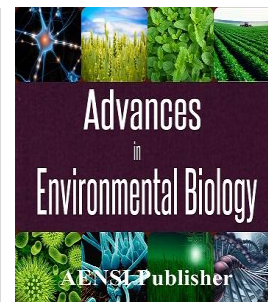




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Carpal Tunnel Syndrome

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ABSTRACT

Carpal tunnel syndrome is the most common periphery nerve-trapping syndrome. CTS (Carpal Tunnel Syndrome) surgery is the most often operation around the world. Carpal tunnel syndrome occurs as a result of nerve compression at wrist level and generally appears with affective and motor findings. This symptom is also called hand acroparesthesia, tenar palsy, tardy median palsy, median neuritis, median tenar neuritis and so on. It is seen more in adult females over the age of 40. First symptoms are generally burn up, hyperkinesia, weakness, pain, pins and needles, or loss of sense that occur in the area where median nerve is eligible for bilateral spread on hand. Neuronal conduction and electrodiagnostic examinations including needle electromyography are the most common auxiliary methods used for diagnosis. Treatment procedures are generally divided into two, being conservative and surgery. Most commonly applied method is open surgical release. In our study, we shared the perfect results obtained from 186 patients with carpal tunnel syndrome whom we applied surgery under local anesthesia without admission to the hospital and we followed up from outpatient clinics. We also showed that with a practical method as we applied, patients could return their social and work lives within a short period of time.

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INTRODUCTION

Carpal tunnel syndrome is a common neuropathy that occurs as a result of median nerve compression in carpal tunnel and that may cause hand pain, paresthesia and hypoesthesia [2].

In carpal tunnel syndrome; pins and needles on hand caused by median nerve compression in carpal tunnel at wrist level, muscle atrophy and weakness at later phases is seen [52, 18].

As for CTS etiology, it is seen that there are reasons including endocrinological disorders, amyloidosis, tumoral formations, traumatic incidents and rheumatic diseases. However, it was noted that the reason was idiopathic in nearly 50% of patients with CTS [26, 51, 18].

While it is common especially in women over the age of 40, it was found in a study in the USA that CTS prevalence in overall population is approximately 3.72%. In addition, it was shown that this prevalence is higher in people whose hand or wrist is overtaxed and/or who are exposed to long-term recurrent traumas [33, 43].

There are conservative and surgical methods to treat carpal tunnel syndrome. For the treatment of CTS as a common syndrome that affects negatively one's daily life activities, if any, etiological reasons should be detected first, and then it should be decided whether to proceed with conservative or surgical treatment. There are many different conservative treatment approaches in CTS. These include physiotherapy modalities such as nonsteroid anti-inflammatory drugs and steroid injections, hand-wrist splints, ultrasound, and laser [22]. In surgical methods, the aim is to increase canal volume and decrease pressure on nerve through open and endoscopic release of transverse carpal ligamentum [40]. Among the reported reasons for symptom maintenance or recurrence after the release of carpal canal are insufficient release, fibrosis and painful scar tissue formation, palmar cutaneous nerve branch trapping, psychological and occupational factors [14, 2].

In our study, we analyzed Carpal Tunnel syndrome as a common syndrome that negatively affects the life standards of patients, as well as treatment practices [18]. We shared the perfect results obtained from 186 patients whom we applied surgery under local anesthesia in outpatient clinics.

Anatomy:

Carpal tunnel consists of tendon package that belongs to wrist bones at the bottom and forearm flexors above it. Median nerve progresses above tendons. Above the median nerve, there is a thick cover that is not so elastic called transverse carpal ligament [19]. Carpal tunnel is a covered canal comprised of scaphoid bone tubercle and trapezium edge at lateral, hamate bone hamulus and pisiform bone at medial. It is a 4 cm-canal that spreads from distal wrist line to the middle of the line drawn from thenar eminence [1]. According to Einhorn and Leddy [17], this height is 5 cm. In this canal; there is flexor pollicis longus, flexor digitorum superficialis, flexor digitorum profundus tendons and median nerve. It constitutes the bottom of transverse carpal ligament Guyon canal at medial side, here it is located over ulnar nerve and ulnar transverse carpal ligamentum. Top of Guyon canal is comprised of volar carpal ligamentum. Superficial palmar fascia is located on both ligamentum and spreads to distal of transverse carpal ligamentum. Palmaris longus tendon ends in this fascia. There are two more layers between transverse carpal ligamentum and skin, under skin. These are interthenar fascia and palmar fascia. These three in total are called flexor retinaculum.

