T.C.

YEDİTEPE UNIVERSITY

INSTITUTE OF HEALTH SCIENCES

DEPARTMENT OF PHYSIOTHERAPY AND REHABILITATION

COMPARING THE EFFECTIVENESS OF MANUAL NEURAL MOBILIZATION AND CONVENTIONAL PHYSIOTHERAPY AND REHABILITATION AMONG PATIENT WITH CARPAL TUNNEL SYNDROME

MASTER THESIS

ŞEYDA AKSAKAL, PT

İSTANBUL – 2020

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ŞEYDA AKSAKAL, PT

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Prof. Dr. FERYAL SUBAŞI, PT

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	Title, Name-Surname (Institution)
Chair of the Jury:	Prof. Dr. Serap İNAL (İstinye University)
Supervisor:	Prof. Dr. Feryal SUBAŞI (Yeditepe University)
Member/Examiner:	Dr. Çiğdem YAZICI MUTLU (Yeditepe University)
Member/Examiner:	Asist. Prof. Dr. Yasemin ÇIRAK (İstinye University)

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This thesis has been deemed by the jury in accordance with the relevant articles of Yeditepe University Graduate Education and Examinations Regulation and has been approved by Administrative Board of Institute with decision dated 02.10.2020 and numbered 2020/09-07.

Prof. Dr. Bayram YILMAZ
Director of Institute of Health Sciences

DECLARATION

I hereby declare that this thesis is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which has been accepted for the award of any other degree except where due acknowledgment has been made in the text.

05.06.2020

Şeyda Aksakal

DEDICATION

I would like to dedicate my thesis to my beloved and loving child İdil Aksakal.

ACKNOWLEDGEMENT

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LIST OF SYMBOLS & ABBREVIATIONS

CTS	Carpal Tunnel Syndrome
LASER	Light Amplification by Stimulated Emission of Radiation
TENS	Transcutaneous Electrical Nerve Stimulation
RCT	Randomized Clinical Trial
GSS	Global Symptom Score
SD	Standard Deviation
CBM	Carpal Bone Mobilization
VAS	Visual Analog Scale
BCTSQ	Boston Carpal Tunnel Syndrome Questionnaire
WHOQOL-BREF	World Health Organization Quality of Life Questionnaire
SPSS	Statistical Package Analyze for Social Sciences
IC	Intercarpal
RU	Radioulnar
CMC	Carpometacarpal
MCP	Metacarpophalangeal
DIP	Distal interphalangeal
PIP	Proximal interphalangeal
EMG	Electromyography
US	Ultrasound
MRI	Magnetic Resonance Imaging
CT	Computed Tomography
PSWD	Pulsed Shortwave Diathermy
CSWD	Continuous Shortwave Diathermy
MWD	Microwave Diathermy
LLLT	Low Level Laser Therapy
OCTR	Open Carpal Tunnel Release
ECTR	Endoscopic Carpal Tunnel Release
SSS	Symptom Severity Scale
FSS	Functional Status Scale
MNM	Manual Neural Mobilization

ENGLISH ABSTRACT

Aksakal, Ş. (2020). Comparing the Effectiveness of Manual Neural Mobilization and Conventional Physiotherapy and Rehabilitation among Patient with Carpal Tunnel Syndrome. Yeditepe University, Institute of Health Sciences, Department of Physiotherapy and Rehabilitation, MSc. Thesis. Istanbul 2020.

The aim of this study is to compare the effectiveness of manual neural mobilization and conventional physiotherapy and rehabilitation among patient with CTS. The study was performed between January 7th and June 1st of 2019 in Kocaeli. The study included 22 volunteer women with carpal tunnel syndrome aged between 30 to 60 years. The Group 1 (n=11; 50,45 ± 5.83 years) received manual neural mobilization and home exercises 5 times a week for three weeks. The Group 2 (n=11; 49,81 ± 8,75) received conventional physiotherapy and rehabilitation and home exercises 5 times a week for three weeks. All patients were evaluated before the intervention and after three weeks of treatment. The pain status of patients was evaluated by Visual Analog Scale (VAS) and also handgrip with Jamar hand dynamometer and pinch strength with Jamar hydrolic pinch gauge was assessed by the investigator. Besides, Boston Carpal Tunnel Syndrome Questionnaire was used to assess symptom severity and functional status. Furthermore, World Health Organization Quality of Life Questionnaire was used to assess quality of life patient with CTS. The main outcome of this study is that both treatment options are effective in reducing pain, increasing hand grip strength, alleviating symptoms, improving functional activities and also quality of life. According to our results, there was no statistically meaningful difference between these two treatment options except some parameters. In terms of left hand grip strength patients who treated with conventional physiotherapy and rehabilitation had statistically shown more improvement than patients who treated with manual neural mobilization. In addition, manual neural mobilization improved functional activity compared to conventional physiotherapy and rehabilitation. In conclusion, the present study revealed that manual neural mobilization and conventional physiotherapy and rehabilitation were effective in treating mild to moderate level of patients with CTS.

Key words: manual neural mobilization, conventional physiotherapy, carpal tunnel syndrome

TURKISH ABSTRACT

Aksakal, Ş. (2020). Karpal Tünel Sendromu Olan Hastalarda; Manuel Nöral Mobilizasyon ve Konvansiyonel Fizyoterapi ve Rehabilitasyonun Etkinliğinin Karşılaştırılması. Yeditepe Üniversitesi Sağlık Bilimleri Enstitüsü Fizyoterapi ve Rehabilitasyon Yüksek Lisans Programı. Yüksek Lisans Tezi. İstanbul 2020.

Bu çalışmanın amacı karpal tünel sendromu olan hastalarda manuel nöral mobilizasyon ve konvensiyonel fizyoterapi ve rehabilitasyonun etkinliğini karşılaştırmaktır. Bu çalışma 7 Ocak- 1 Haziran 2019 tarihleri arasında Kocaeli'nde yapılmıştır. Bu çalışmaya 30 ile 60 yaşları arasında karpal tünel sendromu olan 22 gönüllü kadın katılmıştır. Hastalar rastgele olacak şekilde iki gruba ayrılmışlardır. Birinci grup (n=11; 50,45 ± 5.83 years) manuel nöral mobilizasyon ile ev egzersizi, ikinci grup ise (n=11; 49,81 ± 8,75) konvensiyonel fizyoterapi ve rehabilitasyon ve ev egzersizi haftada beş gün ve üç hafta boyunca almışlardır. Hastalar tedavi öncesi ve üç haftalık tedavi sonrası değerlendirilmişlerdir. Araştırmacı tarafından hastaların ağrı durumları Vizüel Analog Skala (VAS) ile, el kavrama kuvveti Jamar el dinamometresi ve parmak kavrama kuvveti ise pinçmetre ile değerlendirildi. Ayrıca, semptom şiddetini değerlendirmek ve fonksiyonel durumun belirlenmesinde Boston Karpal Tünel Sendromu anketi kullanılmıştır. Ek olarak, karpal tünel sendromu olan hastalarda Dünya Sağlık Örgütü Yaşam Kalitesi anketi kullanılmıştır. Tedavi sonucunda ağrıyı azaltma, el kavrama kuvvetini arttırma, semptomların hafifletilmesi, fonksiyonel aktivite ve yaşam kalitesini iyileştirmede her iki tedavinin de etkili olduğu bulunmuştur. Bizim sonuçlarımıza göre, bazı parametreler dışında iki tedavi arasında istatistiksel olarak anlamlı sonuç bulunmamıştır. Konvansiyonel fizyoterapi ve rehabilitasyon tedavisi alan hastalar manuel nöral mobilizayon tedavisi alan hastalara göre sol el kavrama kuvveti açısından istatistiksel olarak daha anlamlı iyileşme göstermiştir. Ek olarak, manuel nöral mobilizasyon konvensiyonel fizyoterapi ve rehabilitasyonla karşılaştırıldığında fonksiyonel aktiviteyi daha fazla arttırmıştır. Sonuç olarak, bu çalışmaya göre manuel nöral mobilizasyon ve konvansiyonel fizyoterapi ve rehabilitasyon düşük ve orta düzeydeki karpal tünel sendromu olan hastaları tedavi ederken etkin olarak kullanılabilir.

Anahtar kelimeler: manuel nöral mobilizasyon, konvensiyonel fizyoterapi, karpal tünel sendromu

1. INTRODUCTION AND PURPOSE

Lots of people are influenced by compression neuropathies all over the world. These neuropathies happen due to mechanical active firmness of a brief part of a nerve while it transcends throughout a specific place [1]. Carpal tunnel syndrome is generally seen outermost neuropathy, affecting approximately three to six percent of adults in the general population with significant adverse effects on the quality of life of individuals [2]. Females are 3 times further probable to acquire carpal tunnel syndrome than males, and the incidence and harshness raises with lifetime [3]. No known cause of carpal tunnel syndrome arises furthermore widespread in females (65–80%) and between the ages of forty and sixty years; fifty to sixty percent of the subjects are bilateral [4].

CTS is indicating firmness disease of peripheral nervous system of the median nerve nearly wrist; described by manus ache, emotionlessness, and itching in the dissection of the median nerve (1.metacarpal, 2.metacarpal, 3.metacarpal, and the lateral side of the 4.metacarpal) and decline in hold power and also manus task [5]. Physical examination test, for example Tinel's sign, Katz Hand Diagram, Phalen's test, Tourniquet test, flick sign and also square wrist sign are helpful in deciding the identification. Nerve transmission applications and electromyography are able to determine investigative suspect. These diagnostic methods are able to determine the harshness of the disease. The harshness of indicators are divided into mild, moderate, and severe in a clinical manner. Treatment choices are based on the severity of disease [6].

There are many interferences that have been advocated to treat CTS, both conservative and surgical [7]. The treatment decisions are generally chosen relying on the harshness of nerve dysfunction and patient's preferences or needs. Surgical release is regularly applied and has conventionally been thought the accurate healing for mainly severe levels of CTS [8]. Conservative therapy for carpal tunnel syndrome is commonly believed rationalistic choice with beneficial results ranging from twenty to ninety three percent among patients with mild level to moderate [9].

The randomized blinded pilot study was researched by Casale et al was to contrast light amplification by stimulated emission of radiation against transcutaneous electrical nerve stimulation in lessening ache and tingling and also recovering pyramidal tract and extrapyramidal tract of median nerve transmission parameters. The results of

this study, LASER were superior than TENS in recovering both pain and tingling especially neurophysiological parameters in CTS [10].

The recent systematic review has investigated the efficacy of manus therapy interferences in fundamental administration of CTS. Based on results of randomized controlled trials showed that deep pulsed ultrasound was applicable in lessening pain, tingling and sensual deficit, and in recovering median nerve transmission and power. Two RCTs looking at nerve gliding found reductions in pain and raises in active ROM of wrist extension and flexion. Pinch grip strength was also progressed when splinting was added to nerve gliding and tendon gliding exercises [11].

Wrist orthosis is regularly suggested as a reasonably cheap technique for treating CTS. Brininger and co contrasted neutral wrist or MCP extension orthosis against wrist extension orthosis. Consequently, using neutral wrist orthosis was furthermore helpful in lessening indicators [12].

Surgical release and also steroid injection are broadly applied methods of management for CTS. Hui and the rest investigated a RCT of surgical release against steroid injection for CTS. Patients with CTS were monitored at 6 and 20 weeks. The initial consequences was to lessen signs with respect to the Global Symptom Score. It grades indicators on a ratio of zero (no symptom) to fifty (very terrible). Nerve transmission studies and grasp power assessments were used as another consequence evaluations. The findings of this study at 20 weeks following randomization, participants who experienced operation had larger indicative healing than others who were injected. The mean development in GSS after 20 weeks was twenty four point two (Standard Deviation 11.0) in the surgical release group against eight point seven (Standard Deviation 13.0) in the injected group ($p<0.001$); release operation also exhibited in larger enhancement in distal motor latencies of median nerve and sensual nerve transmission speed. Mean grasp strength in the release operation group was declined by one point seven kg (Standard Deviation 5.1) constrasted with a profit of two point four kg (Standard Deviation 5.5) in the injected group [13].

The study of Tal-Akabi and Rushton evaluated the usefulness of carpal bone mobilizing and neurodynamic mobilizing as management of CTS. No meaningful alteration among the 2 types of mobilization was revealed for recovering signs, ache,

hand task, actively movement of wrist, upper limb tightness test or requirement for operation after 3 weeks of treatment. Briefly, restricted proof advocates that there is no meaningful advantage of neural mobilizing over carpal bone mobilizing for recovering near-term results [14].

Baysal et al investigated three different therapeutic mixtures in the conservative treatment techniques of CTS. The mixtures contained tendon gliding and also nerve gliding exercises in mixture with wrist orthosis, US therapy in mixture with wrist orthosis and the mixture of US, wrist orthosis, and also tendon/nerve gliding exercises. All intervention groups, the therapeutic mixtures were meaningfully helpful instantaneously and eight weeks following therapy. The outcomes of the extended period of time participants gratification survey exhibited indicative enhancement was further perceptible in the group cured with orthosis, tendon/nerve gliding exercise and US therapy mixtures. The authors propose that a mixtures of wrist orthosis, tendon/nerve gliding exercise and US is a desirable and valuable non-surgical method of healing in CTS [15].

There are several healing options for soft to temperate levels of CTS containing splinting, electrotherapy, diuretics, oral steroids, NSAIDs, steroid injections, yoga etc. In our knowledge, there are lots of studies related to conservative administration of CTS and these researches were generally comparative investigations. However, these study plans are consisted of comparing one physiotherapy modality intervention to another, placebo versus control splinting, the placebo versus control steroid injections, the effectiveness of oral steroids. An additional trial is still essential to compare the efficiency of physiotherapy methods for patients with regard to CTS.

The target of our study is to contrast the efficacy of manual neural mobilization and conventional physiotherapy and rehabilitation on pain, daily living activities and muscle strength of hand among patients with mild level to moderate CTS.

This study addresses the **null hypothesis** (H0) that there is no difference between manual neural mobilization and conventional physiotherapy and rehabilitation or the **alternative hypothesis** (H1) that is the difference between manual neural mobilization and conventional physiotherapy and rehabilitation among patients with carpal tunnel syndrome.

2. LITERATURE REVIEW

2.1. Anatomy of hand and wrist

2.1.1. Bones

In Figure 2.1., The configuration of the hand is predominantly ascribed to the bones covering the human hand. The hand is consisted of 27 bones, largely separated into 3 groups called carpals, metacarpals and phalanges. The wrist of the hand involves a group of bones titled as carpals. Each carpal bone has its own unique characteristic that participate to a specific function in the wrist [16-17].

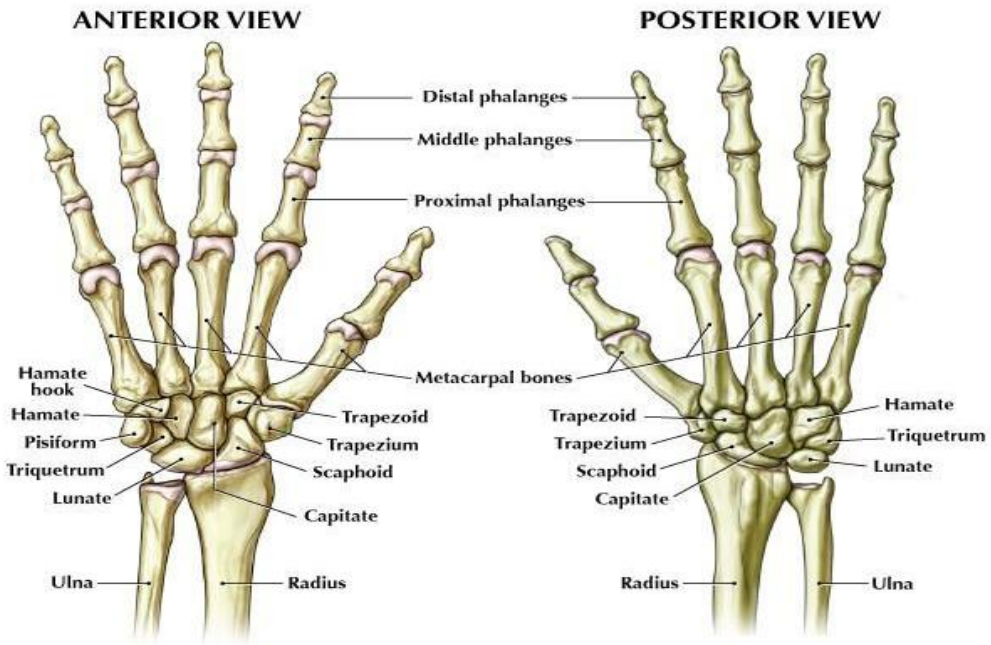

Figure 2.1. Bones of Hand and Wrist

- Scaphoid - prominent tubercle for the connection of flexor retinaculum; channel joint between two rows of carpals, taking most of the power transferred through the radius and often fractured in drops; proximal pole without its particular blood source in one-third of the population thus person to avascular necrosis after a fracture [18].

- Lunate - crescent shape; it is located between the scaphoid and the triquetrum and lies near the median nerve and it is dislocated frequently [17].

- Triquetrum - three-sided; pyramid-shape, with facet for articulation with pisiform [18].

- Pisiform - The name consists of the Latin pisum and formis, is the 4. proximal carpal bone, and it is believed by a few investigators as such a sesamoid bone because of its place in the tendon of the flexor carpi ulnaris (FCU) muscle. It is the only carpal bone that has a tendon attachment of a forearm muscle. The pisiform performs as a significant point of fixation of soft tissues [19].

- Trapezium - It meets at the base of the first metacarpal and is the most laterally positioned carpal bone in the distal line. There are communications with the scaphoid, trapezoid, and 1. and 2. metacarpals [20].

- Trapezoid - smallest bone in the distal line. The name is composed of the Greek trapezion, indicating "improper four sided." The lesser multangular bone communicates with the scaphoid, trapezium, capitate and 2. metacarpal [18-20].

- Capitate - head shaped, largest and middle part of carpals; communicates with seven other bones; intercarpal ligaments guided toward it [18].

- Hamate - hook-like hamulus and to protect for the ulnar artery and nerve, and also connection of flexor retinaculum. It communicates with the 4. and 5. metacarpals, capitate, and triquetrum. The crook is placed distally part of the palmar side, and serves as an attachment of the transverse carpal ligament [18-20].

Metacarpals are the middle part of the fingers and the wrist. This group of bones creates the central part of the hand called the palm. The metacarpals are five in number and are named as:

- Thumb (First MC)
- Index digit (Second MC)
- Middle digit (Third MC)
- Ring digit (Fourth MC)
- Little digit (Fifth MC)

The resting 14 bones are called phalanges. These are called as follows:

- Proximal
- Medial
- Distal [16]

2.1.2. Muscles and tendons

In Table 2.1., Lots of muscles of hand and wrist recline in the forearm and, tapering into tendons, traverse the wrist to attain supplements in the bony or ligamentous components of the hand. In Figure 2.2., The flexors arise from the medial epicondyle of the humerus, or from neighboring and volar aspects of the radius and ulna, and then course depressed the inner of the forearm. They are, hence, in side supinators of the forearm. In Figure 2.3., The extensors of the wrist and digits derive from the lateral epicondyle and portions of the ulna, pass down the dorsal margin of the forearm, and thus maintain in pronation. The thumb reveals in the general flexor-extensor pattern, but its extensors and abductors derive from mid and distal margins of radius and ulna [21].

