# Carpal tunnel syndrome in persons performing cosmetic procedures

## *Zespół cieśni kanału nadgarstka u osób wykonujących zabiegi kosmetologiczne*

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## ABSTRACT

*Carpal tunnel syndrome is the most common chronic median nerve mononeuropathy manifested by nocturnal paraesthesia, sensory disturbances, and weakness or atrophy of the hand muscles. The symptoms of this syndrome are the result of chronic ischemia of the median nerve caused by increased pressure inside the carpal tunnel. The increase in intra-canal pressure may occur as a result of an injury, anomalies in the structure of anatomical structures, endocrine disorders, or in specific positions of the wrist maintained for a long time - maximum dorsal or palmar flexion of the hand. Such positions are very often taken by office workers, whose nature of work resembles that of a beautician.*

*The main goal of this study was to collect and present up-to-date information on the characteristics, clinical picture, etiology and epidemiology of carpal tunnel syndrome (with particular emphasis on the beautician profession) as commonly considered a risk factor for carpal tunnel syndrome. The additional purpose was to present conservative and surgical treatment as the two main methods of improving the patient's health.*

*In the non-advanced forms of carpal tunnel syndrome conservative treatment is used. The most common method is to immobilize the wrist in an intermediate position in the orthosis. Pharmacotherapy is also effective.*

*Physiotherapeutic activities are mainly aimed at improving the patient's quality of life, especially in the area of pain relief. If there is no improvement in response to conservative treatment or worsening of the syndrome's symptoms, surgical treatment should be considered.*

**Keywords:** *carpal tunnel syndrome, neuropathy, physiotherapy, pain, occupational disease*

## STRESZCZENIE

Zespół cieśni kanału nadgarstka jest najczęściej występującą przewlekłą mononeuropatią nerwu pośrodkowego objawiającą się parestezjami nocnymi, zaburzeniami czucia i osłabieniem lub zanikiem mięśni ręki. Objawy tego zespołu są wynikiem przewlekłego niedokrwienia nerwu pośrodkowego spowodowanego zwiększonym ciśnieniem wewnątrz kanału nadgarstka. Wzrost ciśnienia śródkanałowego może wystąpić w wyniku urazu, anomalii w budowie struktur anatomicznych, zaburzeń endokrynologicznych, czy też w specyficznych pozycjach nadgarstka utrzymywanych przez dłuższy czas – maksymalne zgięcie grzbietowe lub dłoniowe ręki. Takie pozycje bardzo często przyjmują pracownicy biurowi, których charakter pracy przypomina zawód kosmetyczki.

Głównym celem niniejszej pracy było zebranie i przedstawienie aktualnych informacji na temat charakterystyki, obrazu klinicznego, etiologii i epidemiologii zespołu cieśni nadgarstka, ze szczególnym uwzględnieniem kosmetyczek, jako powszechnie uważanej za czynnik ryzyka wystąpienia zespołu cieśni nadgarstka. Celem dodatkowym było przedstawienie leczenia zachowawczego i operacyjnego jako dwóch głównych sposobów poprawy stanu zdrowia pacjenta.

W niezaawansowanych postaciach zespołu cieśni kanału nadgarstka stosuje się leczenie zachowawcze. Najpopularniejszą metodą jest unieruchomienie nadgarstka w pozycji pośredniej w ortezie. Skuteczność leczenia wykazuje również farmakoterapia. Działania fizjoterapeutyczne mają głównie na celu poprawę jakości życia pacjenta, szczególnie w zakresie działań przeciwbólowych. W przypadku braku reakcji poprawy na leczenie zachowawcze lub pogłębienia objawów zespołu należy rozważyć wdrożenie leczenia operacyjnego.

**Słowa kluczowe:** zespół cieśni kanału nadgarstka, neuropatia, fizjoterapia, ból, choroba zawodowa

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## INTRODUCTION

The hand, thanks to its ability to make complex and accurate movements, plays an important role in human life. These functions may be impaired or completely abolished due to pain, paresthesia, weakening of muscle strength or sensory disturbances. These symptoms may be the result of upper limb neuropathy, i.e. a condition in which the nerve is pressed by the surrounding anatomical structures [1].

The loss of hand function has serious consequences in everyday life, but above all in professional life. Pain symptoms limit a person's independence. Long-term symptoms have a negative impact on the patient's psyche, leading to serious depressive disorders [2].