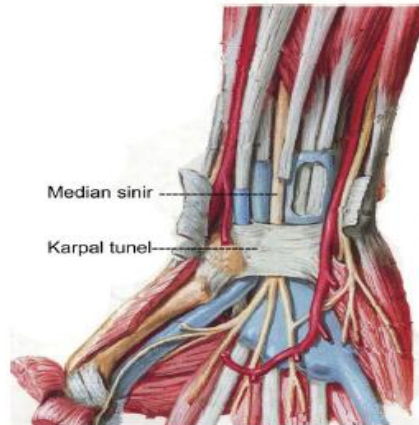


Fig. 1: Anatomy.

Before median nerve is located under transverse carpal ligamentum, palmar cutaneous, palmar cutaneous gives off branch. This branch allows the distribution of the thenar part in the interior face of the hand. This branch plays a role in planning the incision while applying carpal tunnel syndrome surgery. Some believe that this sensation branch extends to ulnar side. Therefore, Franzini *et al.* [23] prefer 1 cm longitudinal incision in the proximal of wrist flexor line while planning the incisions. On the contrary, Abdullah *et al.* [1] perform incisions in the medial of this tendon transversely, stating that palmar cutaneous permanent median nerve displaces from the radial side and always progresses in the lateral of palmaris longus tendon.

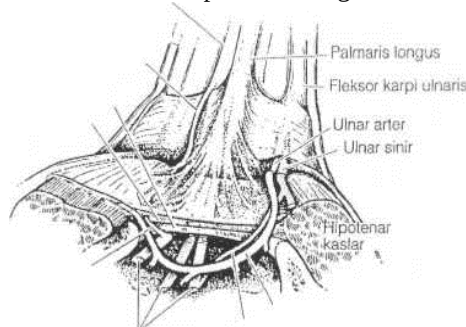


Fig. 2: Carpal Tunnel, illustration of structures with surgical significance.

Median nerve separates into two main truncus at the distal end of the transverse carpal ligament. Lateral truncus gives off motor branch and then gives off the digital nerves going to the radial side of the thumb and index finger. Medial truncus gives off the digital nerves going partially to the lateral face of the ring finger to second finger and third finger. Among these branches, motor branch effects surgical technique.

Various variances might be observed in this branch. According to Lanz classification, motor branch gives off branches from median nerve frequently as extra- ligamentous (%46), less frequently as sub-ligamentous (%31), the least frequently as trasligamentous (%23). This branch originates rarely from the ulnar side of the median nerve. Recurrent motor branch presence is rarely reported [36, 50].

Superficial Palmar Arch is located approximately at a distance of 2-26 mm from the distal end of the carpal ligament. It is located within a fat tissue.

Ramus communicans, which is located between median nerve and ulnar nerve, is present within the fat tissue. This branch enables the communication between these digital nerves. Its injury during surgery leads to paraesthesia formation in middle and ring fingers.

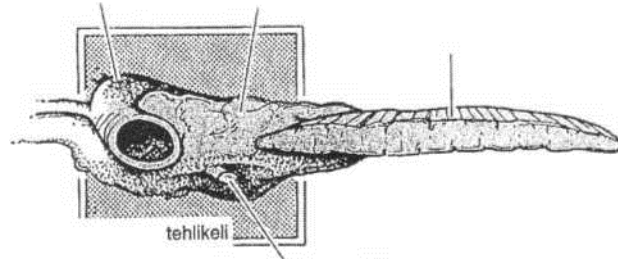


Fig. 3: Significant formations in carpal ligamentum distal section.

Carpal Tunnel Syndrome:

Carpal tunnel syndrome is a term used to define a set of symptoms and findings that arise from the pressure applied on median nerve at hand wrist level. While median nerve progresses toward hand from wrist, it passes through a space called carpal tunnel (wrist tunnel). The compression occurs within this tunnel. In carpal tunnel syndrome, no apparent reason can be identified in the vast majority of the patients [28]. Median nerve compression occurs very frequently in carpal tunnel [6]. Microtraumas in canal region, deformation or shrinking of canal volume, or each pathological incidence leading to the increase of content in the canal constitute complex symptoms and findings [46]. This pathology, called as carpal tunnel syndrome (CTS), is the most commonly seen entrapment neuropathy [4]. CTS is generally idiopathic [46]. Also, two studies conducted in Sweden and USA [28] detected that the number of the CTS surgeries performed annually is between 130-150 in 100.000. CTS is clearly more prevalent among females than males [54, 11], and it is argued that this prevalence does not result from environmental conditions but from genetics [27, 10].

Systemic causes facilitate the localized nerve compression by either increasing the anatomic deformation in entrapment region or leading to the pathological material accumulation that can reduce the volume of that region. Myxedema, acromegaly and amyloidosis increase nerve compression, causing volume narrowing in the canal region through the accumulation of the disease specific material in the tunnel or in the passage. Some systemic reasons are not effective on entrapment region. However, they lead to formation of entrapment neuropathy by the adverse effects they create in nerve metabolism as in diabetes. Sometimes, instead of systemic disease, acquired changes localized in entrapment region can facilitate the chronic compression or lead to nerve compression directly. For example, Colles Fracture in the wrist makes the carpal tunnel volume smaller and creates deformation. Mass nerve like lipoma can be compressed in a more effective way in the entrapment region [20]. CTS develops frequently during pregnancy and it is the most commonly observed neurological complication of the pregnancy. It is thought to be arising from water retention. It vanishes postpartum in a spontaneous way [44, 5].