Table 2.1. Muscles of The Hand and Wrist

ADQ Abductor digiti quinti	ECRB Extensor carpi radialis brevis	EPL Extensor pollicis longus	FPL Flexor pollicis longus
AP Adductor pollicis	ECRL Extensor carpi radialis longus	FCR Flexor carpi radialis	I Interosseus
APB Abductor pollicis brevis	ECU Extensor carpi ulnaris	FCU Flexor carpi ulnaris	L Lumbricalis
APL Abductor pollicis longus	EDC Extensor digitorum communis	FDP Flexor digitorum profundus	ODQ Opponens digiti quinti
APO Adductor pollicis oblique	EDQP Extensor digiti quinti proprius	FDQB Flexor digiti quinti	OP Opponens pollicis
APT Adductor pollicis transversus	EIP Extensor indicis proprius	FDS Flexor digitorum sublimis	PL Palmaris longus
DI Dorsal interosseus	EPB Extensor pollicis brevis	FPB Flexor pollicis brevis	Volar interosseus

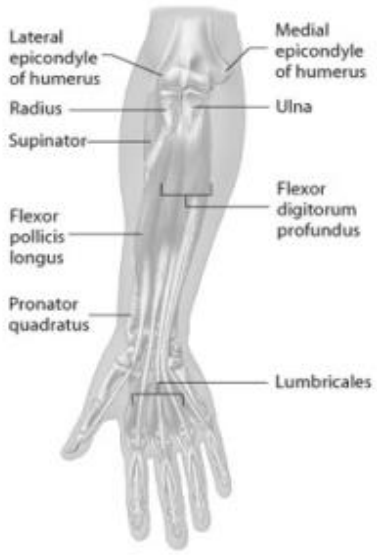

Figure 2.2. Flexors of Wrist and Digits

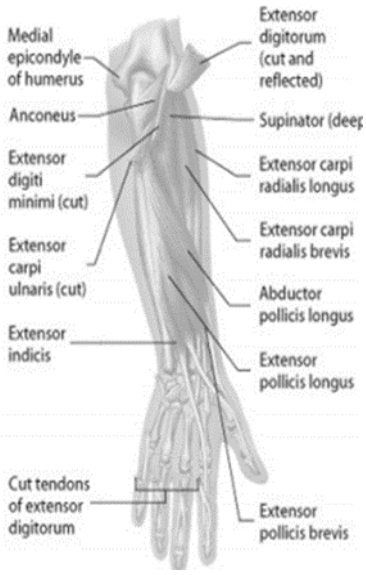

Figure 2.3. Extensors of Wrist and Digits

2.1.3. Joints and ligaments

The wrist joints are described as:

The radiocarpal articulation is a diarthrosis comprised of the communication between the distal radius and the scaphoid, lunate, and triquetrum in addition to the soft tissue arrangements that keep the joint collectively [22].

The intercarpal joints are linking the bones within each line. The IC articulations, the most vital is the midcarpal joint, created linking proximally and distally of the wrist, complete of the pisiform. There are 3 proximal bones who create a hole for the unciform bone and caput of the largest carpal bone. The scaphoid communicates the trapezium bone and trapezoid bone. The pisotriquetral joint is a minor diarthosis articulation [23].

Between the caput of the ulna and the ulnar notch of the radius, there is distal radio-ulnar joint which is a hinge articulation. The articular disc is a robust, three sided and also fibrocartilaginous plate. The articular disc's bottom is attached o the radius, and its top to the origin of the ulnar styloid process. Supination and pronation are the motions at the distal RU joint [23-24].

The RC and midcarpal joints are condyloid joint; so their motions are fundamentally flexion/extension, abduction and also adduction, and mixtures of these

movements. The motions are constructed by the exterior hand muscles: the main flexors are the FCU and FCR; the extensors are the ECRL and brevis and the ECU; the main abductors are the FCR and ECRL and brevis; the adductors are the ECU and FCU [23].

In Figure 2.4., The medial four carpometacarpal joints are arthroidal articulations. The CMC joint of the first metacarpal involves the articulation among the bottom of the thumb and the distal line of the lesser multangular bone. Three other neighboring articulations are functionally related to this joint, which involve the joints between the lesser multangular bone and the scaphoid, the lesser multangular bone and the trapezoid, and the bottom of the 1.metacarpal and the radially of the base of the second metacarpal. The CMC joint of the first metecarpal is also a sellar articulation [23-25].

The metacarpophalangeal joints act as essential task in the functional unit of the manus function. The MCP articulation of the 1.metacarpal is anatomically alike in cooperation its structure and function with the MCP articulations of the other fingers; on the other hand, dissimilarities occur and may be noticed where applicable. The 1.metacarpal of MCP articulation is a ginglymus and permitting only eighty to ninety degrees of flexion with smallest extension and also abduction/adduction [26].

In figure 2.5., The metacarpophalangeal (MP) articulations are condyloid, and the IP joints are ginglymus, although their ligamentous placements are alike. Each capsule is reinforced by a collateral ligament on each side, and the two ligaments fuse on the anterior part of the joint to shape a dense, fibrous or fibrocartilaginous pad termed the palmar ligament. The 4 medial metacarpals are kept collectively by a deep transverse metacarpal ligament related in front to the lumbrical tendons and behind to those of the interossei [23].

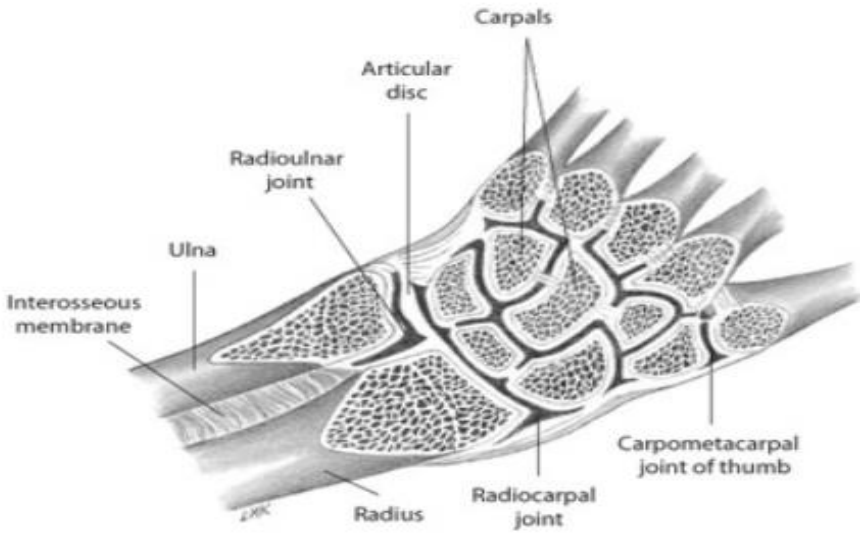

Figure 2.4. Joints of Hand and Wrist

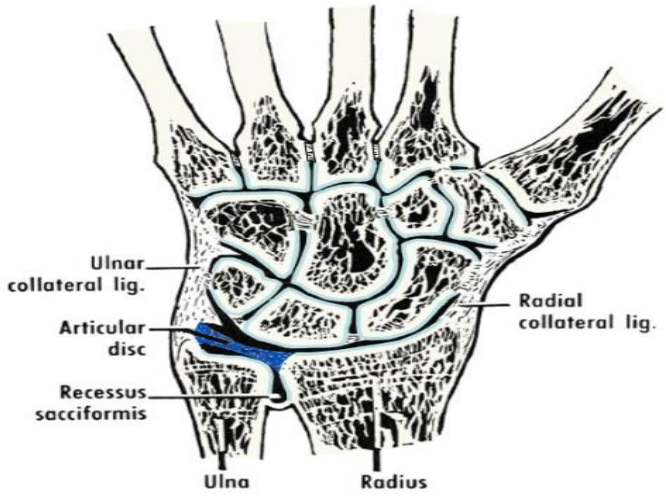

Figure 2.5. Ligaments of Hand and Wrist

2.1.4. Nerves

The cutaneous innervation of the hand is formed primarily by the terminal divisions of three nerves: the median, the radial, and the ulnar. Each of these nerves is formed proximally by the brachial plexus, which arises from the cervical root levels C5 to T1. These nerves course through the axilla and various compartments of the arm and forearm until reaching the wrist where the sensory and motor branches of each nerve distribute throughout the hand. Both the radial and median nerve receive and send input

via each brachial plexus level C5 to T1 while the ulnar nerve receives and sends inputs via just the C8 and T1 spinal levels [27].

The median nerve delivers sensual innervation for the skin of the palmar part of the 1.metacarpal, 2. and 3. metacarpal and the radially of the 4. metacarpal. The median nerve additionally supplies the dorsal side of the first 3 fingertips. The ulnar nerve offers sensual innervation to the palmar part of the 5. digit in addition to the palmar-ulnar portion of the 4. digit. The radial nerve innervate the dorsal shell of the laterally of the palm as well as the lateral 3 and half digits [28].

2.1.5. Blood supply and drainage

In Figure 2.6., The radial and ulnar arteries nourish the hand. These arteries arise from two palmar arterial arches and one dorsal carpal arch. The divisions of these lines have numerous connection, so arterial collateralization in the hand is gorgeous [29].

The ulnar artery arrives the hand with the ulnar nerve by transitory lateral line to the pisiform and medial line to the crook of the hamate (Ulnar tunnel). The superficial divisison brushes laterally beyond the palm and is the main supplier to the superficial palmar arterial line. The deep portion of ulnar artery passes through the hypothenar division and then turns laterally to fulfill the deep palmar arterial line with the deep portion of the radial artery. Both the radial and ulnar arteries have dorsal carpal divisions that congregate on the dorsum of the hand to form the dorsally carpal line, along with divisions of the anterior and posterior interosseous arteries [29].

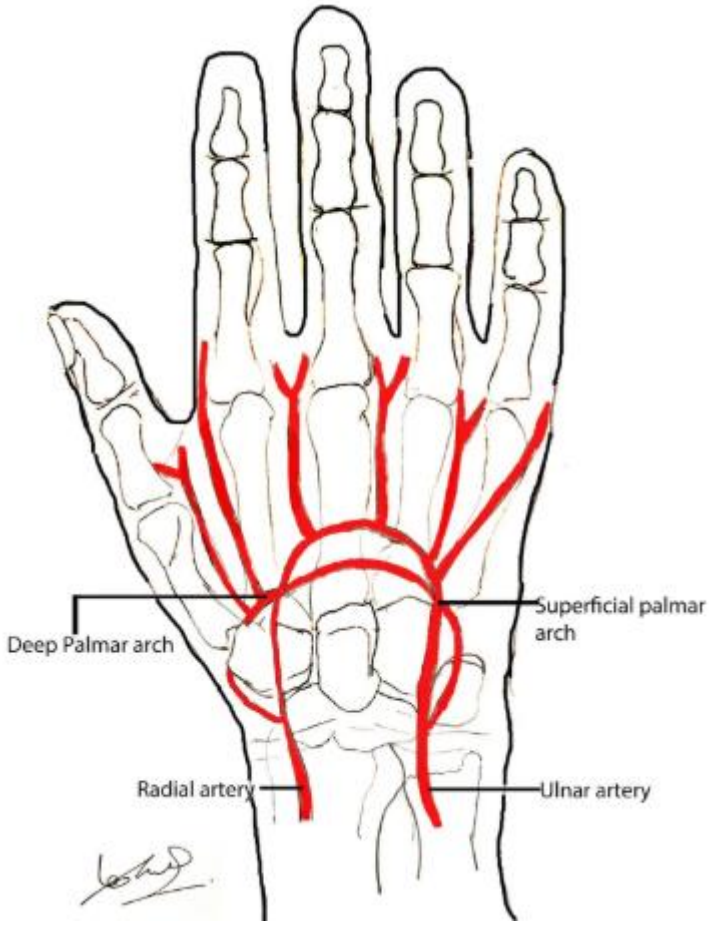

Figure 2.6. Blood supply of the hand

2.2. Biomechanical motions of human hand

The wrist is multifaceted joints in the hand anatomy that involves the RC, MC, and distal RU joints. It permits 6 axis all round movements, containing flexion/extension, pronation–supination, radial/ulnar deviation and circumduction. The wrist attachess the manus and the antebrachium to transfer and deliver the weight among the 2 elements. It may offer firmness of the antebrachium and manus [30].

In its most basic arrangement, the hand consists of a constant wrist with 2 digits, at the smallest, that is able to resist each other with some force. Preferably 1 or 2 of the digits are ability to movement so holding can be achieved. In its slight form, one digit can be constant with 1 digit having the movement to transfer against that firm position. Fingers profit from having feeling and from living painless so that their practice is assisted. As concerns biomechanical movement, the hand has seven maneuvers that set up most hand tasks [31].

- Terminal pinch between the thumb and index finger needs synchronized movements of these digits for reliable duty performance. For example, a pen can be grasped [32].
- The subterminal pinch is the characteristic of human hand task. Opposition results from coincident motions in various routes at the CMC, MCP and IP joints [33].

- Lateral pinch is when the first metacarpal is adducted to the radially of the second metacarpal's middle phalanx. The lateral pinch does necessitate a constant position, which in this place is really the second metacarpal. It also needs a satisfactory length of the finger and a MCP joint, which is abity to resisting first metacarpal adduction [31].

- The chuck grip permits the 2. metacarpal, 3.metacarpal, and 1.metacarpal to organized to enclose a tube-shaped item. A rotational motion and axial power is usually applied to the item when using this type of grip [31].

- The hook grip, all digits transfer except 1.metacarpal, ending position of 2.metacarpal, 3., 4. and 5. metacarpals are same as grasping mode [34].

- In the power grasp position, all digits grasp, the finish point is when 1.metacarpal tip meet the 2. and 3. metacarpal tip [34].

- The span grasp position is when the distal interphalengeal joints and the proximal interphalengeal joints flex to nearly 30° and the fisrt metacarpal is palmarly abducted such that power is generated among the first metacarpal and digits. This position differs from the power grasps positions whereby power is generated among the digits and the palm. Constancy is required at the 1.metacarpal, metacarpophalangeal, and interphalangeal joints. This kind of grip is used to hold such as a ball [31].

2.3. Anatomy of carpal tunnel

In Figure 2.7., The carpal tunnel is an osteofibrous channel positioned in the palmar wrist. It moves along the inside of the wrist to the base of the hand and is enclosed by a robust, fibrous band made up of connective tissue, described the flexor retinaculum. The edges are the carpal bones composing the bottom, and the flexor

retinaculum composing the top. The flexor retinaculum is about three to four cm width. It enters into the scaphoid tuberosity and into the pisiform proximally and consequently into the trapezium and the crook of the hamate distally. On the laterally, it splits into two stratums, a superficial stratum and a deep stratum to adjust the tendon of the FCR [35].

The carpal tunnel is a corridor inner side of the wrist that is encircled by bones and connective tissue. The carpal tunnel involves tendons and the median nerve. Besides the median nerve, the tunnel includes 9 tendons: the FPL, the 4 FDS and the 4 FDP. The median nerve is responsible for feeling and motion in the ball of the first metacarpal and some portions of the hand. If the tissue inner the carpal tunnel increases with swelling, it can put heaviness on the median nerve, which is what induce CTS [35].

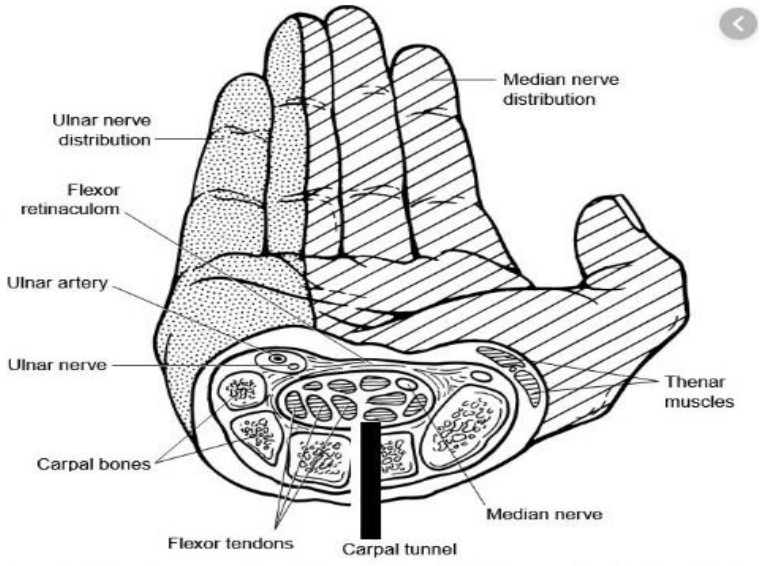

Figure 2.7. The Structures of Hand and Wrist

2.4. Carpal tunnel syndrome

In Figure 2.8., CTS is firstly defined by Paget in 1854 [36], Carpal tunnel syndrome is the largely familiar and recurrent type of median nerve compression neuropathy. Also, it accounts for ninety percent of all entrapment neuropathies. CTS is a continuous focal entrapment neuropathy initiated by a heaviness raising inner side non bending anatomical arrangement. However the borderlines of the tunnel are no articulation with the encompasing tissues and tissue heaviness in the tunnel is larger in

patients with CTS (thirty-two to hundred and ten mm Hg), bounding up with wrist location) versus in normal wrists (two to thirty-one mm Hg) [37]. Physiological proof implies raised heaviness within the tunnel. Additionally, function of the median nerve at that point lessens. Heaviness is increased by wrist motion which is flexion/extension and digit flexion [38].

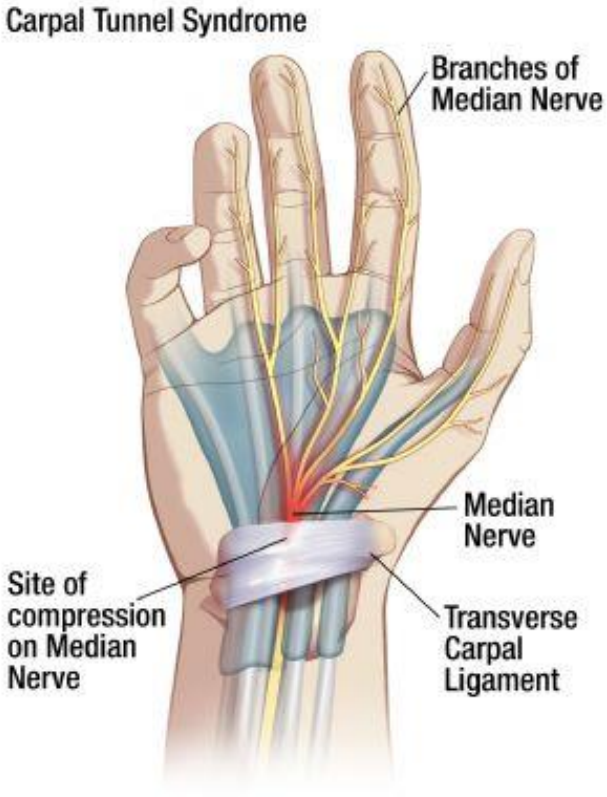

Figure 2.8. Carpal Tunnel Syndrome

2.4.1. Etiology

There are 2 discrete diversities of CTS – acute type and chronic type. The acute type is moderately infrequent and is caused by a quick and continuously increase of heaviness in the tunnel. It is also interrelated with burnings, disorder of blood clotting, infections and also injections. The chronic type is universally familiar and indicators are able to keep on for months to years. Although, only fifty percent of subjects are the reason defined and may be splited into local sources, regional sources and systemic sources as exhibited in Table 2.2. CTS is widespread in pregnant women. It is usually detected during the last three months of pregnancy and it is commonly seen in bilateral.

The greater part of subjects, indicators can mostly solve suddenly or can answer to non surgical management following delivery [39].

Table 2.2. Numerous Reasons of CTS

Local sources	Regional sources	Systemic sources
• Inflammation: For example; tendinitis, inflammatory condition caused by a fungus • Traumatic causes: e.g: Distal radius fracture, misplacement of the carpal bones • Tumors: e.g. Neuroma, cyst, haemangioma etc. • Structural abnormalities: e.g. Becoming thick TCL, bony anomalism, atypical muscle tissues etc.	• OA • RA • Amyloidosis • Gout	• Diabetes Mellitus • Overweight • Hypothyroid • Being pregnant • Finishing menstruation • SLE • Systematic sclerosis • Kidney failure • Long period of haemodialysis • MM • Sarcoidosis • Cancer of blood cells • Alcohol addiction • Bleeder's disease

TCL: Transverse Carpal Ligament OA: Osteoarthritis RA: Rhematoid Arthritis
SLE:Sytematic Lupus Erythematous MM: Multiple Myeloma

2.4.2. Epidemiology

Carpal tunnel syndrome is measured to happen in three point eight percent of the broad community with a larger occurrance rate in females (three to five point six percent) than males (zero point six to two point eight percent). Females with carpal tunnel syndrome experience three times futher than males. CTS is generally seen the ages between twenty five to fifty five years [40].