The main goal of this paper was to gather and present the up-to-date information on the characteristic, clinical picture, etiology and epidemiology of carpal tunnel syndrome, taking into account the profession of beauticians, commonly regarded as a direct risk factor for carpal tunnel syndrome.

The profession of a beautician shows similar motor activities related to the provision of services as office workers. Both these occupations in 2018 showed a similar percentage of occupational diseases (0.7%). Long-term uncomfortable body position at work causes static overloading of the structures involved, and high frequency and repetitiveness of movements can cause fatigue micro-injuries. Over time, the intensity of negative factors increases predisposing to the occurrence of pain and various dysfunctions. The structures of the spine, shoulder girdle and upper limbs are most often affected. One of the dysfunctions considered to be an occupational disease is the carpal tunnel syndrome (CTS) classified as a chronic disease of the peripheral nervous system caused by the way work is performed. CTS was included in the list of occupational diseases in accordance to the Regulation of the Council of Ministers of 30 June 2009. In 2018 this syndrome, apart from cubital tunnel syndrome and common fibula nerve injury in persons performing work in a crouch position, constituted almost 100% of cases of chronic diseases of the peripheral nervous system, both in women and men [1-3].

## SYNDROME'S CHARACTERISTICS

Carpal tunnel syndrome is the most common upper limb neuropathy and is the main cause of hand impairment. Unfavourable working conditions, progress in civilization and bad life habits increase the incidence of diseases [4]. The symptoms of CTS are closely related to the symptoms of peripheral damage to the median nerve. There are three clinical forms of the syndrome: early, intermediate or advanced, which are in direct correlation with the duration of clinical symptoms [1, 2, 5].

## CLINICAL PICTURE

The permanent and most characteristic symptom occurring in CTS are night paresthesias, which determine the proper diagnosis. The most frequent paresthesias include the hand, sometimes they also occur in the forearm and arm area, rarely in the shoulder and occipital area. The frequency of paresthesias increases with the development and duration of the disease. In advanced forms of the disease, daily paresthesias may also occur [2, 5].

Continuous degenerative effect on the median nerve results in progressive sensory disturbances on the surface supplied by this nerve. Initially, the disorder occurs in the area of the fingertip of the first and second finger, and in the later stage of the disease, the disorder covers the entire area supplied by the median nerve. Specific for the later stage of the disease is the occurrence of movement disorders of the hand as a result of damage to the movement branch of the median nerve. In patients with carpal tunnel syndrome, weakness and atrophy of thenar and lumbricales muscles are observed. The symptom of Luthy's bottle is also characteristic, i.e. the symptom of the abductor pollicis brevis muscle movement deficit. In an attempt to hold a round object in the hand, a non-adhesion of the area between the thumb and forefinger is visible on the paresis side [2].

In the carpal tunnel syndrome, vegetative angiomotor disorders corresponding to Raynaud's symptom may occur. Rarely, trophic skin disorders may occur [2].

The clinical picture also shows positive signs of provocative tests: Phalen test, reverse Phalen test, Tinel test, Durkan test, pneumatic band test, two-point sensory resolution test [1, 2, 6].

## ETIOLOGY

Clinical symptoms of carpal tunnel syndrome result from ischemia of the median nerve at the level of the carpal tunnel. The value threatening the nerve is 30 mm Hg pressure [7]. In a healthy person, the pressure inside the carpal tunnel takes the value of about 2.5 mm Hg in the intermediate wrist position and increases to about 30 mm Hg with the maximum dorsal bend of the wrist or to about 32 mm Hg with the maximum palmar bend of the wrist [2]. The intra-channel pressure in people with carpal tunnel syndrome is constantly increased and exceeds the critical value of 32 mm Hg in the neutral hand position. The dorsal and palmar flexion of the hand initiates a significant increase in pressure in the carpal tunnel reaching 110 mm Hg for a dorsal flexion and 94 mm Hg for a palmar flexion [2].

The causes of carpal tunnel syndrome are varied. Median nerve damage or increased intra-channel pressure may be caused by [2, 8]:

- injury,
- tumors located within the carpal tunnel,
- congenital disorders,
- connective tissue diseases of the carpal tunnel area,
- infectious and inflammatory processes,
- hormonal disorders,
- dialysis and hemodialysis,
- pregnancy,
- professional factors.