In chronic nerve compressions, the nerve physiopathology can be summarized as follows. Localized segmental demyelination with distinct borders develop in myelinated nerve fibers as a result of the chronic, localized deformation of the nerve in the entrapment region [35]. This situation leads to impulse conduction block in some fibers and localized slowing of the nerve conduction in others. Later on, axonal degeneration develops in some nerve fibers. Remyelination and regeneration can develop despite the fact that chronic compression did not disappear. In the entrapment region, mostly nerve construction and neuromatosis thickening is observed in its proximal. It is claimed that they develop as a result of the swelling and thickening in endoneural and perineural sheaths. In more chronic cases, localized construction and thickening might be observed in proximal or sometimes in the distal. This localized fibrotic narrowing around the nerve is of great importance, because it prevents the regenerating fibers from passing the compression point and a delayed decompression operation might not yield good result in such cases [20]. It is necessary to touch upon two controversial physiopathological situations briefly in entrapment neuropathies. The first one is the role of the ischemia and the other one is "Double crush" phenomenon. It is thought that in nerve fibers, secondary ischemia especially axonal degeneration might develop probably as a result of the localized blockage of the venous return under the influence of the compression in entrapment region. Similarly, it can lead to changes in the periphery connective tissue, median nerve and carpal syndrome occurrence region. In case of CTS attacks, it is suggested that direct compression associated local demyelination and axonal localized ischemia are responsible for the night pains and paraesthesia. It was clinically detected that local ischemia creates spontaneous neural discharge in the myelinated fibers under compression and this could lead to paraesthesia consequently. On the other hand, it is accepted that the pain arises from mechanical irritation along with the small-scale nerve fiber balance upset in entrapment region. Even if the nerve compression in the entrapment region is very small, if there is another pathology coexisting in lesion proximal, "Double Crush" entrapment neuropathology can manifest itself more

clearly. Proximal pathology can be cervical radicular compression secondary to spondylosis or it can be present at subclinical or clinical polyneuropathy level [55].

Findings:

The first clinically observed findings include callus and pins-and-needles sensation in median nerve field. Primarily, paraesthesia is the first sign since sensory fibers are affected by compression and ischemia. The most common symptoms of carpal tunnel syndrome include pain, paresthesia and/or loss of sense on the radial surface of the 1st, 2nd, 3rd, and 4th fingers, which are the most convenient area for the distribution of the median nerve in the hand. The most specific feature of these symptoms is that they manifest themselves at night or wakes one from sleep. The reason of nocturnal pain (Brachialgia paresthetica nocturna) is the median nerve compression associated with the position during sleep [10]. At further stages of the condition, in situations when the nerve experiences severe compression, in thenar region pain and power and skill loss arise in hands and tenar region (in abductor pollicis brevis and opponens brevis muscles innervated by motor branch of median nerve) atrophy is seen. In some patients, the pain spreads to the elbow from wrist and volar face of the front arm. Carpal tunnel syndrome is most frequently seen among women aged between 40-70 years and generally is bilateral [8, 12, 10].



Fig. 4: Increased pain, edema with misalignment of the left hand.

It was noted that patients had bilateral complaints at the first application between the rates of 59 and 87% [29, 8] or complaints at the other lateral develop at further stages in majority of the patients with unilateral complaints [8]. In patient history, the duration of the signs, whether they occurred on their own or post traumatically, whether there is pregnancy or not, DM, thyroid diseases, connective tissue diseases including romatoid arthritis, systemic diseases like chronic liver disease should be examined, and the relationship of the symptoms with activity and occupation should be studied. However, in overwhelming majority of the patients, no reason is found and it is decided that CTS is idiopathic.

The objective findings obtained during the neurological examinations of the patients with carpal tunnel syndrome include sensitivity in the direct compression on the carpal tunnel, positive Tinel's sign, positive Phalen sign, objective sensation disorder, abductor pollicis brevis weakness, thenar atrophy, severe pain and pharesthesia resulting from the tourniquet application on systolic tension arterial, sensitivity to diapason with a 256 vibration per second in two-points discrimination test [55].

CTS can be separated into three periods in terms of its course.

Subclinical period: In this period, patient has no complaint. However, local conduction slowing is detected in the entrapment region through nerve conduction studies. For example, localized nerve conduction slowing can be detected throughout the wrist canal in asymptomatic left hand of a patient with CTS in his right hand [20] and vice versa. Despite the fact that there is no abnormality in the routine nerve conduction studies in CTS, intermittent or persistent symptoms can be observed. This case has been detected through Sensory ultra-distal test (SUDT) and clinical follow-up [60].