In the United States, CTS has an incidence of one to three subjects per thousand per year, with a occurrence of fifty per thousand, with alike incidence and prevalence in most developed nationalities. CTS generally influences whites, has up to a ten to one predominantly in females. It is the highest point the age of forty six to sixty [41].

2.4.3. Pathophysiology

The compression neuropathy associates happenings of firmness and traction. Nerve entrapment and traction might induce diseases within a neural microcirculation. They might cause lesions in myelinated sheath and axon, in addition to modificatons in the maintaining connective tissue. The entrapted peripheral nerve happens consequently its channel through an anatomical division that has reform too taut, following in changed task within the nerve and adversity of the nerve from the point of entrapment and beyond [42].

There are numerous elements in entrapment neuropathies that are connected to the nature of external power practice. The external squeezing can be performed in many ways involving: (a) a ground level power present for a long period of time; (b) an acute focal implement of a huge external power or (c) repetitive implement of short huge power. The squeezing may also be connected with a few mixtures of stretching, cutting and/or squuezing power implement. Median nerve compression in the tunnel at the wrist is such an illustration of this [43].

There are two point of median nerve firmness:

1) At the proximal margin of the tunnel, induced by wrist flexion and resulting from the modifty in denseness and stiffness among the forearm fascia and the proximal margin of the FR; and

2) At the smallest margin at the crook of the hamate. Standard heaviness in the CTS has been registered to range from two to ten mm Hg. Climactic alterations of the fluid heaviness in the carpal tunnel have been checked with wrist motions, with wrist extension raising the heaviness by ten times, and flexion raising it by eight times[42].

Bauman et al used a wick catheter to exhibit that the tunnel heaviness was larger patients with CTS than in good health participants. In neutral wrist positions, the mean heaviness that is recorded in the subject's carpal canal is thirty two mm Hg. When the wrist flexion is made, the heaviness raises a value of ninety four mm Hg. On the other hand, when the wrist extension is made, it is hundred and ten mm Hg. Pathological adjustments happening in the ligaments, enclosing nerves involving modifiations in the quantity and adjustibility of connective tissue are thought to be the basis for raised heaviness [42].

2.4.4. Symptoms

The indicators change depending upon the rigorousness of the illness. In initial phases, subjects often express of indicators because of the relationship of the sensual part of the median nerve and just terminal evaluations indicators from the participation of motor fibers [39]. Standard symptoms of CTS are displayed in Table 2.3.

The most observed indicator is burning ache related to itching sensation and reduced sensitivity in the divisions of the median nerve distally. The division of the manus included is typically the 1., 2. and 3. metacarpal, and radial half of the 4.metacarpal. Subjects are usually waked up by ache in the mid of the night and mention shaking their manus out of bed forcefully in order to lessen their pain. Patients might also mention ache, paraesthesia and reduced sensitivity of the whole hand, but thoughtful asking will determine that the 5.metacarpal which is innervated by ulnar nerve is infrequently influenced. Nevertheless, all 5 digits may be influenced as well as ulnar nerve damage. Indicators of night time tingling are described to be fifty one to ninety six percent sensitive and twenty seven to sixty eight percent specific. Lesser frequent indicators involve a sensation of lack of coordination and lack of strength in

the influenced manus that is usually made worse by hand function. Subjects might also express of spreading pain to the antebrachium, elbow and sometimes the shoulder. A few subjects also have shoulder pain and will never have any objective proof of sensual alterations [39].

Table 2.3. Standard Symptoms of Carpal Tunnel Syndrome [37]

- Dull, aching discomfort in the manus, antebrachium, or upper arm
- Tingling sensation in the manus
- Weakness of the manus
- Dehydrated skin, edema, or colour alterations in the manus
- Aggravation of symptoms by sleeping
- Aggravation of symptoms by continuous manus or arm arrangements
- Aggravation of symptoms by recurring motions of the manus or wrist
- Alleviation of symptoms by altering manus position or shaking the wrist

2.4.5. Diagnosis

In Table 2.4., First of all, the diagnosis of CTS is made up of physical examination and patient's history of indicators. It is essential to put in mind that not all wrist and digit pain is carpal tunnel syndrome. In addition, not all digit reduced sensitivity or paraesthesia is carpal tunnel syndrome [39].

There are several tests which use in the identification of CTS. Whichever these tests are indicative on their own. A mixtures of indicative tests, symptoms and signs should be assessed when the identification of carpal tunnel syndrome is performed. The physical findings are insufficient indicative value on its own [39].

Table 2.4. A useful parameters for identification of carpal tunnel syndrome

Patient history	Physical examination of the patient	Electrodiagnostic testing
• Characteristic symptoms and signs	• Gathering personal characteristics • Sensory examination • MMT of the upper arm • Provocative tests	• Nerve conduction studies • Electromyography (EMG)

MMT: Manual Muscle Testing

2.4.5.1. Clinical tests of physical examination

A entire evaluation of the upper extremity, involving shoulder, neck, elbow and also wrist, must be made to leave out other reasons. Most patients with initial phase of disease, mild level to moderate CTS may not usually show physical assessment signs. Additionaly, primary clinical examination can give a chance to examiners to seperate CTS than other situations [44]. Distinctive identification of carpal tunnel syndrome is shown in Table 2.5.

Table 2.5. Distinctive Identification of Carpal Tunnel Syndrome [4-7]

Situation	Features
CMC arthritis of the 1.metacarpal	Painfulness 1.metacarpal movement, + grind test, X-ray findings
Volar radial ganglion	Mass near base of 1.metacarpal, above wrist flexion crease
De Quervain tendinosis	Sensitivity on radial styloid distally
Peripheral neuropathy	Having diabetes mellitus; bilateral, lower extremity involvement
FCR tenosynovitis	Sensitivity near base of 1.metacarpal
Raynaud syndrome	Signs associated with cold contact, characteristic skin tone alterations
Ulnar compressive neuropathy	Tingling of the 4. and 5. metacarpals, + Tinel and compression tests
Vibration white finger	Use of vibratory hand power tools, symptoms of Raynaud syndrome
Wrist arthritis	Painful wrist movement, X-ray findings
Pronator syndrome	Antebrachium ache; sensual deficit in thenar distinction; weakness of 1.metacarpal flexion, extension movement of wrist and antebrachium pronation
Cervical radiculopathy	Neck ache, emotionlessness of the 1.metacarpal and 2.metacarpal only, + Spurling test

The various tests of physical examination are shown in Table 2.6. In addition, other tests are explained in the below.

Table 2.6. Clinical Tests of Physical Identification of CTS

Test	Method	Positive finding
Tinel's sign (Figure 2.9)	Tapping the area over and proximally to flexor retinaculum softly with the rubber hammer	Lack of sensation or electric like impression felt under or above the manus
Phalen's sign (Figure 2.9)	Wrist flexion ninety degree in unforced mode	Provocation of symptoms within one minute
Compression test (Figure 2.10)	Squeezing over the flexor retinaculum	Provocation of symptoms within one minute
Phalen's plus compression test	Squeezing over the flexor retinaculum while wrist flexion is made maximum reasonable with compression	Provocation of symptoms within one minute
Arm raising test	Elevating whole arm straight above the head	Provocation of symptoms within one minute

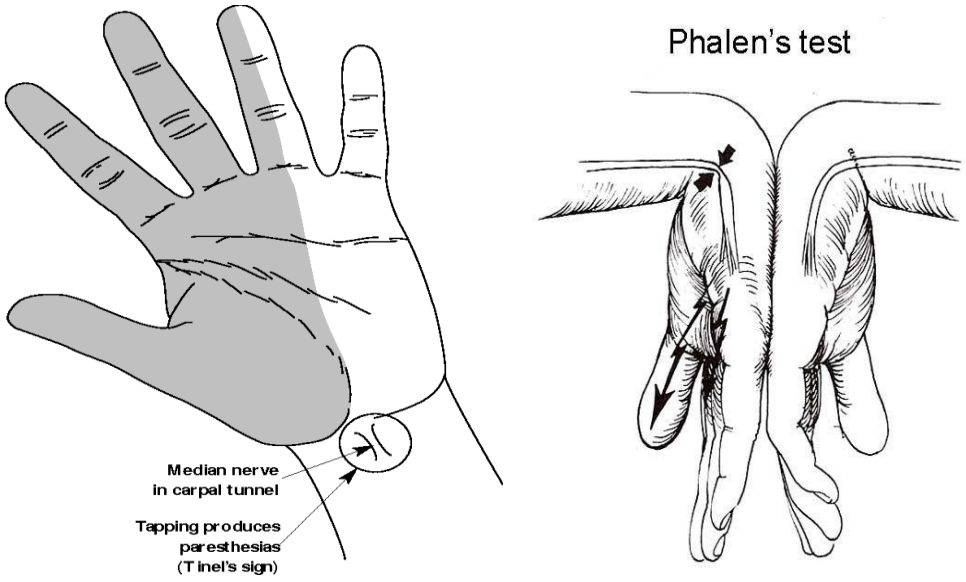

Figure 2.9. Tinel Sign and Phalen's Test

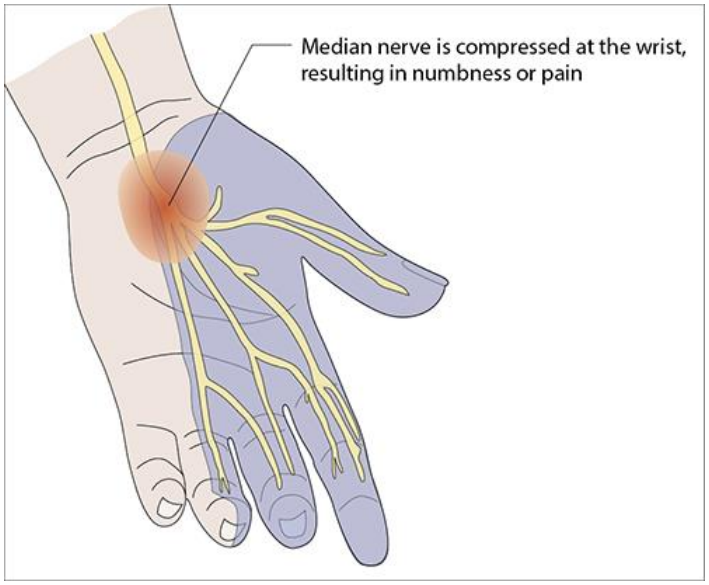

Figure 2.10. Compression Test

- Flicking sign: It is characterized by a short and quick motion of the wrist and manus. It is similar shaking down movement before a clinical thermometer is measured. The question is directed to all subjects which is "What do you really perform with your hand and when your signs are so awful?" [46].

- Square wrist mark: The AP dimension of the wrist splited by the ML dimension equals a ratio of > 0.70 when measured with calipers at the distal wrist crease [39].
- Closed fist test: When after 60 seconds of active digit flexion, itching sensation in the division of the median nerve is started. [47].

- Pressure aggravation test: Tingling sensation in the division of the median nerve territory when manual compression is applied on the volar aspect of the tunnel for one minutes [48]

- Tourniquet test: When a suprasystolic heaviness with a blood-pressure cuff on the upper arm for 1 min provokes tingling in the median territory [47].

- Katz hand diagram (presented in Figure 2.11) : It is a self-administered hand diagram. It has been developed to help in the assessment of upper extremity

paresthesia. A grading system was divided into four categories as presented in Figure 2.12 [49].

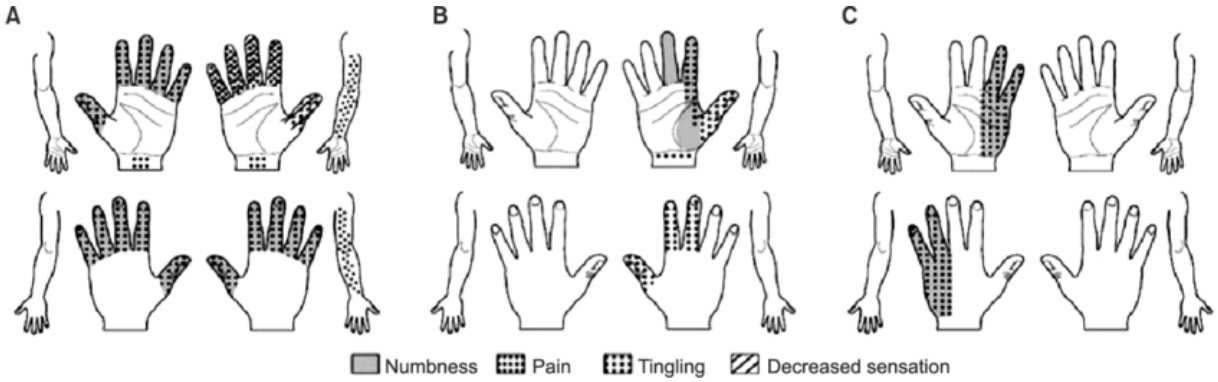

Figure 2.11. Katz Hand Diagram

Grade	Criteria	Comments
Classic	Symptoms include pain, numbness, tingling, and burning in at least 2 digits (thumb, index, and long)	Involvement of the fourth and fifth digits, wrist, and area proximal to the wrist is allowed Involvement of the palm or dorsum of the hand is not allowed
Probable	Symptom pattern same as classic	Palmar symptoms are allowed unless confined to the ulnar side
Possible	Symptoms involve only 1 digit (thumb, index, or long)	Symptoms may involve the dorsum of the hand
Unlikely	No symptoms involving thumb, index, or long digit	

Figure 2.12. Grading Katz Hand Diagram

2.4.5.2. Electrodiagnostic test

Electrodiagnostic testing is a clinically reliable assessment method deciding on median nerve diseases. In Figure 2.13., When the electrical stimulus applied to the nerve, it evaluates numerous parameters in terms of conduction of electrical signal inside the nerve. When the nerve is squuezed or is in diverse phases of destruction or loss of myelin sheath, the transferred electrical signals along the nerve can be blocked

[50]. However axonal impairment, which is related with lessened nerve transmission amplitude, happens at delayed phases of the illness. First of all, nerve transmission studies test only huge nerve fibers, and the lesser nerve fibers that transverse the tunnel is not be tested. Secondly, these tests classify constant nerve damage, but not the recurrent nerve damage in initial phase of carpal tunnel syndrome [51]. Sensory nerve transmission studies of the median nerve across the tunnel was shown in Figure 2.13.

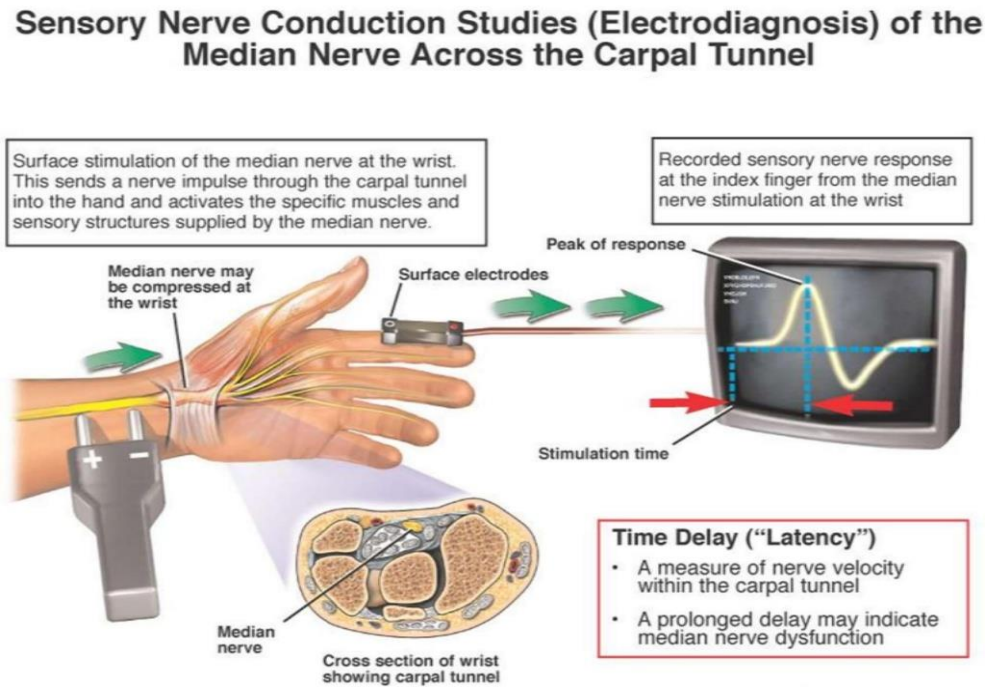

Figure 2.13. Electrodiagnostic Assessment of CTS

The harshness of electrophysiological evaluation of carpal tunnel syndrome is classified into 5 groups, these are explained below;

• Negative: Electrophysiological test results are normal or no symptom related to CTS.

• Mild: Deceleration of the median sensory nerve transmission speed and normal response of distal motor delay.

• Moderate: Deceleration of the median sensory nerve transmission speed and extended response of distal motor delay.

• Severe: Lack of sensual reply and extended response of distal motor delay.

• Extreme: Lack of motor and sensory answer [53]

EDT, involving motor and sensory nerve transmission studies and needle EMG studies, displays a crucial part in the assessment of potential CTS. EDT has been demonstrated to have a maximum level of sensitivity and specificity in evaluating CTS. In addition, it might contribute to categorise changing neuropathic circumstances imitating CTS, for example ulnar compressive neuropathy, C6 radiculopathy etc. If the results of EDT is normal, this might advise that nonneuropathic situations, e.g. CMC arthritis of 1.metacarpal, are reliable for the subject's symptoms [52].

2.4.5.3. Ultrasonography

The Ultrasonography can be used to identify CTS because the median nerve becomes thicker. In addition to this, median nerve flattened inside the tunnel and bending of the flexor retinaculum are totally diagnostic criteria of carpal tunnel syndrome. The usage of US provides quick results and decides harshness of carpal tunnel syndrome as normal response, mild level, moderate level and severe level [38]. Furthermore, US has advantages such as inexpensive, noninvasiveness, quick assesment time and chance of sonography-guided injection versus with conventional EDT [53]. US evaluation also offers maximum temporal and spatial answer to disease, and can possibly provide dynamic anatomical information concerning local arrangements and kinesiology [54].

2.4.5.4. Magnetic resonance imaging

A detailed MRI evaluation of the carpal tunnel is satisfactory to evaluate the areas and volume of the tunnel and its contents. Also, MRI evaluates interconnections of the tunnel in neutral and non-neutral positions as it is an essential phase in controlling the instruments of median nerve trauma in CTS [55]. MRI is outstanding for spontaneous and infrequent pathologic reasons of CTS. For example; ganglion, benign tumor of endothelial cells or bony abnormality - the existance of which might change

medical management [38]. MRI pointers of CTS involve edema of the median nerve and raised signal density on T2-weighted scanning [56].

2.4.5.5. X-rays

The seperation of a normal structural variable from a pathological procedure is an essential characteristic of indicative scanning. Radiographic films are the present technique of examining and determining structural parameters of the wrist. Assessments contain carpal angles, carpal height ratio, and ulnar variance have been used to measure geometric parameters of the wrist [57].

2.4.5.6. Computed tomography

Axial computed tomography scanning is able to categorise the flexor tendons of the fingers consistently. On the other hand, contrast resolution is not sufficient for evaluating soft tissue changes inside the tunnel. Although, with regard to basic x-ray scanning, CT provides numerous noteworthy benefits. The study of causes, the state of being localized, and degree of bony carpal stenosis can be precisely controlled on axial thin-section scanning and on 3 dimensional rebuilted scanning. Additionally, computed tomography is further accurate in discovering soft formation of calcific material in soft tissue and space-occupying lesions inside the tunnel, although, in non-calcified lesions, it is inferior to MRI scanning [58].