The most common cause of traumatic damage to the median nerve is a fracture of the distal part of the radial bone. Usually, the nerve is damaged in the mechanism of the Colles'-type upright fracture, when people fall on a dorsal flexed hand. Symptoms of carpal tunnel syndrome may appear in the fractures and injuries of the scaphoid bone and metacarpar bones. Another source of compression or damage to the median nerve may be post-traumatic haemorrhage formed near the carpal tunnel [2, 9]. The other, although quite rare, factors causing compression on the median nerve are tumors located within the carpal tunnel. They may occur in the form of: cysts, tendon fibroblasts, nerve ganglions, adipose ganglia, mid-nerve hemangiomas and infiltrates in the course of lymphatic leukaemia [2, 6, 10].

CTS may have its origin in congenital anomalies of structures surrounding the median nerve. The symptoms manifest themselves in adulthood in children who are diagnosed with muscles of abnormal anatomical structure and disorders of the median artery. One of the complications that may occur after infections or inflammatory processes is carpal tunnel syndrome. The syndrome may arise as a complication of inflammation of the hand joints in the development of rubella or granulomatous infection of the hand. The occurrence of CTS is also associated with the course of tuberculosis (tuberculitis of the tendons) and leprosy (inflammation and swelling of the middle nerve in the area of the carpal tunnel) [2].

Relatively frequent endocrine disorders may also result from progressive mononeuropathy of the median nerve. If the thyroid function is inadequate, the symptoms characteristic of CTS may occur [2]. Abnormal levels of T3, T4 and TSH hormones lead to the accumulation of mucopolysaccharides between the synovial membranes and tendons; consequently, pressure on the median nerve is exerted [1, 11].

The pathomechanism of CTS formation in dialysis subjects consists of many elements such as ischaemia of the nerve, tendonitis, urethra polyneuropathy, local oedema caused by the production of an arteriovenous fistula and the accumulation of amyloid β2-microglobulin or iron in the tissue of the synovial membrane [2, 12]. The progressive neuropathy of the median nerve in pregnant women is extremely ailment and differs clinically from idiopathic carpal tunnel syndrome. Oedema of the wrist canal area, especially swelling of fingers, causes permanent or daytime paresthesias. In pregnant women, increased electrophysiological symptoms and more frequent isolation of the median nerve conduction are observed [1, 2].

The main cause of CTS is improper performance of work and failure to observe its ergonomic principles [8]. This type of behavior very often occurs in people performing cosmetic procedures. These people often spend a long time in positions predisposing to high bioenergy costs. Occupational activities performed by them are characterized by rhythmicity, repetitiveness, forced position, micro-injuries and overloads of the hand and wrist area. Stretching of anatomical structures or compression play a significant role in occupational pathogenesis [2, 8, 13]. Banach points out that the risk of CTS is significantly increased by fast, cyclic activities, which do not require high force and last less than 10 seconds [2]. An average person performing cosmetic treatments meets the above conditions. The low temperature at the workplace and improper posture, which contributes to increased muscle tension, are also of immeasurable importance in occupational pathogenesis.

## EPIDEMIOLOGY

For all diseases there is a group of people who are particularly vulnerable to the disease. Risk factors increase the possibility of the disease accordingly and are modifiable when the patient has the ability to decide on its occurrence or non-modifiable when the patient has no influence on its occurrence [2].

Non-modifiable factors include: patient's age, patient's sex, menopause, genetic load [2]. The circle of modifiable factors include: obesity and lack of physical activity, diabetes mellitus, alcoholism and smoking addiction, physical activity, abnormal posture and everyday life habits, profession [2].

### Non-modifiable factors

With age, the risk of progressive neuropathy of the median nerve increases. The highest risk group is estimated for people aged 55-60 years [14]. Increased pressure on the nerve is mainly associated with rheumatic changes in the wrist canal area correlated with the patients` continuous professional activity [15]. The female sex is considered to be one of the most important risk factors of carpal tunnel syndrome [16]. But there are also studies which suggest that there are differences in sex-related prevelance only in elderly (almost four time higher prevalence than in men in 65-74 years of age) [17]. Idiopathic carpal tunnel syndrome is even 5 times more common in women than in men, whereas the prevalence of occupational morbidity is found in men than in women [2]. The cause of increasing the pressure in carpal tunnel may be an increased amount of interstitial fluids caused by hormonal changes occurring during

menopause in women. Similar effects occur in women after overectomy or hysterectomy [2, 18, 19]. Some diseases that increase the chance of carpal tunnel syndrome are directly related to genetic factors [18]. Hereditary neuropathy of the median nerve with a tendency to compression nerve injuries or a family predisposition to the transverse carpal ligament hypertrophy increases the risk of developing carpal tunnel syndrome [18].