Pain and paraesthesia period: Almost in all patients, the paraesthesia and the pain increasing nocturnally can spread to median innervated fingers (thumb, index finger, middle finger) . They generally develop on the sleeping position and wake the patient from sleep [46]. Symptoms primarily develop at nights. This is attributed to the wrist median nerve circulatory disorder secondary to interstitial fluid increase resulting from lack of muscle activity during sleep, horizontal position and volar flexion of the hand [15]. Patients with CTS frequently suffer from sleep interruptions and are treated with surgical exploration [37]. Increased pain and paraesthesia are observed with median nerve irritation (nerve percussion at wrist level; Tinel sign and excessive wrist flexion and extension; Falen test) [46]. Falen test indicated that worsening is also present in the electrophysiological findings [6]. These sensual irritation phenomena might be associated with direct nerve compression and local

ischemia [20]. Pain can spread outside the anatomical innervation area, and proximal of the nerve and to shoulder. It can be separated from plexopathy and radiculopathy as a result of that fact that ulnar innervated ring finger remained intact [4]. Paraesthesia is a phenomenon more common than pain [20].

Neurological findings period: Muscle paresis and atrophies in the area innervated by the nerve, signs like hypoesthesia and anesthesia on the skin emerge with the increase of localized demyelination and axonal degeneration at this period. It is found that as the neurological findings become more severe, pain and paraesthesia decrease gradually [55].

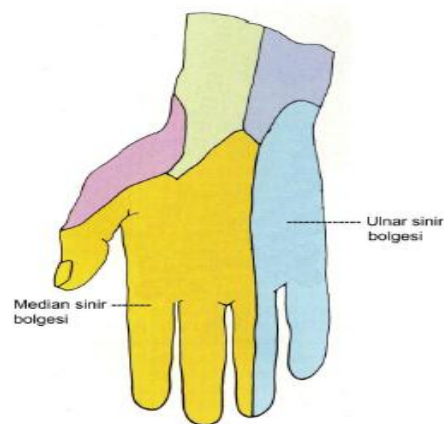


Fig. 5: Anatomy (Median and Ulnar nerve region).

Etiology:

Every process that will increase the compression within the carpal tunnel can lead to CTS signs, putting the median nerve under pressure: This process encompasses a wide spectrum like fractured sequels narrowing the tunnel inside and outside at wrist level, masses occupying a place like ganglion [41] or lipoma, connective tissue diseases like rheumatoid arthritis (RA) [7], tenosynovium thickening resulting from tuberculosis [7, 9] amyloid accumulation [59] water retention [42] associated with pregnancy [57] or hypothyroidism. The factors leading to carpal tunnel syndrome can be separated into two groups. First group consists of local factors. These include flexor retinaculum thickening, colles fracture, carpal bone fractures, rheumatoid arthritis, osteoarthritis, Paget disease, neoplasms, tenosynovitis, and osteophytes, scarring resulting from tendon trauma. Second group consists of systemic diseases. These include diabetes mellitus, gout, amyloidosis, myxedema, acromegaly, multiple myeloma, tuberculosis, pregnancy, mucopolysaccharidosis. It was reported that rarely seen cause result from measles vaccination, persistent median artery thrombosis, snakebite, contraceptive pill use and sublimis muscle compression [3]. In the differential diagnosis of carpal tunnel syndrome cervical disc protrusion, syringomyelia, cervical costa syndrome, scalenus anticus syndrome, De Quervain tenosynovitis and amyloid neuropathy in Rukavina type should be kept in mind [3].

However, in CTS no clear etiology is detected in the vast majority of the patients. In the development of a compression neuropathy, both ischemic and mechanical factors have a role [38]. The trials indicated that the more the compression time, the more severe the functional disorder in the nerve. In patients with carpal tunnel syndrome, no axonal damage but demyelination that can be indicated with electrodiagnostic tests are detected. In other words, the problem in CTS is not nerve fibers themselves but fibrosis developed on epineurium and perineurium, the connective tissues surrounding the nerve. These changes lead to ischemia in the nerve tissue by upsetting the circulation in the blood vessel by penetrating epineurium and perineurium [38]. A vast number of biopsy studies have been conducted with the aim of shedding light to etiology in CTS, and transverse carpal ligament has been examined with flexor tenosynovium [34, 47]. In the majority of these studies, benign fibrous tissue dominance was observed without inflammatory changes in flexor tenosynovium. Fibrotic tissue development was attributed to connective tissue degeneration resulting from recurrent mechanic fatigue [21, 32]. It was argued that cyclooxygenase 2 (COX-2) acts as a mediator in the remodeling of the pathological tissue in synovial hypertrophy that emerge with the development of fibrous tissue, eliminating the impact of cyclooxygenase 2 (COX-2) would have a healing effect [53]. In the research conducted on the tenosynovium of the patients with carpal tunnel syndrome, significant increase was observed in malondialdehyde, interleukin-6 and prostaglandin-2 levels without an increase in interleukin -1 levels, and this was indicated as the proof of non-inflammatory ischemia-reperfusion trauma resulting in a progressive edema and fibrosis in the etiology of CTS [24].