2.4.6. Treatment

Treatment selections depends on degree of symptoms among patients with CTS. Subjects with mild to moderate level of CTS, firstly conservative treatment is adviced. On the other hand, subjects having severe CTS or nerve damage in terms of electrodiagnostic studies will likely be directed surgical release. Conservative management include wrist orthosis, medications, physiotherapy including exercise, electrotherapy, therapeutic US and etc.

2.4.6.1. Wrist Orthosis

Wrist orthosis prevents movements of the wrist with a design that is dressed over the wrist, which generally leaves the fingers and first metacarpal permitted to transfer. It may be used at night time, or at night and during daytime tasks that produce wrist movement. An occupational therapist is able to make a thermoplastic orthosis which is customized size to the subjects. It may be a smoother, controllable orthosis. A individual elastic orthosis that inhibits the wrist from transfering flexion, and continuous the extended and 4.metacarpal in extension at the MCP and IP joints, called the 'MANU' hand orthosis, is industrial constructed [59].

2.4.6.2. Corticosteroids

Diuretics, NSAIDs, pyridoxine, and orally managed corticosteroids have been used with differing grades of achievement in patients with carpal tunnel syndrome. Subjects with mild level to moderate CTS, injection, corticosteroid usage and also a local anesthetic into the divison of carpal tunnel area may be performed. These injections may be indicative besides of healing [60].

Corticosteroid injection is commonly applied method in the administration of CTS. However it has been displayed to be efficient, the duration of its influence is brief, and efficiency is contentious for a long period of time [61]. Orally using corticosteroids are fewer successful than corticosteroid injection. NSAIDs, diuretics, and vitamin B6 are no valuable therapies [7].

2.4.6.3. Physical therapy

The physiotherapy treatment is determined according to the stages involving rest orthosis, alterations of activities and the work station (ergonomic changes), patient instructions, therapeutic US, NMES, grip and pinch reinforceing exercises, joint mobilization, and nerve and tendon gliding exercises [62].

2.4.6.3.A. Alterations of activities and the work station

Task alteration that lessens MCP joint flexion ROM will decrease lumbrical incursion and can manage signs. Harsh manual employees with great lumbricals may be at raised danger of CTS if gratified to grasp tightly for longer working time [63].

Females obtain CTS in their 40 or 50 decades and their responsibility at work may be proposed as the cause. An inspectation of their general consultant verifies usually shows prior occurrences of CTS in their twenties when pregnant. Working in these circumstances would more rationally be reflected an alleviator of CTS, rather than the reason. Physiotherapists and occupational therapists can provide employee's and their employers' recommendation on task alterations, which will commonly operate mild or moderate level of CTS [63].

2.4.6.3.B. Patient instruction

Patient instruction, with alignments about body position while presenting atypical activities of daily lifetime is an essential portion of managing carpal tunnel syndrome.Subjectst must avoid monotonous wrist motions; specifically wrist flexion in relation to extended grasp activities. Patient instruction booklets have exhibited countless usefulness as a accompaniment of treatment in lots of upper limb disorders [64].

2.4.6.3.C. Carpal bone and neural tissue mobilization

Mobilization is a technique of inactive motion of a skeletal joint. It is generally pointed at a 'goal' diarthrosis articulation with the purpose of attaining a curative influence. Carpal bone mobilizing is valuable technique for treating CTS. Reestablish arrangements within a joint to their neutral location or painless condition so as to regain a full range pain free motions. While the nervous system can perform optimally, mobilization techniques alleviate ache reinstating neurodynamic to their optimal status to deliver an optimal placement of movement. CBM may come out in modification of the heaviness in the nervous system. Consequently, it provides to a diffusion of any occurring intra-neural edema. Additionally, CBM is able to lessen adhesions between

carpal bones and median nerve after a trauma. In addition, CBM restore a joint to its neutral, pain free and full ROM. It relieves ache, rearranging neurodynamics to their optimal status to offer an optimal placement of movement within which the nervous system is able to move desirably [65].

Mechanism of Recovery Through Neural Mobilisation;

1) Circulation and nutrition occur desirably through the motion

2) Musculoskeletal tissue alterations, dimension and exert mechanical power on neural arrangements

3) Narrowing power on adjacent neural arrangements

4) Raising nerve stress and intraneural heaviness

5) Assissting venous return

6) Distributing swelling

7) Lessening heaviness within the perineurium

8) Restricted fibroblastic motion and narrowing scar formation [65].

2.4.6.3. D. Electrotherapy

Physiotherapy includes electrotherapeutic agents treating with carpal tunnel syndrome. Therapeutic US, shortwave diathermy (pulsed (PSWD) and continuous (CSWD) modes), laser, NMES, microwave diathermy, interferential, TENS, biofeedback [66].

Electrotherapy has been applied for various medical circumstances. PSWD, US and laser are used for bio-stimulation of tissue. Continuous mode of short wave diathermy and microwave diathermy are used for warming up tissues to contribute healing process and resolution of musculoskeletal disease. Transcutaneous electrical nerve stimulation and interferential are used for electrical stimulation through the muscle and nerves to lessen ache because of musculoskeletal disease [67].

First of all, transcutaneous electrical nerve stimulation is applied for decreasing pain via a nerve signal inhibiting mechanism, but it has also been used to contribute healing process. Secondly, these devices typically transport biphasic stimulus pulses between ten to a hundred mA in amplitude. Users can usually adjust pulse amplitude, pulse width and pulse rate. The stimulus pulse is transferred to a pair of electrodes which are manually putted over huge muscle groups and also nerves that are to get the stimulation [68].

US is as an alternative diathermy technique in pysiotherapy. It competes hot pack, microwave and radio frequency warming. It is generally preferred in the healing of soft tissue injuries, additionally it may be applied to bone and joint circumstances and to raising wound healing [69]. Biophysical responses of US are divided into thermal and nonthermal. Nonthermal responses are splitted into cavitation and acoustic streaming. Moreover, thermal responses increase cellular activity because of heating mechanism [70].

Paraffin therapy is a traditionally applied physiotherapy method in treating patients with hand circumstances, for example RA, OA and CTS. Paraffin therapy offers superficial warming to the hands. It lessens pain, improves symptoms and local circulation. Combination of paraffin therapy and a wrist orthosis can provide better effects to improve symptoms [71].

Low Level Laser therapy is a method using the light against biologic system. It promotes tissue regeneration, lessens inflammation and decreasing pain. When comparing other medical laser methods, LLLT does not have a warming effect, but rather a photochemical mechanism which means the light is absorbed and provoke a chemical alteration [72]. It can be used for pain modulation in numerous musculoskeletal circumstances, involving OA and myofacial pain syndrome. In recent literature, the positive effects of laser therapy in CTS are reported [73].

2.4.6.4. Surgical decompression

Surgical release is generally applied in severe level of CTS. It is also indicated in cases where conservative treatment is not achieved.

A long curvilinear volar incision is applied in standard procedure of open carpal tunnel release. And then the incision was restrained to the palm. A 2 to 3 cm long incision is adviced recently for a standard OCTR without particular prepared devices. In addition to cutting the TCL, the overlying structures from the skin to the median nerve are also seperated. An epineurotomy is sometimes applied if there is epineurium thickness. In addition to this, scar tissue within the nerve an internal neurolysis may be performed to separate the involved fascicles from this fibrosis. Comperatively, endoscopic carpal tunnel release is a new technique. It has advantage when seperating the transverse carpal ligament from within the tunnel the overlying structures stays untouched. This may lessen morbidity and accelerate return to work post operatively [74].

3. MATERIALS AND METHODS

3.1. Participants

Our is designed as a randomized controlled clinical investigation. The sample size is determined by using power analysis (Appendix 3). The study population was 22 women. Patients with CTS were recruited from physiotherapy clinics in Kocaeli through a referral from clinicians of orthopedics and traumatology, physical medicine and rehabilitation and neurology. These patients who met inclusion criteria were included in the study. They were seperated into 2 groups by using simple randomization according to the hospital admission order of the patients. This study was performed between January 7th and June 1st of 2019 in Kocaeli. Yeditepe University Clinical Reseach Ethical Committee approved in this intervention at the date of 03.01.2019 and issue number was (Appendix 1). According to instructions of the Helsinki Declaration, the intervention was conducted. All patients joined willingly to the intervention and they signed the informed consent form (Appendix 4).

Inclusion criteria

- CTS classified as mild to moderate level
- Being women
- Being in between 30-60 years of age
- Continuity of symptom minimum one month

Exclusion criteria

- Current pregnancy
- Previous CTS operation in the assessed hand
- Earlier steroid injection in the assessed hand
- Receiving physical therapy in the past six months
- Trauma to the study hand

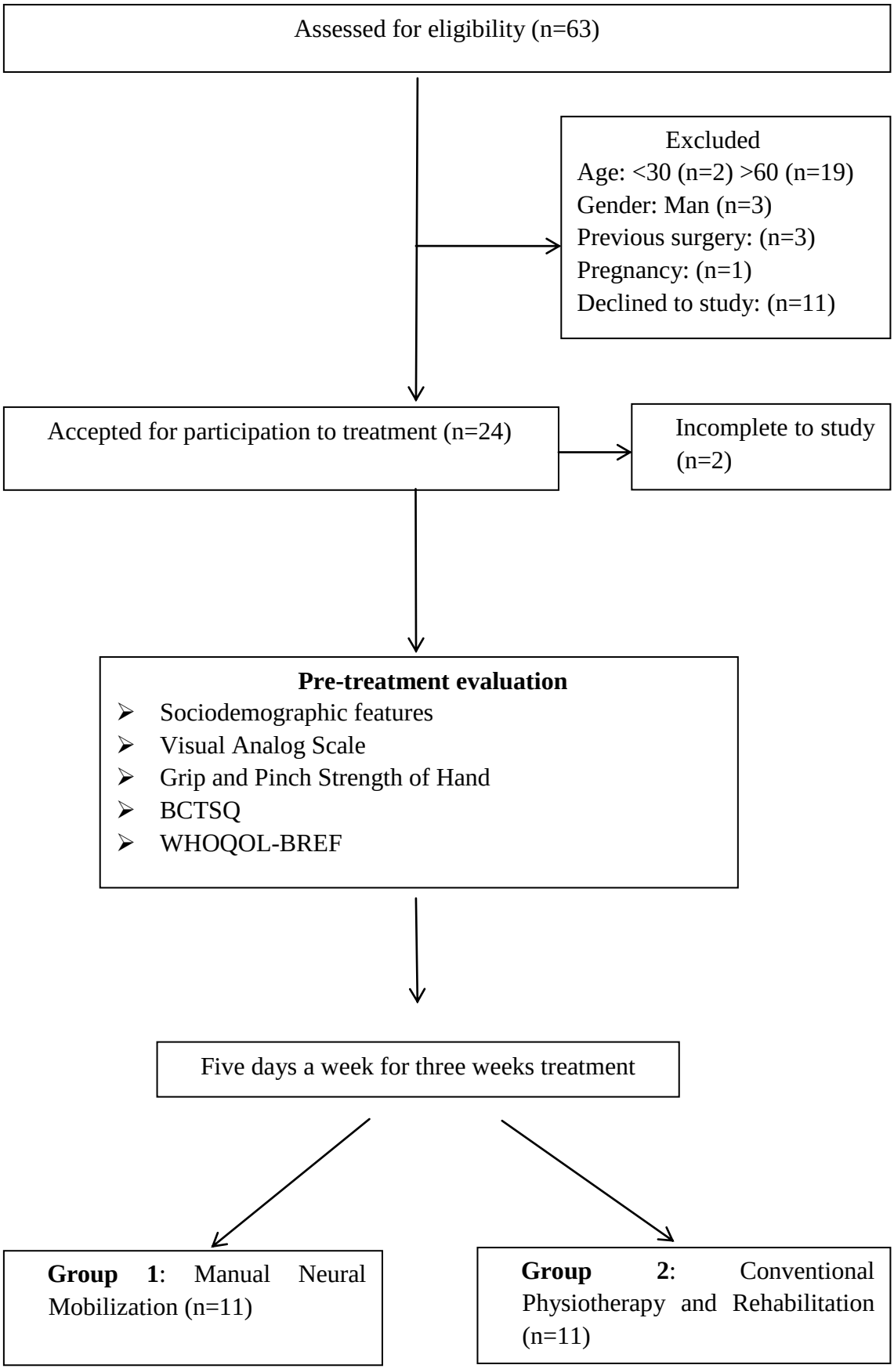

Figure 3.1. Flow Chart of The Study

3.2 Method

3.2.1 Evaluation

The patients were assessed with questionnaires, which include questions about their sociodemographic features, visual analog scale, grip and pinch strength of hand, BCTSQ and also WHOQOL-BREF. All of the assessments were done at outpatient clinic in Kocaeli. Sociodemographic features were examined with a form. It contains name-surname, age, gender, marital status, address, educational status chronic disease and etc. VAS has commonly used method for the evaluation of pain severity and relief. Grip strength is measured by a dynamometer, additionally pinch strength is assessed a pinch gauge. BCTSQ is a self-administered and reliable questionnaire which evaluates symptom severity and functional circumstances of patients. Perceived health-related QOL was examined with WHOQOL-BREF. Flow chart of the study was shown in Figure 3.1.

3.2.1.1 Sociodemographic feature of participants

The sociodemographic questionnaire involved name, age, gender, phone number, address, living area (big city, city, district or village), social insurance, marital status, alcohol and cigarette use, type of house (apartment, private, guesthouse or hotel, or nursing home), living with (single, wife/husband, wife/husband and children, caretaker) and also asked questions to understand educational status, working condition, income level. It also comprised chronic diseases such as hypertension, diabetes, osteoarthritis and hyperlipidemia. At last, walking aid (none, walking stick, crutch, walker or wheelchair) is questioned by the researcher. This form was prepared by the researcher and is presented in Appendix 5.

3.2.1.2 Visual analog scale

The visual analog scale is a simple and often applied technique for evaluating changes in pain intensity [75]. It has the benefit of being easily administered and requires no verbal or reading skills [76].

This scale is a continuous horizontal or vertical line, usually 10 cm in length, connected by 2 verbal instructions, one for each identify symptom’s severity. Descriptions, the time interval for reporting, and verbal descriptor commentator have

varied widely in the literature depending on the planned use of the scale. For pain severity, the scale is most commonly attached by “no pain” (zero) and “worst thinkable pain” (ten) [77]. To inhibit clustering of scores around a desired numeric value, numbers or verbal instructions at middle points are not adviced. Descriptions of VAS is exhibited in Appendix 6. The Turkish version was used in this study.

3.2.1.3 Grip and pinch strength of hand

Evaluation of hand function typically includes grip and pinch strength. These assessments are simple, inexpensive and also to help determining upper extremity injuries. When injured hand grip strength is evaluated, the other non-affected hand uses as a control [78].

A Jamar hand dynamometer evaluates grip strength. Additionally, a Jamar hydraulic pinch gauge assesses pinch strength (Figure 3.2) [78]. Their instructions are performed and all patients are positioned typically. They are valuable measurement methods if they are calibrated properly [79].

All hand strength evaluations were directed by a researcher. Participants were positioned with the shoulder adduction and neutral rotation, elbow flexion at ninety degree with the antebrachium in the neutrally positioned and wrists zero to thirty degree of flexion and also zero to fifteen degree of ulnar deviation [80]. Each subject was asked to hold tight the dynamometer three times with each hand and for each testing locations. The test was applied on one hand after another. There was a 1- minute relaxing period between each grasp in order to prevent fatigue. The mean value of three grasp was taken into account [81]. Grip strength rating for females (in kg) were shown in Table 3.1. Handgrip and pinch strength test in Turkish version is presented in Appendix 7.

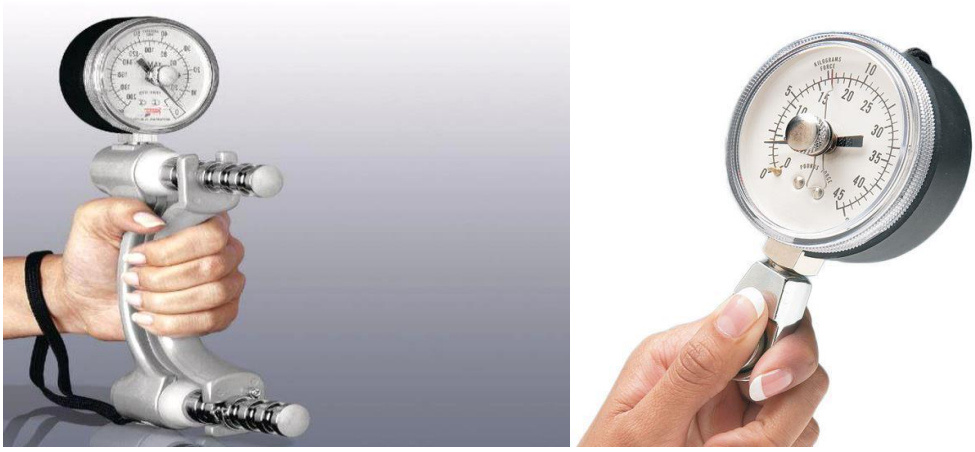

Figure 3.2. Jamar Hand Dynamometer and Hydraulic Pinch Gauge

Table 3.1. Grip Strength Rating for Females (in kg)

Age	Weak	Normal	Strong
30-34	< 21.5	21.5-35.3	> 35.3
35-39	< 20.3	20.3-34.1	>34.1
40-44	< 18.9	18.9-32.7	>32.7
45-49	< 18.6	18.6-32.4	>32.4
50-54	< 18.1	18.1-31.9	>31.9
55-59	< 17.7	17.7-31.5	>31.5
60-64	< 17.2	17.2-31.0	>31.0

3.2.1.4 Boston carpal tunnel syndrome questionnaire

The BCTSQ is a self-administered scale to evaluate symptom severity and functionality. The SSS determines signs related to harshness, occurrence, time and kind. The FSS assesses how the signs affect daytime activities [82]. The adaptation of BCTSQ in Turkish, which was validated by Sezgin, M. et al (2006), was used in this study, is exhibited in Appendix 8. All questions were asked by the researcher because of avoiding losing time.

BCTSQ consists of 18 items in two altered parts: the SSS and the FSS. The SSS contains eleven questions that evaluates ache intensity during the day and night, time of ache during the day, inactivity, faintness, itchy sensation at night, occurrence of that night itchy sense, and ability graded from one (normal) to five (very serious, very difficult, more than five times, and continued). Morever, the FSS is an eight itemed subscale which access daily hand roles (writing, buttoning clothes, grasping, reading a book, grasping a phone, household chores, opening a glass vial cap, carrying shop bags, having a bath and clothing). The FSS is also scored from one (Can do easily) to five (Cannot achieve the activity totally). The complete score is analysed as the mean of all items for each subscale. Higher scores exhibit a worse symptom or function. All responses should be included with the symptoms within twenty four hours and for the last 2 weeks [82-83]. Grading of Boston Carpal Tunnel Syndrome Questionnaire is presented in Table 3.2.

Table 3.2. Grading of Boston Carpal Tunnel Syndrome Questionnaire

SSS	**FSS**
11: Asymptomatic	8:Asymptomatic
12 to 22:Mild	9 to 16:Mild
23 to 33:Moderate	17 to 24:Moderate
24 to 44:Severe	25 to 32:Severe
45 to 55: Very Severe	33 to 40:Very Severe

*These scores can be converted into the values used on this site by dividing by 11 for SSS

*These scores can be converted into the values used on this site by dividing by 8 for FSS [84]

3.2.1.5 World health organization quality of life questionnaire (WHOQOL-BREF)

The WHOQOL-100 is a universal QOL tool that was planned to be applicable to subjects living dissimilar status, and nations [85]. The WHOQOL-100 depends on totally subjective assessment, to assess the identified QOL. It is considered as a multidimensional concept [86]. The questionnaire (Appendix 9) modified in Turkish language and it was validated by Eser et al (1999) [87].