### Modifiable factors

There is a strong correlation between an elevated body mass index (BMI) and the occurrence of the median nerve neuropathy. Even 2-4 times more often, obese people develop carpal tunnel syndrome, and an increase in BMI of one degree above the appropriate age group increases the risk of carpal tunnel syndrome by up to 8% [15, 19]. The incidence of diabetes is closely related to obesity, lack of physical activity, smoking and alcohol abuse. The group of people with diabetes who develop CTS may vary from 5 to even 60%. The risk of asymptomatic neuropathy of the median nerve is the same both in type 1 diabetes and type 2 diabetes [2]. Diabetes mellitus is an unquestionable factor increasing even 2.5-3.5 times the probability of occurrence of CTS [19]. Increased pressure inside the carpal tunnel is caused by the position of the hand in the palm or dorsal flexion and by activities that require the wrist to work harder [2]. This setting may be forced when performing certain sports or activities such as cycling. Badminton, table and ground tennis, rock climbing, artistic gymnastics and sports acrobatics are among the disciplines that are responsible for wrist overload and high levels of trauma in the radial wrist joint [20, 21]. Forced wrist positioning can also result from everyday habits. The adoption of an abnormal body position, abnormal motor pattern performed daily for a long period of life is one of the major risk factors of CTS [18]. The main ergonomic mistakes in everyday life include improper use of the mouse and computer keyboard and overloading the wrist during manual transport [2, 19]. A large group of risk is also involved in wheelchair users due to continuous loads and hand overloads [22]. The most frequently cited risk factor for carpal tunnel syndrome in the literature is professional work. Monotonous, fast, constant velocity movements of fingers and toes and wrists, which do not require high muscular strength, result in increased pressure in the wrist canal and lead to hand overload syndromes [2]. The main factors affecting the increase the pressure in the carpal tunnel and wrist overload are bending and straightening movement, radial and elbow sideflexions in the radial-wrist joint as well as supination and pronation in the distal radio-ulnar joint [15]. An additional unfavourable risk factor is the use of devices emitting vibrations (air hammers, saws, grinders) and a workstation with low temperatures (coolers, hands working in cold water) [2].

## CONSERVATIVE TREATMENT

Before the decision about the necessity to undergo surgery, less invasive conservative treatment should be undertaken [2]. Mild, early forms of carpal tunnel syndrome usually react positively to conservative treatment, both pharmacotherapy and physiotherapy [24]. The aim of conservative treatment is to decompress the median nerve, minimize pain and paresthesia, improve hand feeling and regenerate hand function and efficiency [4, 23, 25]. The elements that should be taken into account when qualifying the patient for the types of conservative or surgical treatment are [2, 4, 6, 25]:

- severity of pain,
- degree of damage to the median nerve,
- occurrence of coexisting diseases (directly and indirectly related to carpal tunnel syndrome),
- muscular atrophy,
- progressive or significant sensory loss,
- anatomical deformations,
- cause of the syndrom,
- patient decision.

In the assessment of the prognosis of conservative treatment it is also important to analyze the positive and negative factors conducive to the occurrence of carpal tunnel syndrome. Conservative treatment may be performed with the use of pharmacotherapy or physiotherapy. Pharmacological therapy consists in general administration of simple analgesics and injection of non-steroidal anti-inflammatory drugs or cyclooxygenase-2 inhibitors into the carpal tunnel by local injections [24]. Pharmacotherapy is also used when the cause of carpal tunnel syndrome is pregnancy or hypothyroidism [2].

Physiotherapeutic treatment has a much wider range of physical therapy treatments, kinesitherapy, massage and soft tissue mobilization, and orthopaedic supply. The most common and satisfactory method of treatment is the immobilization of the wrist in the orthosis. The hand is placed in the splint in the medium position to relieve mechanical nerve irritation, reduce pressure in the carpal tunnel and eliminate pain [2, 4]. The best therapeutic effects are achieved when using the splint not only during sleep but also during the day [2, 6, 25]. It is worth noting that the use of a hand orthosis is associated with no contraindications and no complications [2]. The main task of physical therapy in conservative treatment is to reduce pain and inflammation of the wrist area. The most common therapeutic methods used are thermo-therapy, laser therapy, electrotherapy, pulsed low-frequency magnetic field, sonotherapy [2, 4, 25, 26].