It is claimed that there is a relationship between carpal tunnel syndrome and the work motions performed and the repetitive work motions lead to CTS along with different hand problems. However, some studies did not reveal a relationship between heavy manual work and fibrous tenosynovial thickening in carpal tunnel [45, 10].

Diagnosis:

Carpal tunnel syndrome diagnosis is made by taking patient history and physical examination [61]. In clinical examination, fracture sequel at wrist level, deformities secondary to the connective tissue diseases like rheumatoid arthritis and occupying mass that could make compression on the median nerve is looked for. Various clinical tests have been defined for the diagnosis of CTS from its very emergence, however, only 2 out of them have become classic tests. These are Tinel and Phalen tests, aiming at revealing the symptoms by compelling. Various tests like two-point discrimination, grip strength measurement, Semmes-Weinstein monofilament test, reverse-Phalen test have been defined, but their specificities couldn't be proved or they couldn't find many users due to their difficulty in application [58]. In Tinel test, manual percussion is performed on the potential entrapment region of the nerve. Patient's ability to perceive tingling sensation spreading to the region where the nerve provides its sensation means that the test is positive [16]. In Phalen test, wrist is moved to the flexion position acutely as possible and the compression on the median nerve is increased and wrist is kept in the same position for a minute. The test is considered positive in such a situation where patient complaints are revealed in this way [13, 39, 10]. Phalen (wrist flexion) and reverse-Phalen (wrist extension) refer to the pressure increase inside the canal as a result of the shrinkage of carpal tunnel cross section at hamatum level with wrist flexion and extension [25, 48]. These tests should be performed on both hands regardless of the fact that patient has a complaint or not.

Some examination methods, confirming the clinical diagnosis of the carpal tunnel syndrome or facilitating the differential diagnosis are available. Standardized examination methods of carpal tunnel syndrome are electrodiagnostic examinations consisting of nerve conduction studies and needle electromyography, which are of utmost importance in the diagnosis and follow-up of neurological problems. These examinations show great sensitivity and specificity for CTS and allow for the staging of the neurological disorder [29, 49]. However, negative results might be obtained in CTS patients and positive results might be obtained in healthy volunteers without complaint through electrodiagnostic examinations. Specificity of the nerve conduction studies is over 95%, but it must be evaluated with clinical findings due to low sensitivity. Other disadvantages of electrodiagnostic examinations are that they are invasive methods, bear the risk of the infections transmitted through blood and consequently patient dissatisfaction [30, 10]. Electrodiagnostic tests measures the sensory conduction pace and distal motor delay of median nerve between 1st finger-wrist and 3rd finger-wrist, and needle EMG is performed. In line with the neurophysiologic examinations of the patients, they are separated into three groups as mild, moderate and advance. Only the patients with slowed sensorial conduction pace are placed into mild CTS group. Those who have a slowing down in sensorial conduction rate and accompanying increase in the median nerve distal motor delay are placed into moderate CTS group. Patients whose sensorial conduction cannot be recorded, and patients with an increase in the median nerve distal motor delay or also whose motor conduction cannot be recorded are placed into advance group. Clinical examination methods bear subjective properties, neurological symptoms of CTS are not specific to the median neuropathy occurring in wrist but might develop in proximal median neuropathy or polyneuropathy resulting from pronator or anterior interosseous syndromes, thoracic outlet syndrome and cervical radiculopathy and especially the sensitivity of the electrodiagnostic studies are not complete. Therefore, solid diagnostic tools, which will guide the treatment and allow for the staging are required. Particularly, making CTS diagnosis through imaging methods is the most ideal one [10].

It is reported that ultrasonography yields the same results with the electrodiagnostic tests in CTS diagnosis through the ultrasonography studies performed measuring the median nerve section in carpal tunnel proximal, inside and outside, its specificity and sensitivity values are similar to electrodiagnostic tests and is very helpful in terms of treatment planning in case of the presence of occupying mass and tenosynovitis within the carpal tunnel. It is noted that magnetic resonance imaging (MRI) gives objective and typical morphological data in the diagnosis and staging of the CTS and accordingly is helpful in guiding the treatment. MRI, an expensive and difficultly accessible method, is considered a useful examination method in the event that MRI clinical findings and/or electrodiagnostic test results are not satisfactory [31, 10]. Also, MRI is very beneficial in understanding the residual problem in operated patients who made insufficient improvement or didn't show improvement at all. Insufficient loosening of the transverse carpal ligament, the compression of the scar tissue on median nerve can be imaged with MRI [10]. MRI shows maximum benefit in defining the occupying lesions within the carpal tunnel. These may be flexor tendon tenosynovitis or ganglion, lipoma or granulomatous infections. MRI is one of the most sensitive and specific diagnostic tools in cases with signs, in patients for whom correlation with age and/or profession was not established and in cases secondary to the unilateral or occupying masses within the carpal tunnel and in median nerve anomalies [10].