The WHOQOL-BREF is the brief type of the WHOQOL-100. It is practical in conditions where time is limited, where the respondent burden must be reduced [87]. It involves 1 item from each of the 24 QOL facets included in the WHOQOL-100, plus 2 benchmark items from the general facet on overall QOL and general (not included in the scoring). The instrument consists of 4 domains: Domain 1: physical health; domain 2: psychological health; domain 3: social relationships; domain 4: environmental health [89]. Items inquire 'how much', 'how completely', how often', 'how good' or 'how satisfied' the respondent felt in the last 2 weeks; altered answer scales are distributed across the domain [90]. Domain scores are graded in a positive route (i.e. higher scores imply a higher quality of life). The mean score of items within each domain is used to analyze the domain score. Mean scores are then multiplied by 4 in order to make domain scores comparable with the scores used in the WHOQOL-100 [91].

Domain and facet scores can be converted to a 0-100 scale using the following formula:

TRANSFORMED SCORE= (SCORE-4) x (100/16).

Physical domain= ((6-Q3) + (6-Q4) + Q10 + Q15 + Q16 + Q17 + Q18)x4.

Psychological domain= (Q5 + Q6 + Q7 + Q11 + Q19 + (6-Q26))x4.

Social Relationships domain= (Q20 + Q21 + Q22)x4.

Environment domain= (Q8 + Q9 + Q12 + Q13 + Q14 + Q23 + Q24 + Q25)x4. [92]

3.3 Treatment protocol

The study was conducted with two groups, each of them were taken different treatments. Patients with CTS were distributed randomly to avoid any bias in the results of the trial. Treatments were administered five days a week. Each patient evaluated

before the intervention and after three weeks of treatment. In the treatment group 1, patients were treated with manual neural mobilization and home exercise program, on the other hand conventional physiotherapy and rehabilitation and home exercises were applied by the researcher in the treatment group 2.

Group 1: Initial step: Mobilization directed transverse wrist extension was applied along with extended 1.metacarpal and radial abduction and following flexor tendon gliding exercise. Researcher passively applied 3 times in each treatment session and for thirty second each time. Patients were placed in order to being no tightness on median nerve. So that head and neck in neutrally positioned and the involved arms placed at the patients' sideway.

Figure 3.3. Transverse wrist extension mobilization along with 1.metacarpal extension and radial abduction

Secondly: The manual neural mobilization containing oscillatory elbow flexion/extension was performed. As the treatment continued, a position was changed because of raising tension on the nerve. It was applied three times in each session, with fifteen repetitions. In addition to manual neural mobilization, patients also done at the same home exercise program like the treatment group 2. In addition, all patients were guided to exercise regularly.

Figure 3.4. Shoulder depression and no tension on median nerve

Figure 3.5. Shoulder abduction

Figure 3.6. Antebrachium supination and shoulder external rotation

Figure 3.7. Wrist and digit extension

Figure 3.8. Elbow extension

Group 2: Transcutaneous electrical nerve stimulation was applied for twenty minutes each session, a frequency of eighty Hz, with a pulse duration of sixty μs, and at an intensity that created a cushioned tingling sense. Therapeutic US was carried out to the volar carpal tunnel region for five minutes per session, a frequency of one MHz, with an intensity of one W/cm2, and a duty cycle of twenty percent. The paraffin therapy was applied with the dip-and-wrap technique for 20 min per session. Additionally, the aforementioned physiotherapy, all patients performed home exercise program including thumb opposition, squeezing a ball, wrist flexion and extension, radial/ulnar radiation, finger extension with rubber band, streching wrist flexion/extension and also flexor tendon gliding exercises (shown in Appendix 10 and 11). During tendon-gliding exercises, the digits were positioned in 5 seperate place. Those were straight, hook, fist, table top, and straight fist. Brochures defining exercises were also given to all patients. Besides, all patients in this study were followed up with a home exercise program chart that was prepared by the researcher for the control of continuity. This chart is presented in Appendix 12.

Figure 3.9. Straight position

Figure 3.10. Hook position

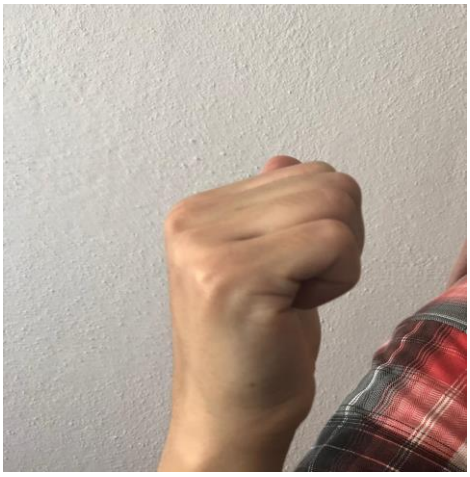

Figure 3.11. Fist position

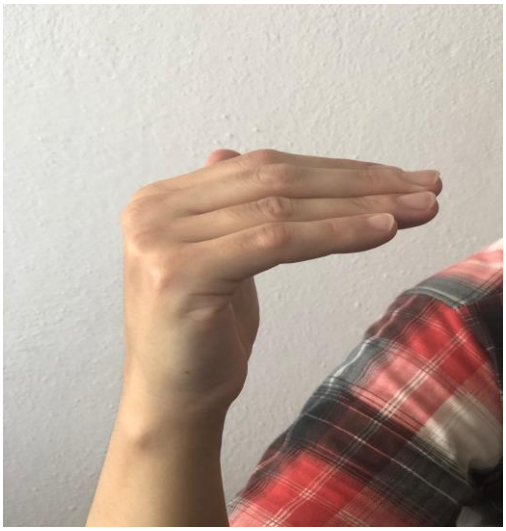

Figure 3.12. Table top position

Figure 3.13. Straight fist position

3.4 Statistical analysis

In this study 'Statistical Package Analyze for Social Sciences' version 20.0 is used for the statistical analyses. The error margin of our study was identified as alpha equals to zero point zero five, power equals to zero point two, and the standard score was taken as one point ninety six for the table value corresponding to ninety five percent confidence level. The effect size of our study was designated as 1.15. Consequently, the sample size was identified as 22 persons according to the results of power analysis.

The statistical data were expressed as mean ± standard deviation ($\bar{x}$±SD) and percentages (%) for normally distributed variables. For quantitative variables, the number (n) and percentage (%) were calculated. Nonparametric tests were used when

parametric conditions could not be achieved. The level of significance was accepted as $p<0.05$ for two tailed hypothesis.

Before the statistical analysis, a "**Kolmogorov–Smirnov test"** was used to assess the distribution of data. A parametric test was used for normally distributed data (age, BCTSQ-SSS/FSS) and a non-parametric test was used for data that was not normally distributed (VAS, handgrip and pinch strength, WHOQOL-BREF).

Sociodemographic features of patients were compaired between groups using a "**Fisher and Monte Carlo Chi- Square Test**" for categorical data.

"**Dependent t test**" and "**Wilcoxon t test**" were used to carry out the changes within group. "**Independent t test**" and "**Mann Whitney U test**" were used to assess the changes between groups.

"**Dependent t test**" and "**Independent t test"** were used for normally distributed data. In addition, "**Wilcoxon t test**" and "**Mann Whitney U test**" were used for data that was not normally distributed.

4. RESULTS

The study population consisted of 22 volunteer patients, 11 women in manual neural mobilization group in the mean age of 50,45 ± 5.83 (min-max = 39-56) and 11 women in conventional physiotherapy group in the mean age of 49,81 ± 8,75 (min-max = 35-59). Categorical variables between two groups were compared using Chi-square test. The relation of catergorical data was evaluated using Fisher Exact and Monte Carlo test. After statistical analysis it was found that, there was no statistically significant difference between groups in all of the parameters when the sociodemographic features were compaired as seen in the Table 4.1 ($p>0.05$).

Table 4.1. Sociodemographic Features of Groups

	Group 1(n=11)	**Group 2 (n=11)**	**Intergroup Analysis (p* value)**
	Mean ± SD	**Mean ± SD**	
Age	50.45±5.83	49.81±8.75	0.84
Gender			
Women	11 (100%)	11(100%)	-
Men	0	0	
Dominant Hand			
Right	11(100%)	10(90.9%)	1.00
Left	0	1(9.1%)	
Affected Hand			
Right	6(54.5%)	4(36.4%)	
Left	2(18.2%)	2(18.2%)	0.84
Bilateral	3(27.3%)	5(45.5%)	
Living Area			
Big city	11(100%)	10(90.9%)	1.00
District	0	1(9.1%)	

Social Insurance			
PI	1(9.1%)	0	1.00
SSI	10(90.9%)	11(100%)	
Marital Status			
Single	1(9.1%)	0	1.00
Married	10(90.9%)	11(100%)	
Alcohol Use			
None	11(100%)	10(90.9%)	1.00
Rarely	0	1(9.1%)	
Cigarette Use			
None	11(100%)	9(81.8%)	
1/week	0	1(9.1%)	0.48
1/day	0	1(9.1%)	
Type of House			
Apartment	6(54.5%)	7(63.6%)	1.00
Private	5(45.5%)	4(36.4%)	
Household Status Houseowner	11(100%)	10(90.9%)	1.00
Family's house	0	1(9.1%)	
Living With			
Single	1(9.1%)	0	
Wife/Husband	2(18.2%)	1(9.1%)	0.58
Wife/Husband and children	8(72.7%)	10(90.9%)	
Education Level			
Primary school	3(27.3%)	4(36.4%)	
Middle school	2(18.2%)	0	0.29
High school	3(27.3%)	6(54.5%)	

University	3(27.3%)	1(9.1%)	
Working Status			
Unemployed	8(72.7%)	7(63.6%)	
Retired	1(9.1%)	2(18.2%)	1.00
Physical work	2(18.2%)	2(18.2%)	
Income Level			
MW	3(27.3%)	4(36.4%)	
2×MW	5(45.5%)	4(36.4%)	1.00
3×MW	3(27.3%)	3(27.3%)	
Chronic Disease			
Hypertension	1(9.1%)	1(9.1%)	
Diabetes	1(9.1%)	2(18.2%)	
Osteoarthritis	1(9.1%)	0	1.00
Hyperlipidemia	1(9.1%)	0	
None	7(63.6%)	8(72.7%)	
Walking Aid			-
None	11(100%)	11(100%)	

Group 1: Manual Neural Mobilization Group 2: Conventional Physiotherapy

Abbreviaations: PI: Private Insurance SSI: Social Security Insurance

MW: Minimum Wage

p: the accepted level as $p<0.05$

Table 4.2. Comparison of the Visual Analog Scale within group and between groups after treatment

	Groups	**Pretreatment Median (25-75%)**	**Intergroups p***	**Posttreatment Median (25-75%)**	**Intergroups p***	**Intragroups p***
VAS	1	6.00 (5.00-7.00)	0.10	3.00 (2.00-4.00)	0.51	**0.003****
	2	5.00 (4.00-6.00)		2.00 (2.00-4.00)		**0.003****

Group 1: Manual Neural Mobilization Group 2: Conventional Physiotherapy
Abbreviations: VAS: Visual Analog Scale
Intergroups p*: Man Whitney U Test Intragroups p*: Wilcoxon T Test
p: the accepted level as $p<0.05$
*$p<0.05$; ** $p< 0.01$

Man Whitney U test was used to analyze the results of VAS scores between groups while Wilcoxon T Test was using to evaluate the results of within group changes after treatment.

There was no statistically difference between groups in terms of visual analog scale scores at begining of the treatment ($p>0.05$). There was significant improvement in the VAS scores in both groups after treatment ($p<0.01$). On the other hand, there was no statistically difference between groups after treatment results ($p>0.05$). The results were shown in Table 4.2.

Table 4.3. Comparison of Handgrip and Pinch Strength within group and between groups after treatment

	Groups	**Pretreatment Median (25-75%)**	**Intergroups p***	**Posttreatment Median (25-75%)**	**Intergroups p***	**Intragroups p***
R/HGS	1	24,66(22.00-29,33)	0.74	28.00(24.00-34.00)	0.27	**0.005****
	2	25,33(23,30-28,66)		30,66(26,66-36,66)		**0.003****
L/ HGS	1	20.00(19,33-24.00)	0.06	22,66(21,30-28,66)	0.04*	**0.007****
	2	23,33(21,33-29,33)		28.00(24,66-29,33)		**0.005****
R/ PS	1	4,16(2,33-4,50)	0.24	4,33(2,50-4,66)	0.27	**0.006****
	2	2,83(1,83-4,33)		4,50(3,33-5,83)		0.68
L/PS	1	5,33(3.00-5,83)	0.06	3,33(2,50-4.00)	0.05	0.43
	2	4,83(2,83-6,50)		3,83(3.00-5,83)		0.59

Group 1: Manual Neural Mobilization Group 2: Conventional Physiotherapy

Abbreviations: R: Right L: Left HGS: Handgrip Strength PS: Pinch Strength

Intergroups p*: Man Whitney U Test Intragroups p*: Wilcoxon Signed Ranks Test

p: the accepted level as $p<0.05$

*$p<0.05$; ** $p< 0.01$

Man Whitney U Test was used to analyze the results of handgrip and pinch strength scores between groups changes while Wilcoxon T Test was using to evaluate the results of within groups as shown in Table 4.3.

At baseline versus at after 3 weeks treatment, right handgrip strength improved in both groups ($p<0.01$). However, there was no statistically difference between groups after treatment ($p>0.05$). Besides, left handgrip strength improved in both groups, whereas Group 2 had statistically shown more improvement than Group 1 ($p<0.01$). There was statistically difference between groups in terms of left handgrip strength after treatment ($p<0.05$).

Comparison between pretreatment and posttreatment results concerning right/left pinch strength, there was no statistically difference between groups ($p>0.05$). There was only improvement in right pinch strength in Group 1 ($p<0.01$).

Table 4.4. Comparison of Boston Carpal Tunnel Syndrome Questionnaire within group and between groups after treatment

	Groups	**Pretreatmen Mean ± SD**	**Intergroups p***	**Posttreatment Mean ± SD**	**Intergroups p***	**Intragroups p***
SSS	1	2,64±0,41	0.32	1,68±0,33	0.30	**0.001****
	2	2,45±0,43		1,52±0,36		**0.001****
FSS	1	3,44±0,57	0.20	2,51±0,49	**0.007****	**0.001****
	2	3,11±0,60		1,82±0,56		**0.001****

Group 1: Manual Neural Mobilization Group 2: Conventional Physiotherapy
SSS: Symptom Severity Scale FSS: Functional Status Scale
Intergroups p*: Independent T Test Intragroups p*: Dependent T Test
p: the accepted level as $p<0.05$
*$p<0.05$; ** $p< 0.01$

Independent T test was used to assess the results of SSS and FSS scores between groups. In addition, Dependent T test was used to analyze within group changes. There

was no statistically difference between groups regarding symptom severity scale and functional status scale at the begining of the treatment ($p>0.05$). SSS and FSS scores improved after 3 weeks treatment compared with baseline in both groups ($p<0.01$). In patients in group 1 was observed more improvement in FSS scores ($p<0.01$). The results were presented in 4.4.

Table 4.5. The association between pretreatment EMG results and BCTSQ-SSS and BCTSQ-FSS scoring

SSS		EMG	
		Mild	Moderate
BCTSQ	Asymptomatic	0	0
	Mild	2 (66,6 %)	1 (33,3%)
	Moderate	7 (46,6%)	8 (53,4 %)
	Severe	1 (25%)	3 (75 %)
	Very Severe	0	0

Table 4.6. The association between pretreatment EMG results and BCTSQ-SSS and BCTSQ-FSS scoring

FSS		EMG	
		Mild	Moderate
BCTSQ	Asymptomatic	0	0
	Mild	1 (100%)	0
	Moderate	3 (37,5%)	5 (62,5%)
	Severe	3 (27,2%)	8 (72,8%)
	Very Severe	1 (50%)	1 (50%)

Table 4.7. Comparison of World Health Organization Quality of Life Questionnaire within group and between groups after treatment

	Groups	**Pretreatment Median (25-75%)**	**Intergroups p***	**Posttreatment Median (25-75%)**	**Intergroups p***	**Intragroups p***
GH	1	62,50(50.00-75.00)	0.51	62,50(62,50-75.00)	0.33	0.06
	2	62,50(50.00-62,50)		71,42(57,14-78,57)		**0.01***
PH	1	60,71(46,43-67,86)	0.19	71,42(57,14-78,57)	0.21	**0.03***
	2	67,86(64,29-75)		75(75,00-78,57)		**0.004****
P	1	66,67(54,17-70,83)	0.84	66,67(54,17-70,83)	0.79	0.31
	2	66,67(62,50-70,83)		66,67(62,50-70,83)		1.00
S	1	75.00(58,33-75.00)	0.69	75.00(66,67-91,67)	0.79	0.18
	2	75.00(66,67-75.00)		75.00(66,67-75.00)		0.89
E	1	71,88(68,75-75.00)	0.33	71,88(68,75-75,00)	0.74	1.00
	2	71,88(59,38-71,88)		71,88(59,38-75.00)		0.10

Group 1: Manual Neural Mobilization Group 2: Conventional Physiotherapy

Abbreviations: GH: General Health PH: Physical Health

P: Psychological S: Social E: Environmental

Intergroups p*: Man Whitney U Test Intragroups p*: Wilcoxon T Test

p: the accepted level as $p<0.05$

*$p<0.05$; ** $p< 0.01$

Man Whitney U test was used to analyze WHOQOL-BREF scores between groups, Wilcoxon T test was assessed within group changes and presented in Table 4.5.

There was no significant difference between groups at baseline ($p>0.05$). General health in the group 2, physical health in both groups are improved statistically ($p<0.05$). Comparing at baseline versus at after 3 weeks treatment, there was no statistically difference between groups ($p>0.05$).

5. DISCUSSION AND CONCLUSION

In our study investigated to compare the usefulness of manual neural mobilization and conventional physiotherapy and rehabilitation among patient with CTS. The main outcome of this study is that manual neural mobilization and conventional physiotherapy effective in reducing pain, increasing hand grip strength, alleviating symptoms, improving functional activities and also quality of life. According to our results, there was no statistically meaningful difference between these two treatment options except some parameters. In terms of left hand grip strength patients who treated with conventional physiotherapy and rehabilitation had statistically shown more improvement than patients who treated with manual neural mobilization. In addition, manual neural mobilization improved functional activity compared to conventional physiotherapy and rehabilitation.

Entrapment of the median nerve is named CTS which is mostly seen focal peripheral neuropathy [93]. The standard symptoms are nocturnal pain, tingling, reduced sensibility to touch, deficit of function in the division of the median nerve [94]. To relieve the pressure on the median nerve, numerous treatment choices, both surgical and conservative. Conservative treatment should be highlighted as a reasonable stage so that it can be useful in the management of mild level to moderate CTS [95]. Although there are numerous studies regarding CTS and its associated treatment options, very few studies assessed the comparison between manual neural mobilization and conventional physiotherapy.

CTS is most often seen between the ages of 30 and 60 [96]. Females are 3 times as probability to experience CTS as males [40]. Consistent with in this study, all patients were between 30 and 60 years old and all patients were female (Table 4.1). According to study of Robbins (1963) has revealed that the volume of the carpal tunnel is lessened maximal flexion and extension movements of the wrist. In terms of this study, hardworking housewifes generally use their hands including squeezing cleaning cloth, wash dishing, polishing and etc., all activities require a full ROM of wrist. Consequently, always monotonous household chores may lead to median nerve lesion [97]. Moreover, Mattioli and Baldasseroni et al. contrasted rates of undergone surgical release of CTS among blue and White collar workers and housewives in the overall

population. They found that housewives exhibited remarkably similar age-related patterns to female blue-collar workers, with rate ratios several times higher than those of female white-collar workers. As a result, as an occupational class, full-time housewives seem to have a increased possibility of surgical release of CTS, probably associated to house work [98]. In accordance with our study, most of the patients (n=15 (68.18%)) were housewifes (Table 4.1).