The main goal of kinesitherapy, massage and soft tissue mobilization treatments is to improve the flexibility of muscles, tendons, ligaments and the median nerve. The kinesitherapy is based on the use of specific sequences of

movements of the wrist, elbow and shoulder joints, which allow for neuromobilization of the median nerve. The therapeutic role of massage and deep tissue therapy is based on relaxing and stretching the structures forming the base of the carpal tunnel. It should be remembered that the effects of conservative treatment are determined by the change in ergonomics of patient's work, movement patterns triggering pain and everyday habits [6]. The initiation of conservative treatment should be preceded by careful consideration and tests to determine whether the reduction of sensations and delayed surgical treatment will not contribute to progressive damage to the medial nerve and, consequently, minimize the chances for a complete return to efficiency [2].

## SURGICAL TREATMENT

If conservative treatment is insufficient or if the therapeutic effects are unsatisfactory, surgical decompression of the median nerve should be considered. The obligatory condition for surgery is the diagnosis confirmed by the clinical picture and objective tests [2, 27]. The anterior-posterior and lateral X-rays, images of the carpal tunnel and ultrasounds are routine examinations to diagnose the carpal tunnel syndrome. The more detailed and more accurate anatomical evaluation of the wrist canal includes computed tomography (CT) or magnetic resonance imaging (MRI) examination [2]. When qualifying the patient for surgery, the indications and contraindications for this method of therapy should also be analyzed (tab. 1).

**Table 1** *Indications and contraindications for surgical treatment of CTS*

| INDICATIONS | CONTRAINDICATIONS |
|---|---|
| intensification of pain and paresthesia | hypertrophy of the peridesmium |
| the occurrence of daytime paresthesias | granulation tissue deposits |
| progressive damage to the median nerve | mineralised tissue deposits |
| the appearance of muscular atrophy within the hand | medial nerve bipartite |
| progressive loss of superficial sensation | dialysis fistula within the hand |
| | hematoma or exudative fluid in the carpal tunnel |
| | image disorder (in case of endoscopic procedure) |
| | traumatic etiology of carpal tunnel syndrome (in case of endoscopic surgery) |
| | rheumatoid arthritis (in case of endoscopic surgery) |
| | reoperation (for endoscopic surgery) |

**Source:** *[2]*

The essence of surgical treatment of the CTS is to relieve the pressure on the median nerve by cutting the transverse carpal ligament. Decompression of the median nerve may be performed by means of various surgical techniques. These techniques include [9]:

a) open methods (classic):
- by means of wide-area access,
- small-scale cutting technique,
- dual-cut method;

b) closed methods (endoscopic, minimally invasive):
- double-sided access technique,
- one-sided access technique.

After the surgical treatment, postoperative physiotherapy is widely used. Physical therapy like ultrasounds, laser- and magnetotherapy combined with soft tissue mobilization, dynamic neural mobilization, stretching and strengthening exercises and scar tissue techniques are included in the postoperative therapy program [28]. Using the postoperative therapy is clinically relevant to accelerate return to work time and recovery overall. However it doesn't modify functional recovery of the hand and doesn't reduce occurrence of the symptoms [28, 29].

## SUMMARY

Night paresthesias, sensory disturbances and atrophy of hand muscles are characteristic symptoms for carpal tunnel syndrome. Median nerve damage may occur during trauma or as a result of chronic ischaemia. The key stage of treatment is to make a correct diagnosis using electrophysiological tests and provocative tests. This will allow to visualize the changes and disorders within the nerve and make the right decision about the treatment. Physiotherapeutic treatment is widely used in both conservative and postoperative treatment. Complex physiotherapeutic treatment in combination with other treatment methods such as pharmacotherapy and surgical treatment is the basis for the cure.

There is still lack of evidence showing the correlation between beautician profession and occurrence of the CTS. We can only assume the possible correlation based on the research combining manual working style and using ergonomic principles with occurrence of the CTS. There is need to provide a research which can show the clear correlation between the beautician working petterns and occurence of the CTS.

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**CITE / SPOSÓB CYTOWANIA**

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