Methods:

In carpal tunnel syndrome treatment, it is aimed to decrease pain and paraesthesia, maintain and increase the muscle strength and maintain hand functions. In the treatment, medical and physical therapy are prioritized and secondarily surgical treatment is applied. Intermittent parasthesia or pain, incapacity, positive proactive tests,

hypersensitivity to 256 cps is present at beginning or early compression period when epineural blood circulation disorder leading to decreased axonal transport was present and there were no morphological changes. Conservative treatment is preferred in those patients. In moderate compression in which there is a fixed inhibition in intraneural microcirculation along with epineural and intrafascicular edema and in which intraneural fibrosis can also be seen, decreased vibratory sense, positive proactive tests, tenar weakness, abnormal sensation complaints are present. Long lasting epineural edema might be followed by endoneural edema and fibrosis and fiber loss might happen. In such a serious compression: EMG indicates denervation potentials in the muscles innervated by the median nerve. Persistent sensual changes, 2-point discrimination over 4 mm, thenar atrophy are present [3].



Fig. 6: Occupying mass in MRI T1-weighted coronal and axial section is observed and the mass extends to carpal tunnel and exerts compression on the median nerve.

General approach in the treatment of entrapment neuropathology is the removal of two compressions through surgery. Surgery indication time is important accordingly. The compression of the patients before third period (neurological findings period) is promising. The results obtained with the surgical approaches performed within the third period might not be satisfactory because the construction resulting from the fibrosis within the epineural perineural tissues of the nerve might block the passage of the regenerated fibers that will come from the proximal [55]. On the other hand, in addition to the localized axonal degeneration, atrophy might develop in the nerve fibers in the distal of the compression. In this case, a delayed decompression surgery can be beneficial as the solidness of the fibers in the distal of the compression [55]. Despite the fact that not many procedures are performed in CTS as surgical treatment, and mostly surgical decompression operations or physical treatment and rehabilitation measures are taken, it would be beneficial to dwell upon treatment principles [55].

Medical treatment can be applied in the following cases:

1. The patients with pretty moderate symptoms and without objective neurological sign.
2. The patients with intermittent symptoms and showing spontaneous improvement.
3. The situations in which the disease will be treated with a special treatment due to systemic disease. For example myxedema.
4. Pregnancy CTS.
5. The patients for whom surgical intervention might be risky and very old patients.
6. If there is a total median paralysis at the later stages of the CTS, and total degeneration was detected in the nerve electrophysiologically and there is no pain and parasthesia in the patients, in such cases, it is very clear that mostly compression in the surgery will not yield fruitful results [55].

Protective methods can be listed as follows:

1. Decrease in daily hand and arm activities.
- 2 Splinting the wrist from the volar side.

To this end, a solid paperboard is placed in the middle parts from carpal surface to front arm and is wrapped or a special orthopedic volar splint is made. Especially with this method, localized compression is decreased since this method limits wrist flexion. Since the pain becomes severe at night, it is recommended to use this splint at night for some patients. Wrist splint is used for a few weeks. If the symptoms continue or intensify, local steroid injection or perioral anti-inflammatory treatment is performed [55].

Medical Treatment:

Perioral corticosteroids or non-steroid anti-inflammatory medicines can be tried for a short time when wrist splint is used. If they don't provide a significant improvement after the treatment of a couple of weeks, it shouldn't be used anymore. In some patients, pain and paraesthesia can increase in pre-menstrual periods. In these cases, diuretic medicines might be administered [46, 20, 55].

Local Corticosteroid Injections:

Steroid injections localized in the wrist canal can provide an improvement for a couple of weeks and months. However, this method is not curative. It has risks and complications. It should be tried in patients with objective neurological findings. Injection should not be performed in the patients with swollen wrist. Hydrocortisone or methyl prednisolone is commonly used. % 1 1-2 cc methyl prednisolone (20 mg) and lidocaine (Xylocaine) mixture is injected. It is injected just above the carpal tunnel in the wrist with a needle No. 25. Injection should not be performed into the transverse carpal ligament. As it is unnecessary and might be severely painful. Injection is performed above the wrist line transversely and ulnar lateral of the palmaris longus tendon. The solution administered this way flows into carpal tunnel from the proximal. Generally, single injection is sufficient. Multiple injections should be avoided. Pain and paresthesia recur within a few weeks and after 6 months [46, 20, 55].