Alam and Khan et al. conducted randomized controlled study which consists of neural mobilization group (including median nerve mobilization with gliding technique with a home exercise program involving median nerve self-mobilization and therapeutic ultrasound group (including ultrasound therapy on carpal tunnel with intensity of zero point eight w/cm2 for five min during each session). The results of that study, neural mobilization directed to median nerve is more favorable than therapeutic US in lessening ache intensity and functional restrictions due to carpal tunnel syndrome [99]. These results are not consistent with our findings. According to Lee et al., a mean decline in visual analog scale of three cm symbolizes a clinically essential change in pain severity that identifies to patients' awareness of adequate pain control [100]. In this study, after fifteen sessions of treatment, manual neural mobilization and also physiotherapy and rehabilitation (including TENS, ultrasound and paraffine) were clinically effective in reducing average daily pain ($p<0.01$). However, there was no significant difference between groups after treatment ($p>0.05$) (Table 4.2). In our study, in addition to their treatment methods, both group performed home exercises including streching, strengthening and also flexor tendon gliding exercises. These exercises are mostly suggested to lessening mechanical compression of median nerve patients with CTS. Consistent with our results, nerve and tendon gliding exercises might reduce pain by promoting to the distribution of oxygenated blood to the division of median nerve. As a result, gliding exercises are advised as an essential support in the non surgical management of CTS [101]. Also, our results are accordance with the findings of Horng and Yi-Shiung et al. They found that the mixtures of tendon gliding exercises with non surgical treatments (including splint and paraffine therapy) might be more valuable than nerve gliding exercises [102].

Power is a good pointer of hand function, and its measurement must be involved as the part of any hand evaluation. Without the ability to grasp, a patient becomes functionally self determining and is unlikely to be able to act or play. Since CTS can decrease hand grip strength and the associated functions [103]. According to the study of Pınar et al., pretreatment and posttreatment hand grip strengths reveal that the rate of healing [104]. Using modalities such as TENS, ultrasound and paraffine has been recommended as an effective tretment in patient with CTS. These treatments would increase soft tissue extensibility and blood flow along with pain and muscle spasm decrement [105]. So far, physical therapy of the affected area would decrease patients' pain and also increase function. In this study, both group showed statistically significant improvement in grip strength when at baseline versus at three weeks of treatment results were compaired ($p<0.01$). However, there was no statistically significant difference between groups after treatment except left hand grip strength ($p>0.05$) (Table 4.3). In terms of left handgrip strength, patients with treated conventional physiotherapy (Group 2) had statistically shown more improvement than treated with manual neural mobilization (Group 1) ($p<0.05$). There were three bilateral CTS hands in Group 1, whereas five bilateral CTS hands in Group 2. Also, one patient in Group 2 was left handed. All patients tended to do home exercises to their affected hands. According to Kozin and co, grip strength and applied force depends on muscles and their innervations. Measuring grip strength in median nerve compression is also determined by patient's ability to use other muscles [106]. According to systematic review of McKeon and Yancosek, neural mobilization influences the nerve anatomy and physiology to moving a nerve available ROM [107]. To the best of our knowledge, neural mobilization may provide reducing adhesions and lessening signs by permitting the nerve to transfer freely and therefore to result in an enhancement of blood flow to the nerve. As a result, a damaged nerve starts to recovery and regenerate [15-107]. Consistent with our study, comparison between pretreatment and posttreatment results concerning right/left pinch strength, there was no statistically difference between groups ($p>0.05$). There was only improvement in right pinch strength in Group 1 ($p<0.01$).

Heebner and Roddey conducted a randomized trial. Subjects were splited into 2 groups. First group took a standard therapy (including patient education, wrist orthosis, and tendon-gliding exercises) and second group taken same standart care and

additionally active neurodynamic mobilization exercise. Except first group had recovered scores on the FSS of the CTSQ contrasted to second group at 6 months. The adding of neural mobilizing to standard therapy did not lead to in recovered outcomes [108]. In contrast to our study, manual neural mobilization combined with home exercises including tendon gliding showed greater functional improvement compared to conventional physiotherapy and rehabilitation. However, compared to our study and the study of Heebner and Roddey, there was no follow up period in this study. Also, the current study revealed that manual neural mobilization and also physiotherapy and rehabilitation lessen symptom severity and improve functional activities of patients after three weeks of treatment ($p<0.01$). However, when two groups compaired, Group 1 demonstrated greater functional improvement ($p<0.01$) (Table 4.4). Consistent with our findings, Kocjan (2016) compared manual therapy procedures on measuring of ache and hand task subjects with CTS. The outcomes of that study showed that a mixture of nerve mobilization and mid-carpal distraction are slightly bigger profits in consequence measurements: symptom harshness, hand functionality and ache intensity, than only neuromobilization performed [109]. Similarly, Oskouei et al consisted of randomized controlled trial to compare usual treatment (including wrist orthosis, TENS and curative US) and in addition to the routine treatment with neuromobilization. There were meaningful enhancements in the SSS, VAS, tension test of median nerve and Phalen's sign in two groups. Although, the FSS and distal motor latency of median nerve were meaningfully enhanced only in the treated group. Nerve mobilization in mixture with usual treatment improves some clinically more effective than usual physiotherapy [110].

Life quality is particularly affected by chronic and recurring diseases resulting in pain and restriction of function of some organs. The carpal tunnel syndrome is such a disease [111]. Patients usually experince sleep-troubling symptoms, for instance getting up due to ache or itchy and emotionlessness at night. Symptoms of carpal tunel syndrome deteriorate the quality of patient's life [111-112]. The measurement of patient gratification is considered an essential outcome indicator to evaluate health care quality [113]. In literature, Basson and co conducted a sytematic review and meta-analysis about neural mobilization for neuromusculoskeletal conditions. There were twelve study about CTS. In the study of Akalin et al, patient gratification investigation was undertaken by telephone after treatment. In addition, Baysal et al used to survey for

assessment of patient satisfaction at 8 weeks follow-up only. Similarly in our study, Horng et al used WHOQOL-BREF version to evaluate patient satisfaction. However, patient satisfaction was not evaluated in other studies [112]. Horng et al conducted a randomized study with 3 groups. Patients took non surgical treatments (wrist orthosis and paraffin, same in group three), but group one experienced added tendon gliding exercises and group two experienced added nerve gliding exercises. Only group one exhibited meaningful enhancements in their grades on FSS; the DASH questionnaire; and the physical health parameter of the WHOQOL-BREF [102]. According to the study of Wolska et al., the statistically significant dependence was found between the satisfaction with the health state and pain intensification as well as the time of duration of the carpal tunnel syndrome symptoms [111]. In accordance with our study, we detected meaningful improvement in the scores for general health domain of WHOQOL-BREF in Group 2 ($p<0.05$). Additionally, both group exhibited statistically meaningful development in physical health parameter of WHOQOL-BREF ($p<0.05$). Comparing at baseline versus at after three weeks of treatment, there was no statistically difference between groups ($p>0.05$) (Table 4.5). Besides, our study indicated that pain relief, improving symptoms and and functional activities may also improved observed QOL, only in the "physical health parameter" which involves activities of daytime, pain and discomfort and also sleeping and relaxation time.

In this study, there were some limitations that can be reflected in the other studies. Primarily, although sample size was determined by power analysis, it is relatively small. Greater sample sizes will be required for next clinical studies. Another limitation is that short treatment period and no follow over time. Also, in this study was for 3 weeks treatment period. It might have been inadequate to discover clinical alterations in reaction to treatting chronic type of patients with CTS and did not permit us to screen whether the perceived adjustments were permanent. Consequently, recurrence rates and long-term results are unidentified. In another limitation, our study sample contained only of women. However, with no males participated in this study, the outcomes may not be transferable to males. Furthermore, in presence study, all patients had electromyographic diagnosis. Physical examination (such as Tinel sign, Phalen Sign) may be used the confirmation the diagnosis of CTS. Semmes-Weinstein monofilament test may be performed. In this study, BCTSQ was used, DASHQ may be

preferred in future studies. In addition to this, we used WHOQOL-BREF form to assess quality of life which could be evaluated with SF-36.

In conclusion, manual neural mobilization and conventional physiotherapy and rehabilitation can help to lessen pain and symptoms and also enhance function patient with CTS in short treatment period. Next studies may focus on long term efficacy and which treatment types of manual neural mobilization and conventional physiotherapy and rehabilitation are most effective for CTS. The present study revealed that manual neural mobilization and conventional physiotherapy and rehabilitation were effective in treating mild to moderate CTS. The judgement to offer this method of conservative management to subject with CTS might be depended on the physician's knowledge and also subject’s choices.

6. REFERENCES

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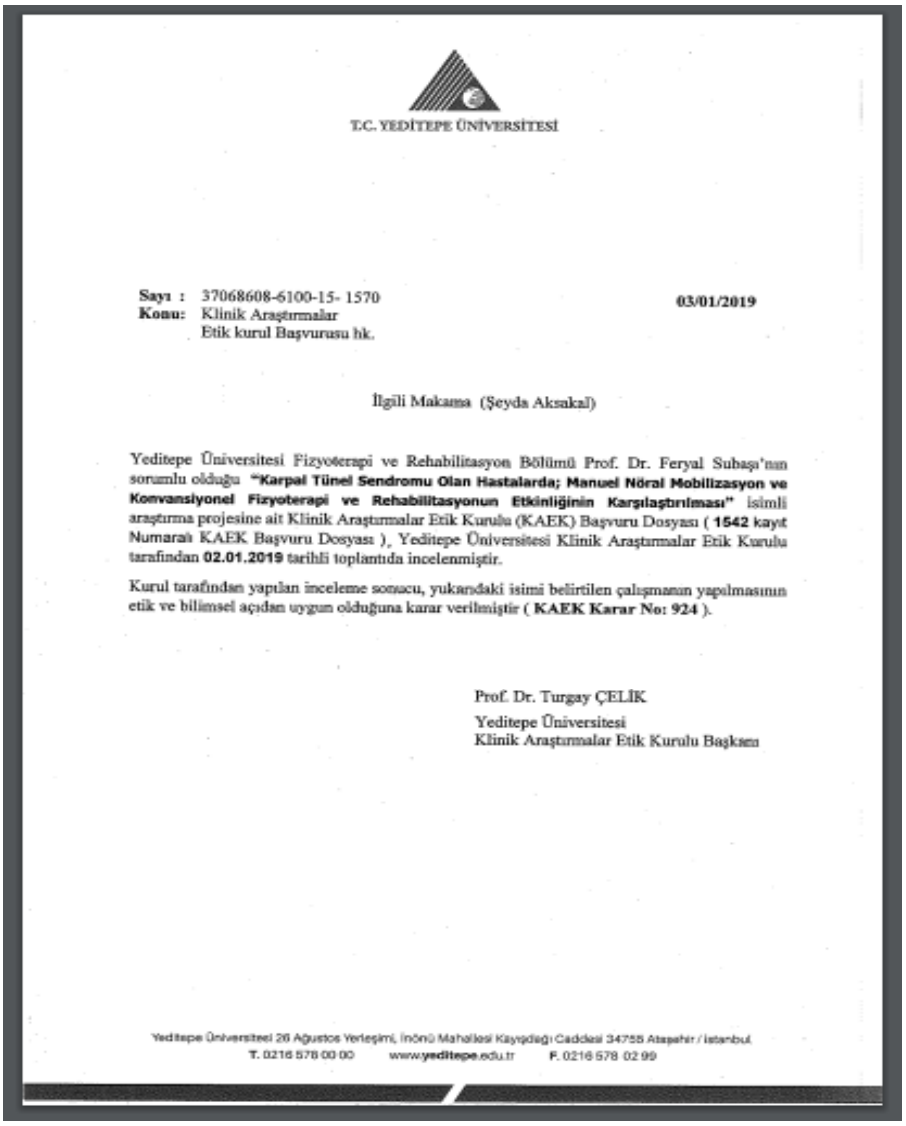
7. APPENDİX

7.1. Ethical Approval



T.C. YEDİTEPE ÜNİVERSİTESİ

Sayı : 37068608-6100-15- 1570 **03/01/2019**
Konu: Klinik Araştırmalar
Etik kurul Başvurusu hk.

İlgili Makama (Şeyda Aksakal)

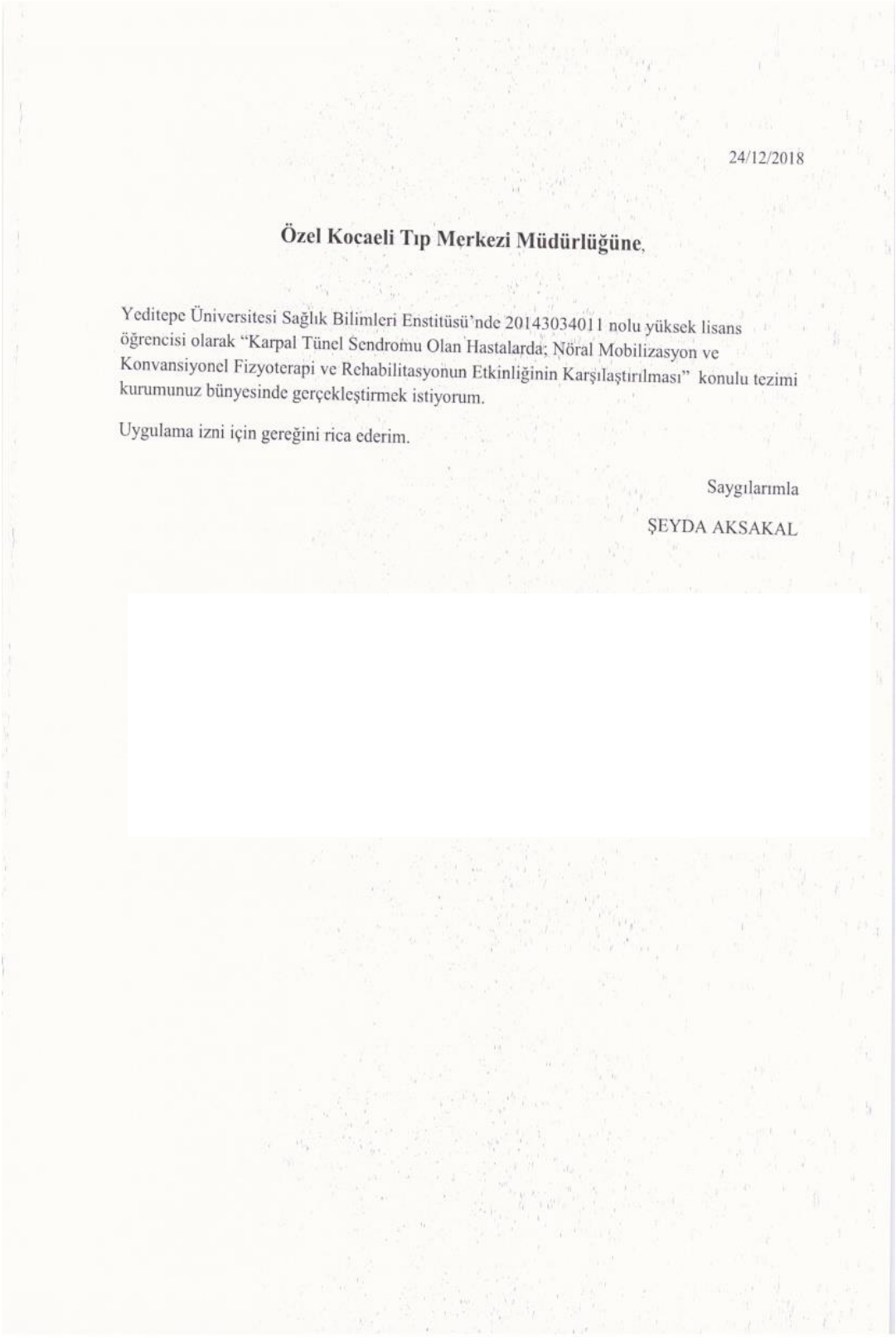
Yeditepe Üniversitesi Fizyoterapi ve Rehabilitasyon Bölümü Prof. Dr. Feryal Subaşı'nın sorumlu olduğu **"Karpal Tünel Sendromu Olan Hastalarda; Manuel Nöral Mobilizasyon ve Konvansiyonel Fizyoterapi ve Rehabilitasyonun Etkinliğinin Karşılaştırılması"** isimli araştırma projesine ait Klinik Araştırmalar Etik Kurulu (KAEK) Başvuru Dosyası (**1542** kayıt Numaralı KAEK Başvuru Dosyası), Yeditepe Üniversitesi Klinik Araştırmalar Etik Kurulu tarafından **02.01.2019** tarihli toplantıda incelenmiştir.

Kurul tarafından yapılan inceleme sonucu, yukarıdaki isimi belirtilen çalışmanın yapılmasının etik ve bilimsel açıdan uygun olduğuna karar verilmiştir (**KAEK Karar No: 924**).

Prof. Dr. Turgay ÇELİK
Yeditepe Üniversitesi
Klinik Araştırmalar Etik Kurulu Başkanı

Yeditepe Üniversitesi 26 Ağustos Yerleşimi, İnönü Mahallesi Kayışdağı Caddesi 34755 Ataşehir / İstanbul
T. 0216 578 00 00 www.yeditepe.edu.tr F. 0216 578 02 99

7.2. Approval from Hospital



24/12/2018

Özel Kocaeli Tıp Merkezi Müdürlüğüne,

Yeditepe Üniversitesi Sağlık Bilimleri Enstitüsü'nde 20143034011 nolu yüksek lisans öğrencisi olarak "Karpal Tünel Sendromu Olan Hastalarda; Nöral Mobilizasyon ve Konvansiyonel Fizyoterapi ve Rehabilitasyonun Etkinliğinin Karşılaştırılması" konulu tezimi kurumunuz bünyesinde gerçekleştirmek istiyorum.

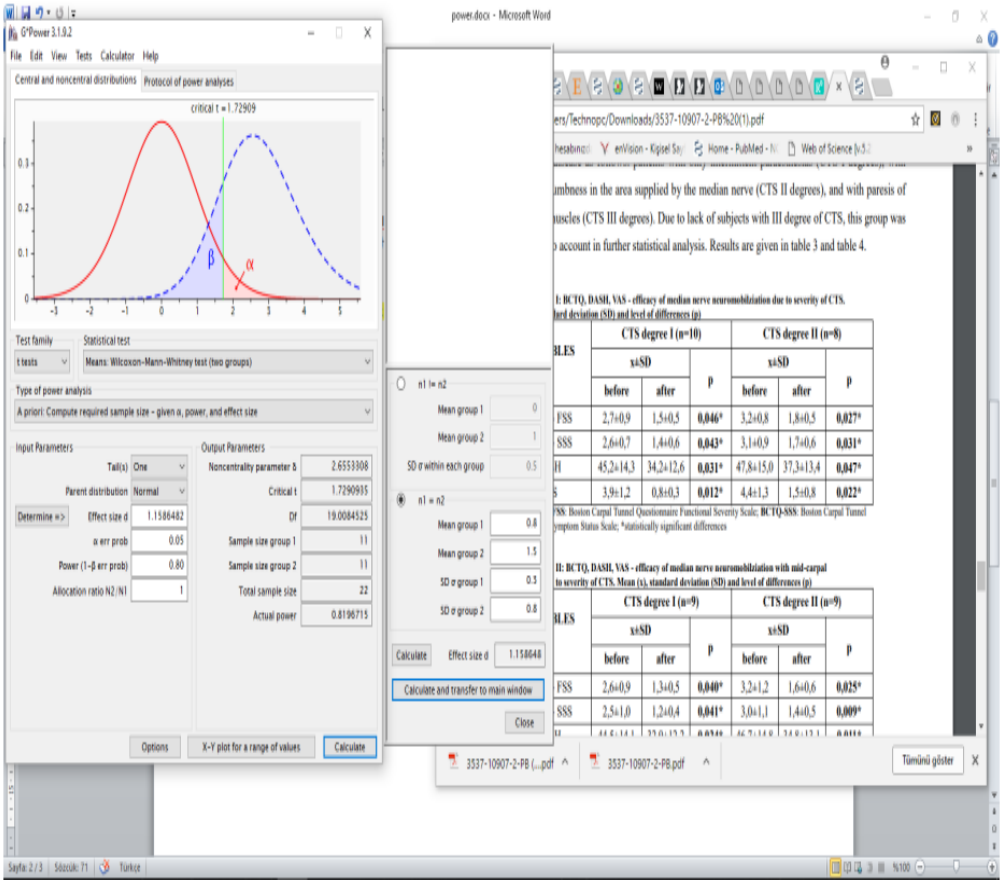
Uygulama izni için gereğini rica ederim.

