnosis-consequences of trauma and a complex regional pain syndrome (CRPS). Concerning the similarity of clinical image and the possibility of simultaneous progression of both CRPS and CTS, all patients underwent additional medical imaging (definitely-X-ray, EMG, and ultrasonography). The last mentioned ensured objective assessment of the MN's structural and functional conditions and confirmed the diagnosis of MN CIN in the CC.

Clinical details, symptoms, results of an objective examination, and the statistical comparison of values related to patients from the first and the third group are demonstrated in Figures 3 and 4.

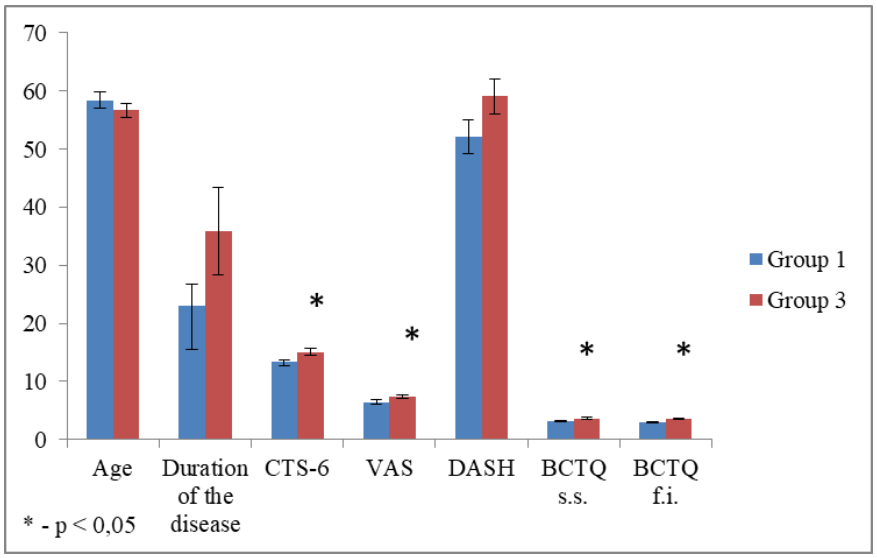


Figure 4. Comparison of values of clinical results of the patient groups 1 and 3

The clinical progression of the CTSo was specific with the statistically significantly higher severity of the pain syndrome according to VAS and more frequent pain irradiation to the shoulder and forearm, more expressed sensor deficiency, and the upper limb functional activity impairments. CTSo patients had significantly higher mean values of BCTQs.s. and BCTQf.i. compared to the respective values of the CTSi patients (Figures 3 and 4).

Distinguishing was a significantly higher incidence of positive Phalen's test. For these patients, the phenomenon could be explained by higher pressure in their carpal canal due to inflammation-associated effusions. In our opinion, inflammation processes of the joint and para-articular tissues caused even more expressed pain syndrome. Analysis of the CTS-6 scale has demonstrated that mean value was significantly higher, compared to the 3rd group patients.

In contrast to patients from the 1st and the 2nd groups, for the 3rd group of patients with CTSo, Phalen's test was the most sensitive among the three provocative ones.

In cases of CTS on the background of an orthopedic pathology, the ultrasonography examination and/or X-Ray is a must. Medical visualization was the method to give us essential information on CTS's etiology. According to the US and X-ray imaging, 31% had synovitis, 32.1% – tenosynovitis, and DOW – 28.6%, volume neoplasm of a wrist – 8.3%.

CTS is the most widespread and studied tunnel syndrome of the upper limb, caused by compression of the median nerve in the wrist's carpal tunnel [13]. Etiologically it splits into idiopathic and secondary CTS [14]. The secondary forms of CTS are not very common and may occur after wrist area dislocation-fractures and frequent orthopedic diseases (osteoarthritis, arthritis, synovitis of the wrist, and tenosynovitis of different origin). Most of the scientific studies are dedicated to idiopathic forms of CTS and only some of them contain general information, without clinical features of the courses, on its secondary forms like posttraumatic and associated with an orthopedic pathology.

There are no publications on clinical symptoms, course features, and data of an objective examination of patients with secondary forms of CTSt and CTSo in the available literature. For the first time, we have determined the specificity of the progression of a post-traumatic CTS and the one on the background of an orthopedic pathology. Common clinical features of both secondary forms of the CTS, compared to the idiopathic one, were more expressed reported and objective sensor deficiency, pain syndrome severity according to VAS, and the upper limb functional impairment. Typical of CTSt were earlier occurrences of more expressed and spread autonomic vegetative impairments

(namely, hand swelling), motor deficiency, and for the CTSo-frequent pain irradiation to the shoulder and forearm. Majority of cases with the 3-5 clinical stage of the disease (with the existence of objective sensor and motor deficiencies) and autonomic vegetative disorders in the CTSt group might be associated with the progression of a concomitant complex regional pain syndrome (CRPS) due to the limb's injury and immobilization. A sub-acute start and well-expressed clinical image in this group of patients made these patients seek medical aid early. In CTSt cases, the majority of patients appeared with previous diagnosis- consequences of trauma and a complex regional pain syndrome (CRPS). Concerning the similarity of the clinical image and the possibility of simultaneous progression of both CRPS and CTS, all patients underwent additional medical imaging (definitely-X-ray, EMG, and ultrasonography). The last mentioned ensured objective assessment of the MN's structural and functional conditions and confirmed the MN CIN diagnosis in the CC. The CTSt and CTSo patients have statistically significantly higher BCTQs.s. and BCTQf.i. values, than the same values of CTSi patients.

It is essential that a quantity of cases from the common group of CTS patients (32.7%) had no typical clinical signs of the MN CIN (the sum total of scores by the CTS-6 scale was below 12). Indeed, this made the clinical physicians doubt the CTS diagnosis. In such cases, additional instrumental methods played a major role to confirm the MN impairment in the CC, provide information on the CTS's etiology. Together with the clinical progression, they helped to resolve further treatment tactics. For example, in a case of a severe stage of the MN CIN due to the post-traumatic CTS caused by a fracture malunion, it is expedient to consider an orthopedic surgical correction of the deformity with simultaneous carpal ligament release. At the same time, if damage to the MN in the CC is mild, but there is overloading tenosynovitis, it requires conservative treatment and observations in dynamics. Instrumental methods should be applied to monitor the progression. Paraclinical examination instrumental methods (EMG, US, X-Ray/CT) should be involved, if a secondary CTS form is suspected. An early diagnosis and determination of the CTS's form and severity are essential factors to make a correct decision on further treatment tactics.

Conclusion

Clinical progression of post-traumatic CTS and the same associated with an orthopedic pathology have specific features, compared to its idiopathic form. The identified clinical features provide an opportunity to justify the choice of an additional instrumental examination method to confirm a median nerve's compression-ischemic neuropathy and determine its severity and etiology of CIS that in turn, promotes making a decision on the further treatment tactics.

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Authors' Contributions

All authors contributed to data analysis, drafting, and revising of the paper and agreed to be responsible for all the aspects of this work.

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