Surgical intervention:

In moderate and severe compression, surgical treatment is preferred. Surgical methods are as follows:

1. Open surgery with standard incision
2. Microsurgery
3. Endoscopic surgery.

The only established and effective method to be applied in the majority of the CTS patients is compression in the surgery. If the methods above are not effective, if the signs progress, if neurological signs are present, very clear and explicit conduction abnormalities are present, if the CTS symptoms cannot be eliminated with the treatment of the systemic disease, surgery is the only method. The principle in the surgery is completely exploring the carpal tunnel and carpal tunnel ligament and to decompress the whole canal with a curved longitudinal incision. Under these conditions, surgery is promising. Pain and paraesthesia go away easily. Motor and sensorial neurological signs become normal in time and in a slower way. The failure of the surgical intervention might result from the insufficient incision of the transverse carpal ligament in the incision performed transversely and vertically, the incision of the palmar motor branch of the nerve, the occurrence of the abnormal scarification in the peripheral tissues. Surgical failure manifests itself in the following ways:

- 1) The symptoms persist despite the surgery.
- 2) Similar symptoms recur after a certain improvement.
- 3) New symptoms replace the previous ones postoperatively [46, 20, 55].

Non-operative surgery alternatives are as follows:

- Wrist splint in neutral position
- Local steroid injection into the carpal tunnel
- Non-steroid anti-inflammatory drugs
- Physical treatment agents
- Iontophoresis
- Vitamin B 6 - B 12
- Chiropractic
- Patient education
- Rehabilitation applications.

Immobilizing the wrist at the neutral position elevates the carpal tunnel space to maximal, decreases the compression and enables symptomatic improvement. Therefore, splint is recommended as the initial surgical alternative.

It was only found effective in early cases (first 3 months) and cases with mild symptoms and pregnant women. Splint is applied for 3-4 weeks, especially at nights and during the activities intensifying the symptoms. Post treatment recurrence rates with only splint application were reported as 34 - 90%. With the development of designs that are light, washable, and wearable all day long and limit the functions minimally, higher success rates are reported [3].

With regard to surgery, 2 incisions are performed in the approach that can be called as minimal invasive technique. In the first incision, subcutaneous tissue is opened with a 1 cm vertical incision at the junction point of the line starting from the radial side of the ring finger and tiger stripes, palmar aponeurosis is passed and distal end of the transverse carpal ligament and fatty tissue are seen. Median nerve is opened by incising the distal end of the transverse carpal ligament. Secondly, an incision 1 and 1.5 cm approximately is used at the distal wrist line in which the line is inside. While the incision is performed, palmaris longus tendon lateral is not reached.

Upon completing the incision, transverse carpal ligament is opened, scraping the palmar fascia and excluding the palmaris longus tendon to the radial side. Median nerve is found, opening the ligament and ligament and palmar fascia is incised and median nerve is relaxed in the proximal primarily. Later, transverse carpal ligament is incised via sharp and tin pin Matzenbaum scissor starting from the sub-wrist line until wrist and median nerve is relaxed. Transverse carpal ligament is incised in the ulnar side of the median nerve through wrist. While the distal end of the ligament is incised, it is understood that the scissor end is relieved. Later, whether the ligament was incised completely or not, is controlled with clamp end and nerve hook. Patients with very thick ligament may experience discomfort while the distal end is incised. Hemostasis should be ensured with the compression performed in the palm for a couple of minutes. After the operation is completed, abductor strength of the pollicis brevis and other flexors, sensation field in the tenar area should be controlled [3].

Conservative Treatment:

Even though surgery is applied in many patients, conservative treatment has a place in the CTS. A clear benefit of the nonsteroid anti-inflammatory drugs has been identified. The most commonly applied method in conservative surgery is splinting of the wrist. The point that should be underlined here is that ready-to use splints are in 30 degree extension, which is the functional usage position of the wrist, and that this extension results in many disadvantages rather than advantages because this extension increases the carpal tunnel pressure, which is known to increase in CTS. With regard to the splints used in the neutral position where the carpal tunnel pressure is the lowest, it is convenient to use these splints only nocturnally since they limit the wrist functions. Yet another method, which is commonly used, is decreasing the pressure within the tunnel through corticosteroid injection into the carpal tunnel. However, the efficiency of this method is limited since the signs recur within a short time. Corticosteroid injection can be used in early period patients with mild involvement who does not have permanent injury on the nerve tissue with the aim of eliminating the signs for a while. Another conservative method, which is used more and more lately is the exercises that help nerves and tendons gain mobility. It is aimed to help the tendons and median nerve gain the distal and proximal sliding movement through these exercises, and it is noted that recovery rate in the patients on whom these programs are applied is high. In advance cases or in case that do not respond to the conservative treatment, CTS treatment is surgical median nerve relaxation. Open and endoscopic methods are used with incisions of various sizes for carpal tunnel relaxation, but what's more important than the method used or incision is performing the carpal tunnel relaxation completely and without damaging any tissue fiber. Pneumatic tourniquet use, regional intravenous anesthesia instead of local or general anesthesia or axillary block application is recommended [10].