Saygılarımla

ŞEYDA AKSAKAL

7.3. Sample Size Calculation - Gpower

Sample size was calculated by using power analysis based on the article which name was "Efficacy of neural mobilization and mid-carpal mobilization in the treatment of carpal tunnel syndrome" (α=0.05, 1-β=0.20" effect size=1.15). As a result of this study, sample size was determined 11 people in each groups by using Gpower.



7.4. Informed Concent Form in Turkish

BİLGİLENDİRİLMİŞ GÖNÜLLÜ OLUR FORMU

"Karpal Tünel Sendromu Olan Hastalarda; Nöral Mobilizasyon ve Konvansiyonel Fizyoterapi ve Rehabilitasyonun Etkinliğinin Karşılaştırılması" isimli yüksek lisans araştırma çalışması Özel Kocaeli Tıp Merkezi'nde yapılacaktır.

Araştırma Yeditepe Üniversitesi Fizyoterapi ve Rehabilitasyon Anabilim Dalı tez çalışmasıdır. Bu çalışmanın karpal tünel sendromu olan hastalar için konservatif tedavi seçeneklerinden olan nöral mobilizasyon ve konvansiyonel fizyoterapiden hangisinin veya hangilerinin etkili/etkisiz olduğunu belirlemektir. Çalışmaya gönüllülük esasına dayanarak 22 karpal tünel sendromu olan 30 ile 60 yaşları arasında kadın katılımcılar dahil edilecektir.

Tedavi kapsamında bir gruba nöral mobilizasyon diğer gruba ise konvansiyonel fizyoterapi uygulanacaktır. Her iki gruba da haftanın 5 günü ve 3 hafta süreli toplamda 15 seans tedavi uygulanacaktır. Bu tedaviye ek olarak her iki gruba da ev egzersiz programı verilecek ve bir çizelge yardımı ile takibi yapılacaktır.

Bu araştırmaya katılıp katılmama kararını vermeden önce, araştırmanın neden ve nasıl yapılacağını bilmeniz gerekmektedir. Bu nedenle bu formun okunup anlaşılması büyük önem taşımaktadır. Eğer anlayamadığınız ve sizin için açık olmayan şeyler varsa, ya da daha fazla bilgi isterseniz bize sorunuz. **Cevaplarınız bizim için değer taşımaktadır.**

Bu çalışmaya katılmak tamamen gönüllülük esasına dayanmaktadır. İstediğiniz zaman çalışmayı sonlandırabilirsiniz.

Bu formlardan elde edilecek bilgiler tamamen araştırma amacı ile kullanılacaktır. Araştırmada yapılan değerlendirmelerin sonuçları yalnızca araştırma kapsamındaki çalışmalarda ve sadece sorumlu araştırmacı tarafından kullanılacaktır. **Kişisel bilgileriniz herhangi bir amaçla, kurum yöneticileri veya üçüncü kişilerle kesinlikle paylaşılmayacaktır. Bu çalışma için gönüllü katılımcıdan, özel ya da devlete ait sağlık ödeneklerinden hiçbir şekilde ücret talep edilmeyecektir.**

Katılımınız için teşekkür ederiz.

Sorumlu Araştırmacı ve Danışman Öğretim Üyesi: Prof. Dr. Feryal SUBAŞI
Yardımcı Araştırmacı: Fzt. Şeyda AKSAKAL

Araştırma Süresince 24 Saat Ulaşılabilecek Kişi Adı / Soyadı / Telefonu:
Prof. Dr. Feryal Subaşı - 02165780000/3216
Fzt. Şeyda Aksakal - 05368116787

"Karpal Tünel Sendromu Olan Hastalarda; Nöral Mobilizasyon ve Konvansiyonel Fizyoterapi ve Rehabilitasyonun Etkinliğinin Karşılaştırılması" isimli çalışmada katılımcıya/gönüllüye verilmesi gereken bilgileri okudum ve katılmam istenen çalışmanın kapsamını ve amacını, gönüllü olarak üzerime düşen sorumlulukları tamamen anladım. **Çalışma hakkında yazılı ve sözlü açıklama, adı belirtilen araştırmacı tarafından yapıldı.** Bu çalışmayı istediğim zaman ve herhangi bir neden belirtmek zorunda kalmadan bırakabileceğimi ve bıraktığım takdirde herhangi bir olumsuzluk ile karşılaşmayacağımı anladım.

Bu koşullarda söz konusu araştırmaya kendi isteğimle, hiçbir baskı ve zorlama olmaksızın katılmayı kabul ediyorum.

Gönüllünün Adı /Soyadı /İmzası /Tarih

Açıklama Yapan Kişinin Adı /Soyadı /İmzası /Tarih
Fzt. Şeyda AKSAKAL

7.5. Sociodemographic Features Form in Turkish

Sosyo-Demografik Form

Hastanın Adı Soyadı: .... Tarih: ...../...../......

Yaş:	☐ 20-30	☐ 31-40	☐ 41-50	☐ 51-60	☐ 61-65	☐ 65-70	☐ 71-75	☐ >76

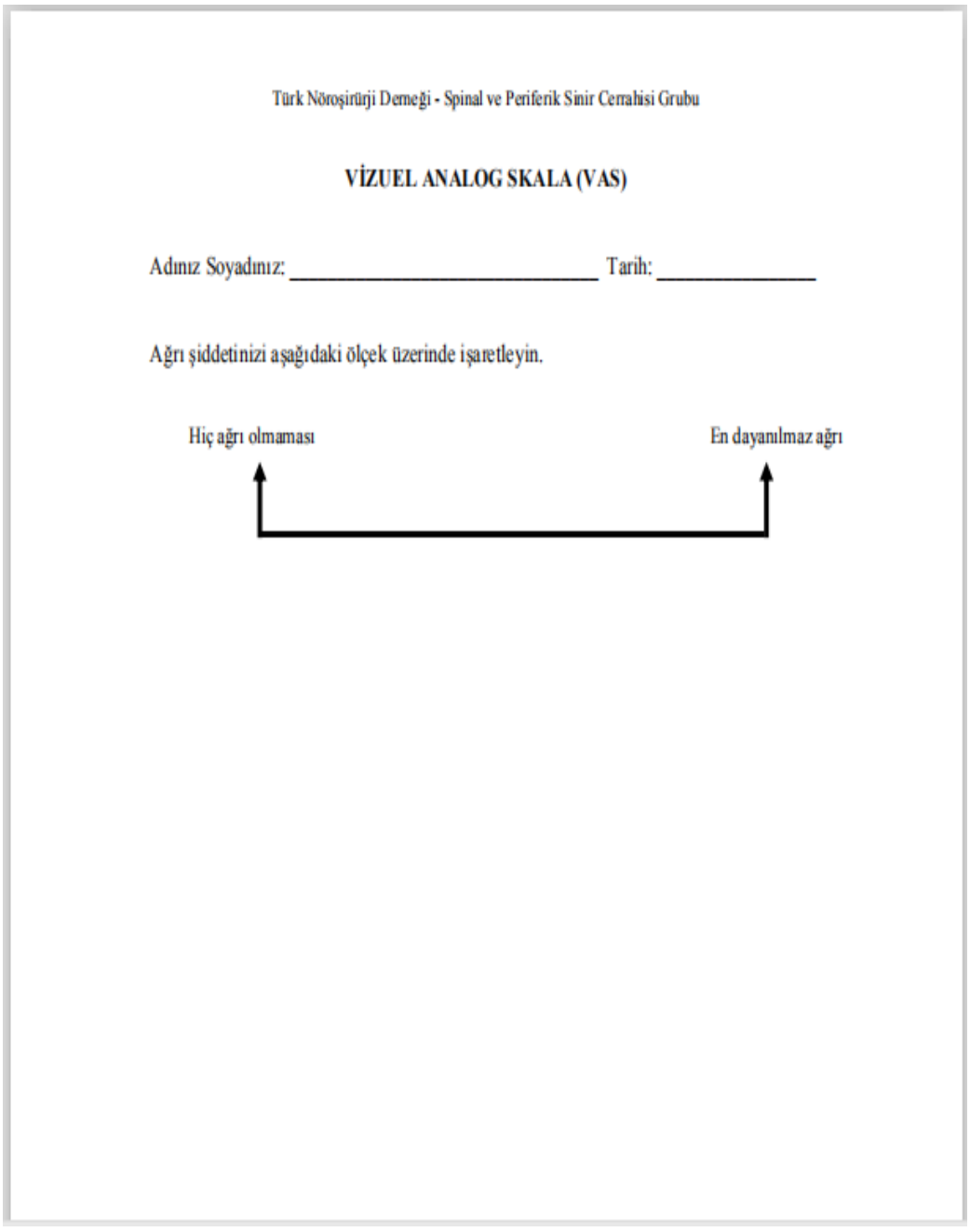
Cinsiyet: ☐ Kadın ☐ Erkek | Telefon: 0 (_ _ _) _ _ _ _ _ _ _

Adres: ____

Yaşadığı Yer:	☐ Büyük şehir	☐ Şehir	☐ İlçe	☐ Köy	
Sosyal Güvence:	☐ Özel Sigorta	☐ SGK	☐ Yeşil Kart	☐ Yok	
Medeni Durum:	☐ Evli	☐ Bekar	☐ Eşi vefat etmiş	☐ Boşanmış	
Alkol Kullanımı:	☐ Yok	☐ Nadiren	☐ Haftada 1 kadeh	☐ Günde 1 kadeh	
Sigara Kullanımı:	☐ Yok	☐ Bırakmış	☐ Tek-tük	☐ Haftada 1 paket	☐ Günde 1 paket ..... paket/yıl
Yaşadığı Ev:	☐ Apartman dairesi	☐ Müstakil	☐ Misafirhane - otel	☐ Bakım evi	
Kaldığı ev:	☐ Kendisine ait	☐ Ailesine ait	☐ Kira		
Yaşama ortamı:	☐ Tek başına	☐ Eşiyle	☐ Eşi ve çocuklarıyla	☐ Bakıcı ile	
Eğitim Durumu	☐ Okur-yazar değil	☐ İlkokul	☐ Ortaokul mezunu	☐ Lise mezunu	☐ Üniversite
İşi:	☐ Çalışmıyor	☐ Emekli	☐ Masa-başı iş	☐ Bedensel iş	
Gelir Düzeyi	☐ Asgari Ücret Altı	☐ Asgari Ücret	☐ Asgari Ücretin 2 Katı	☐ Asgari Ücretin >3 Katı	
Kronik Hastalıklar:	☐ Hipertansiyon	☐ Diyabet	☐ Osteoartrit	☐ Hiperlipidemi	
Yürümeye yardımcı araç:	☐ Yok	☐ Baston	☐ Koltuk Değ.	☐ Walker	☐ Tekerlekli sandalye

www.fitronline.com

7.6. Visual Analog Scale in Turkish Version



Türk Nöroşirürji Derneği - Spinal ve Periferik Sinir Cerrahisi Grubu

VİZUEL ANALOG SKALA (VAS)

Adınız Soyadınız: _____ Tarih: _____

Ağrı şiddetinizi aşağıdaki ölçek üzerinde işaretleyin.

Hiç ağrı olmaması — En dayanılmaz ağrı

7.7. Handgrip and Pinch Strength in Turkish version

El Kavrama Gücü Ölçüm Testi

Handgrip Strength Test (HGST)

Hastanın Adı Soyadı: ..... Tarih: ..../..../.....

Bu testin amacı el ve ön kol kaslarının maksimum izometrik kasılma gücünü test etmektir. Testin yapılabilmesi için el kavrama dinamometresi gereklidir (Jamar™, Camry™, Smedley™ gibi).

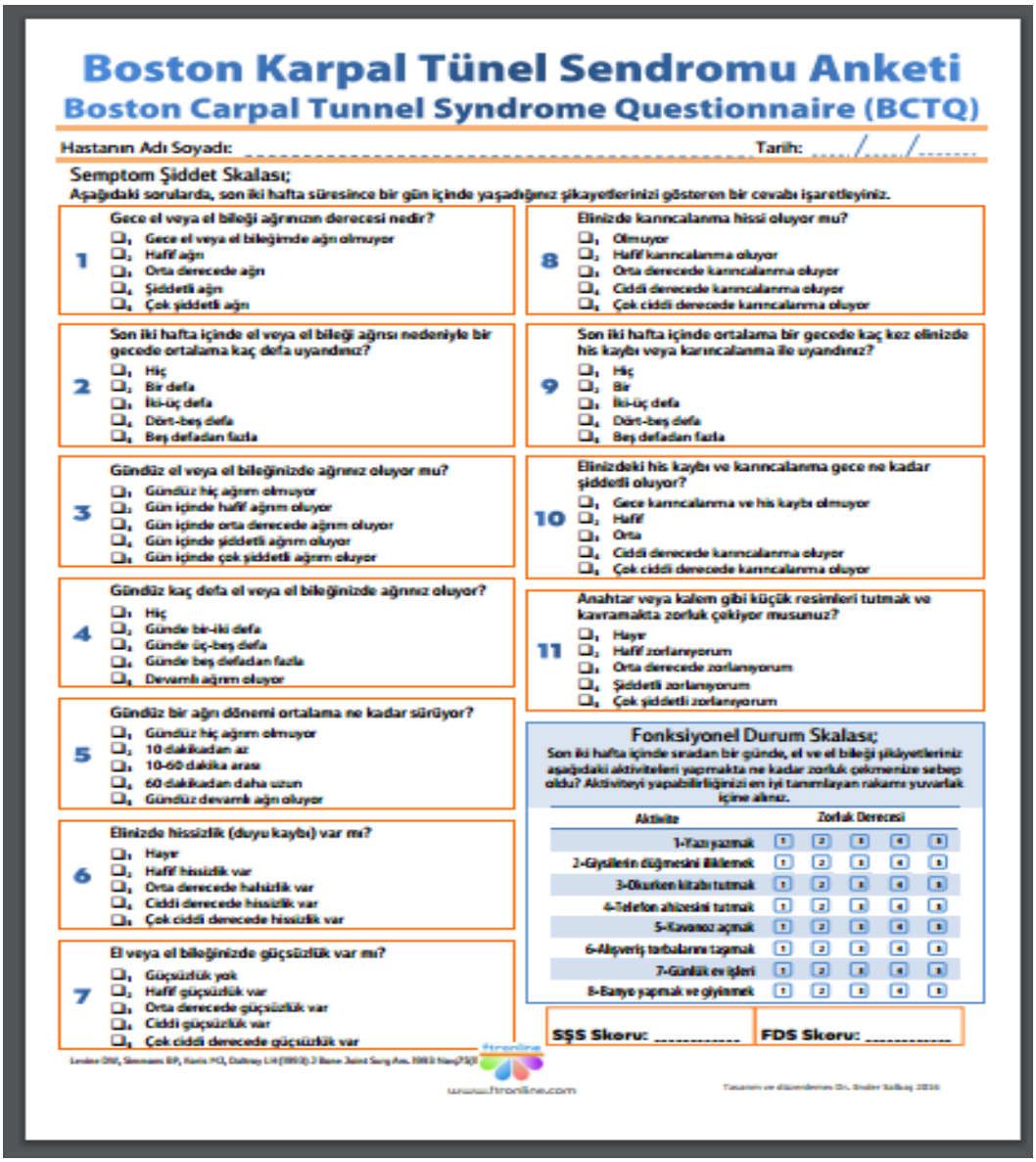
Dinamometre Örnekleri

Kavrama gücü hasta sandalyede otururken değerlendirilmelidir. Dirsekler gövdeye yakın ve 90° fleksiyonda tutulur. El bileği nötraldedir. Ölçüm yapılacak kişiden dinamometreyi kavrayarak yapabileceği en kuvvetli şekilde sıkması istenir. Test sonucu üç ölçümün ortalaması hesaplanarak belirlenir.

Ölçüm için norm değerler: 20-69 yaş erkeklerde 47-40kg (sol el 2 kg daha az) kadınlarda 30-24kg (sol el 1,5-2kg az)

	Sağ (kg)	Sol (kg)
1. Ölçüm	.....	.....
2. Ölçüm	.....	.....
3. Ölçüm	.....	.....
Ortalama	.....	.....

7.8. Boston Carpal Tunnel Syndrome Questionnaire in Turkish Version



Boston Karpal Tünel Sendromu Anketi

Boston Carpal Tunnel Syndrome Questionnaire (BCTQ)

Hastanın Adı Soyadı: _____ Tarih: ____/____/_____

Semptom Şiddet Skalası;

Aşağıdaki sorularda, son iki hafta süresince bir gün içinde yaşadığınız şikayetlerinizi gösteren bir cevabı işaretleyiniz.