MATERIAL AND METHOD

We included 186 patients with moderate (122 patients) and advance (74 patients) carpal tunnel syndrome in our study. We treated them at different in different times. 143 of our patients are female and 43 of them are male. The average age of our patients is 54.8. At least 86% of our patients have pregnancy history. 91% of our patients are able to do their housework (which necessitates hand usage) and perform work, which requires the usage of hands. 16 patients have undergone surgery in different health care facilities in association with carpal tunnel syndrome, but they couldn't obtain good results. Fracture history was present in 24 patients at the same wrist. 18 patients have romatoid arthritis, and were diagnosed and received treatment.

None of our patients responded to the conservative methods for various reasons. All patients underwent wrist graphs and ultrasonography examination. All patients were diagnosed with moderate and advance CTS through examination findings, tests and EMG test. Upon making the precise diagnoses of all patients in the polyclinic, their standard blood tests are performed and they are referred to outpatient clinic. Prophylactic antibiotics were administered to all patients.

Wrists braces of all patients with carpal tunnel syndrome were prepared in a sterile way. Tourniquet application was performed. Serum was diluted physiologically, and local anesthesia was applied, performing xylocain infiltration. The procedure was performed subcutaneously with a vertical incision of 2 cm performed above the carpal tunnel, and automatic skin ecarteur was placed in a way that encompasses the subcutaneous parts, and in this way subcutaneous bleeding control and ecartation was achieved. After finding the median nerve from the distal, transverse carpal ligament was loosened at total vertical axis protecting the nerve. Free ends of the ligament were resected in order to prevent adhesion. In cases with hardened nerve sheath, the sheath was relaxed by protecting the nerve fibers in the vertical axis. Control was achieved by helping the patient make finger moves. Thenar motor branch of the median nerve was controlled. After bleeding control, skin and subcutaneous parts were closed primarily with a 3/0 vicryl suture. Compressive bandaging was performed on all patients without making detection and active movement had just started. Patients were followed up from the clinic and all of them recovered. No problem including the scar complication was observed in our patients.

Discussion:

Carpal tunnel syndrome is a term used for defining a set of the signs and findings resulting from the compression on median nerve at wrist level. CTS is a commonly seen neuropathy resulting from the compression of the median nerve in the carpal tunnel and can lead to pain, paresthesia and hypoesthesia in hand [2]. Conservative and surgical alternatives are present for its treatment. A study conducted in the US revealed that CTS prevalence in overall population is approximately 37.2%⁵. The only established and effective method that can be applied in patients with CTS is surgical decompression [46, 20, 55]. Therefore, the method we applied without interrupting the social life of the patients and need for hospital stay and cheaply is beneficial in many respects.

Majority of our patients are at moderate level (according to EMG test). We think that neural sheath loosening that we applied in patients with advance CTS yields fruitful results. Also, it is of importance that our patients don't have nerve involvement secondary to coexisting metabolic disease for obtaining positive results. We identified that 16 patients on whom we applied revision were not exposed to surgery-associated trauma. We didn't observe synovial involvement in carpal tunnel in patients with romatoid arthritis.

We think that making postoperative movement limitation in our patients is important for early rehabilitation without the need for physical therapy.

Low mean average (54.8) and non-inclusion of old aged patients are the limitations of our study.

Non-inclusion of CTS diseases secondary to metabolic diseases is the limitation of our study.

Even though there are 24 patients with wrist fracture history in our study, we identified that in the surgery of these patients, canal anatomy associated with wrist fracture is not affected. In these patients, transverse ligament might be affected associated with the trauma.

We believe that sheath loosening that we apply in patients affected at a high rate is very helpful, but all nerve interventions can be applied on all nerve layers microscopically.

Our study was conducted by the same surgeon without involving a variety of patients with regard to the demographic features. This is the limitation of our study. However, its practical application, that it does not isolate the patients from social life and obtaining positive results are important.

Conclusion:

Treatment of carpal tunnel syndrome, a condition commonly seen among women is of great importance. Rather than the reasons, treatment should be well planned. Since the conservative methods generally ensure short-term relaxation, we obtain the best results in patients with moderate and advance level of CTS with surgical applications. Performing the surgical applications in the way we elaborated in the study consisting of 186 patients with local anesthesia and without a serious risk and hospitalizing those yields the quickest and best results in terms of the doctor and the patient. We believe that multi-centered studies including comprehensive CTS patients and patients from all age spectrums, and evaluating different applications are required for various reasons.

Contribution of Authors:

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