1 Gece el veya el bileği ağrınızın derecesi nedir?
- ❑ Gece el veya el bileğinde ağrı olmuyor
- ❑ Hafif ağrı
- ❑ Orta derecede ağrı
- ❑ Şiddetli ağrı
- ❑ Çok şiddetli ağrı

2 Son iki hafta içinde el veya el bileği ağrısı nedeniyle bir gecede ortalama kaç defa uyandınız?
- ❑ Hiç
- ❑ Bir defa
- ❑ İki-üç defa
- ❑ Dört-beş defa
- ❑ Beş defadan fazla

3 Gündüz el veya el bileğinizde ağrınız oluyor mu?
- ❑ Gündüz hiç ağrım olmuyor
- ❑ Gün içinde hafif ağrım oluyor
- ❑ Gün içinde orta derecede ağrım oluyor
- ❑ Gün içinde şiddetli ağrım oluyor
- ❑ Gün içinde çok şiddetli ağrım oluyor

4 Gündüz kaç defa el veya el bileğinizde ağrınız oluyor?
- ❑ Hiç
- ❑ Günde bir-iki defa
- ❑ Günde üç-beş defa
- ❑ Günde beş defadan fazla
- ❑ Devamlı ağrım oluyor

5 Gündüz bir ağrı dönemi ortalama ne kadar sürüyor?
- ❑ Gündüz hiç ağrım olmuyor
- ❑ 10 dakikadan az
- ❑ 10-60 dakika arası
- ❑ 60 dakikadan daha uzun
- ❑ Gündüz devamlı ağrı oluyor

6 Elinizde hissizlik (duyu kaybı) var mı?
- ❑ Hayır
- ❑ Hafif hissizlik var
- ❑ Orta derecede hahsizlik var
- ❑ Ciddi derecede hissizlik var
- ❑ Çok ciddi derecede hissizlik var

7 El veya el bileğinizde güçsüzlük var mı?
- ❑ Güçsüzlük yok
- ❑ Hafif güçsüzlük var
- ❑ Orta derecede güçsüzlük var
- ❑ Ciddi güçsüzlük var
- ❑ Çok ciddi derecede güçsüzlük var

8 Elinizde karıncalanma hissi oluyor mu?
- ❑ Olmuyor
- ❑ Hafif karıncalanma oluyor
- ❑ Orta derecede karıncalanma oluyor
- ❑ Ciddi derecede karıncalanma oluyor
- ❑ Çok ciddi derecede karıncalanma oluyor

9 Son iki hafta içinde ortalama bir gecede kaç kez elinizde his kaybı veya karıncalanma ile uyandınız?
- ❑ Hiç
- ❑ Bir
- ❑ İki-üç defa
- ❑ Dört-beş defa
- ❑ Beş defadan fazla

10 Elinizdeki his kaybı ve karıncalanma gece ne kadar şiddetli oluyor?
- ❑ Gece karıncalanma ve his kaybı olmuyor
- ❑ Hafif
- ❑ Orta
- ❑ Ciddi derecede karıncalanma oluyor
- ❑ Çok ciddi derecede karıncalanma oluyor

11 Anahtar veya kalem gibi küçük resimleri tutmak ve kavramakta zorluk çekiyor musunuz?
- ❑ Hayır
- ❑ Hafif zorlanıyorum
- ❑ Orta derecede zorlanıyorum
- ❑ Şiddetli zorlanıyorum
- ❑ Çok şiddetli zorlanıyorum

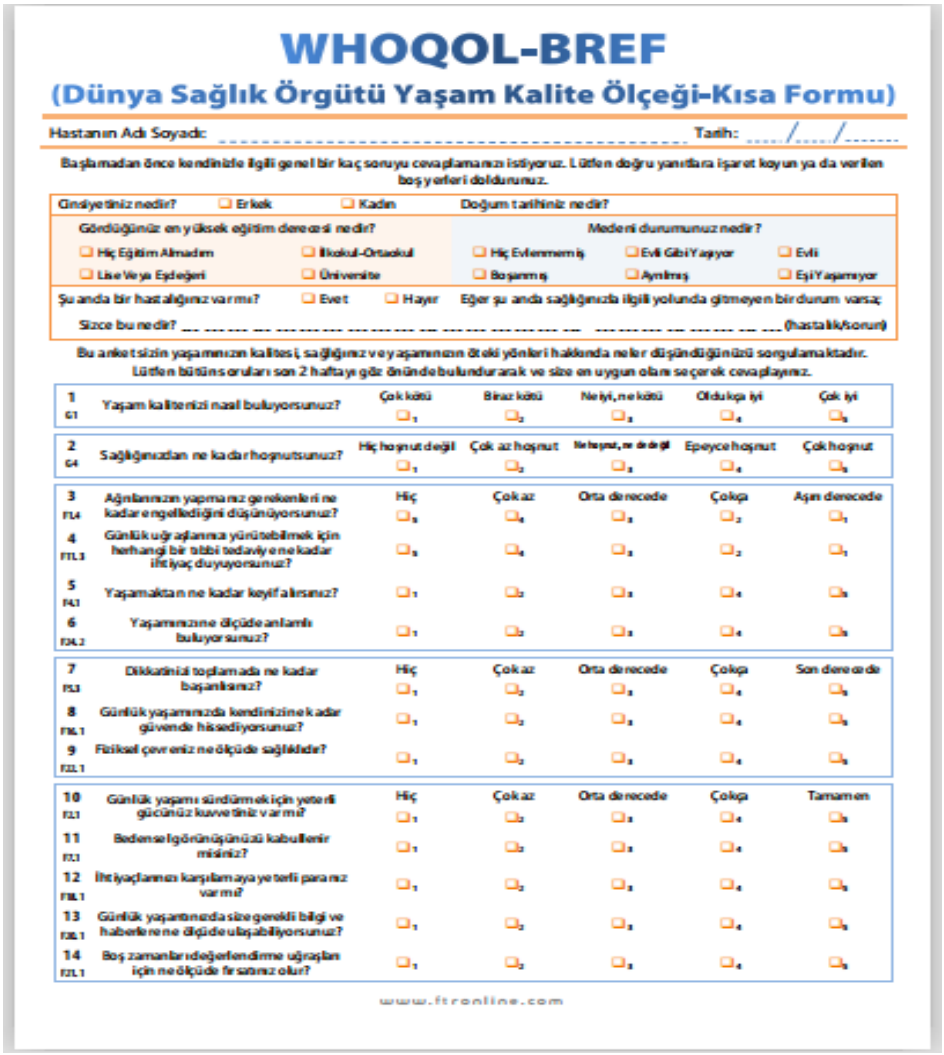
Fonksiyonel Durum Skalası;

Son iki hafta içinde sıradan bir günde, el ve el bileği şikâyetleriniz aşağıdaki aktiviteleri yapmakta ne kadar zorluk çekmenize sebep oldu? Aktiviteyi yapabilirliğinizi en iyi tanımlayan rakamı yuvarlak içine alınız.

Aktivite	Zorluk Derecesi				
1-Yazı yazmak	1	2	3	4	5
2-Giysilerin düğmesini iliklemek	1	2	3	4	5
3-Okurken kitabı tutmak	1	2	3	4	5
4-Telefon ahizesini tutmak	1	2	3	4	5
5-Kavanoz açmak	1	2	3	4	5
6-Alışveriş torbalarını taşımak	1	2	3	4	5
7-Günlük ev işleri	1	2	3	4	5
8-Banyo yapmak ve giyinmek	1	2	3	4	5

SŞS Skoru: _____ FDS Skoru: _____

7.9. World Health Organization Quality of Life Questionnaire in Turkish Version(WHOQOL-BREF)



WHOQOL-BREF

(Dünya Sağlık Örgütü Yaşam Kalite Ölçeği-Kısa Formu)

Hastanın Adı Soyadı: ..... Tarih: ...../...../.....

Başlamadan önce kendinizle ilgili genel bir kaç soruyu cevaplamanızı istiyoruz. Lütfen doğru yanıtlara işaret koyun ya da verilen boş yerleri doldurunuz.

Cinsiyetiniz nedir? ❑ Erkek ❑ Kadın Doğum tarihiniz nedir?

Gördüğünüz en yüksek eğitim derecesi nedir?
❑ Hiç Eğitim Almadım ❑ İlkokul-Ortaokul
❑ Lise Veya Eşdeğeri ❑ Üniversite

Medeni durumunuz nedir?
❑ Hiç Evlenmemiş ❑ Evli Gibi Yaşıyor ❑ Evli
❑ Boşanmış ❑ Ayrılmış ❑ Eşi Yaşamıyor

Şu anda bir hastalığınız var mı? ❑ Evet ❑ Hayır Eğer şu anda sağlığınızla ilgili yolunda gitmeyen bir durum varsa;
Sizce bu nedir? ..... (hastalık/sorun)

Bu anket sizin yaşamınızın kalitesi, sağlığınız ve yaşamınızın diğer yönleri hakkında neler düşündüğünüzü sorgulamaktadır. Lütfen bütün soruları son 2 haftayı göz önünde bulundurarak ve size en uygun olanı seçerek cevaplayınız.

1 G1	Yaşam kalitenizi nasıl buluyorsunuz?	Çok kötü ❑1	Biraz kötü ❑2	Ne iyi, ne kötü ❑3	Oldukça iyi ❑4	Çok iyi ❑5
2 G4	Sağlığınızdan ne kadar hoşnutsunuz?	Hiç hoşnut değil ❑1	Çok az hoşnut ❑2	Ne hoşnut, ne değil ❑3	Epeyce hoşnut ❑4	Çok hoşnut ❑5
3 F1.4	Ağrılarınızın yapmanız gerekenleri ne kadar engellediğini düşünüyorsunuz?	Hiç ❑5	Çok az ❑4	Orta derecede ❑3	Çokça ❑2	Aşırı derecede ❑1
4 F1.3	Günlük uğraşlarınızı yürütebilmek için herhangi bir tıbbi tedaviye ne kadar ihtiyaç duyuyorsunuz?	❑5	❑4	❑3	❑2	❑1
5 F4.1	Yaşamaktan ne kadar keyif alırsınız?	❑1	❑2	❑3	❑4	❑5
6 F24.2	Yaşamınızın ölçüde anlamlı buluyorsunuz?	❑1	❑2	❑3	❑4	❑5
7 F5.3	Dikkatinizi toplamada ne kadar başarılısınız?	Hiç ❑1	Çok az ❑2	Orta derecede ❑3	Çokça ❑4	Son derecede ❑5
8 F16.1	Günlük yaşamınızda kendinizine ne kadar güvende hissediyorsunuz?	❑1	❑2	❑3	❑4	❑5
9 F22.1	Fiziksel çevreniz ne ölçüde sağlıklıdır?	❑1	❑2	❑3	❑4	❑5
10 F2.1	Günlük yaşamı sürdürmek için yeterli gücünüz kuvvetiniz var mı?	Hiç ❑1	Çok az ❑2	Orta derecede ❑3	Çokça ❑4	Tamamen ❑5
11 F7.1	Bedensel görünüşünüzü kabullenir misiniz?	❑1	❑2	❑3	❑4	❑5
12 F18.1	İhtiyaçlarınızı karşılamaya yeterli paranız var mı?	❑1	❑2	❑3	❑4	❑5
13 F20.1	Günlük yaşantınızda size gerekli bilgi ve haberleşme ne ölçüde ulaşabiliyorsunuz?	❑1	❑2	❑3	❑4	❑5
14 F21.1	Boş zamanlarınızı değerlendirme uğraşları için ne ölçüde fırsatınız olur?	❑1	❑2	❑3	❑4	❑5

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WHOQOL-BREF Sayfa-2

15 FA1	Bedensel hareketlilik (etrafta dolaşabilme, bir yerlere gidebilme) beceriniz nasıldır?	Çok kötü ❑1	Biraz kötü ❑2	Ne iyi, ne kötü ❑3	Oldukça iyi ❑4	Çok iyi ❑5

		Hiç hoşnut değil	Çok az hoşnut	Ne hoşnut, ne değil	Epeyce hoşnut	Çok hoşnut
16 FA3	Uykunuzdan ne kadar hoşnutsunuz?	❑1	❑2	❑3	❑4	❑5
17 FA5	Günlük uğraşlarınızı yürütebilme becerinizden ne kadar hoşnutsunuz?	❑1	❑2	❑3	❑4	❑5
18 FA4	İş görme kapasitenizden ne kadar hoşnutsunuz?	❑1	❑2	❑3	❑4	❑5
19 FA3	Kendinizden ne kadar hoşnutsunuz?	❑1	❑2	❑3	❑4	❑5
20 FA3	Aile dışı kişilerle ilişkilerinizden ne kadar hoşnutsunuz?	❑1	❑2	❑3	❑4	❑5
21 FA3	Cinsel yaşamınızdan ne kadar hoşnutsunuz?	❑1	❑2	❑3	❑4	❑5
22 FA4	Arkadaşlarınızın desteğinden ne kadar hoşnutsunuz?	❑1	❑2	❑3	❑4	❑5
23 FA1	Yaşadığınız evin koşullarından ne kadar hoşnutsunuz?	❑1	❑2	❑3	❑4	❑5
24 FA1	Sağlık hizmetlerine ulaşma koşullarınızdan ne kadar hoşnutsunuz?	❑1	❑2	❑3	❑4	❑5
25 FA1	Ulaşım olanaklarınızdan ne kadar hoşnutsunuz?	❑1	❑2	❑3	❑4	❑5

26 FA1	Ne sıklıkta hüzün, ümitsizlik, bunalto, çöküntülük gibi duygulara kapılırsınız?	Hiçbir zaman ❑5	Nadiren ❑4	Arasıra ❑3	Çoğunlukla ❑2	Her zaman ❑1

27 u	Yaşamınızda size yakın kişilerle (eş, iş arkadaşı, akraba) ilişkilerinizde baskı ve kontrolle ilgili zorluklarınız ne ölçüdedir?	Hiç ❑1	Çok az ❑2	Orta derecede ❑3	Çokça ❑4	Aşırı derecede ❑5

Bu formun doldurulmasında size yardım eden oldu mu? ❑ Evet ❑ Hayır | Bu formun doldurulması ne kadar sürdü? _____

THE WHOQOL Group. Development of the World Health Organization WHOQOL-BREF Quality of Life Assessment. (1998) Psychological Medicine, 28, 551-558

Skorlama Yönergesi

Alt Parametre	Oluşturan sorular
Genel sağlık durumu	1 ve 2. Soruların toplamı
Fiziksel sağlık	3, 4, 10, 15, 16, 17, 18. Soruların toplamı
Psikolojik	5, 6, 7, 11, 19, 26. Soruların toplamı
Sosyal ilişkiler	20, 21, 22. Soruların toplamı
Çevre	8, 9, 12, 13, 14, 23, 24, 25. Soruların toplamı

Bu şekilde elde edilen skorlar "ham" skordur. Yüzdelik sisteme değiştirmek için gerekli olan formül;

$$\frac{(Hastanın\ ham\ skoru) - (o\ alt\ parametreye\ ait\ olabilecek\ en\ düşük\ skor)}{o\ alt\ parametrenin\ skor\ aralığı} \times 100$$

Örnek: Fiziksel sağlık alt parametresini ele alalım; toplam 7 madde var. Hastanın skor toplamı 30 olsun
[(30-7) / (35-7)] x 100 = (23/28) x 100 = %82,14

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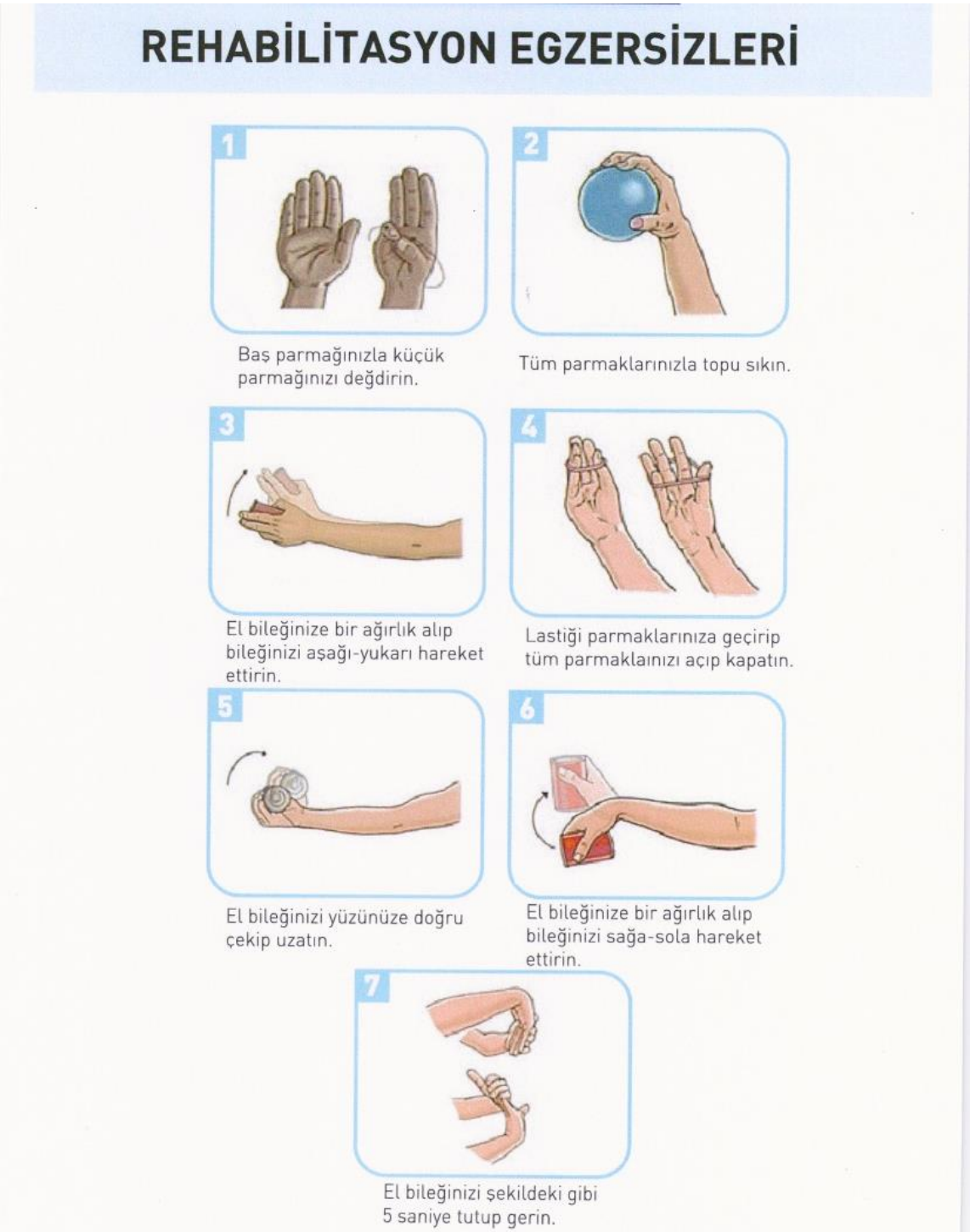
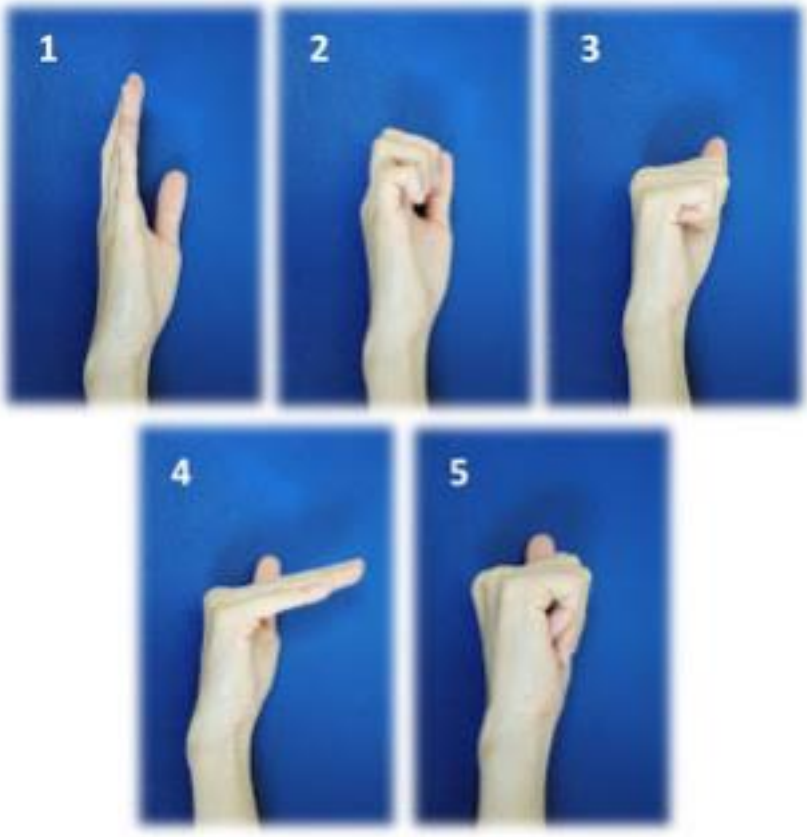
Tasarım ve düzenleme: Dr. Metin Saltuk, 2016

7.10. Home Exercise Form 1



7.11. Home Exercise Form 2



7.12. Home Exercise Following Chart

Pazartesi	Salı	Çarşamba	Perşembe	Cuma	Cumartesi	Pazar

8. CIRRICULUM VITAE

Kişisel Bilgiler

Adı	Şeyda	**Soyadı**	Aksakal
Doğum Yeri		**Doğum Tarihi**	
Uyruğu		**TC Kimlik No**	
E-mail		**Tel**	

Öğrenim Durumu

Derece	**Alan**	**Mezun Olduğu Kurumun Adı**	**Mezuniyet Yılı**
Doktora			
Yüksek Lisans			
Lisans	FTR	Yeditepe Üniversitesi	2014
Lise	-	Bahçeşehir Koleji	2009

Bildiği Yabancı Diller	**Yabancı Dil Sınav Notu ***
İngilizce	Çok İyi

*Başarılmış birden fazla sınav varsa(KPDS, ÜDS, TOEFL; EELTS vs), tüm sonuçlar yazılmalıdır.

İş Deneyimi (Sondan geçmişe doğru sıralayın)

Görevi	**Kurum**	**Süre (Yıl-Yıl)**
Fizyoterapist	Dr. Hatice Ergüner Fizik Tedavi ve GETAT Kliniği	2020 -
Fizyoterapist	Özel Kocaeli Tıp Merkezi	2014 - 2020

Bilgisayar Bilgisi

Program	**Kullanma Becerisi**
Microsoft Office Programları	İyi
SPSS	Orta

***Çok iyi, iyi, orta, zayıf olarak değerlendirin