TR
KIRSEHIR AHI EVRAN UNIVERSITY
HEALTH SCIENCES INSTITUTE
PHYSICAL THERAPY AND REHABILITATION
DEPARTMENT

COMPARISON BETWEEN TWO DEFFIRENT TREATMENTS ON CARPAL TUNNEL SYNDROME

MORTADHA SAEED AL-TALKANE

MASTER'S THESIS

KIRSEHIR / October 2022

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ACCEPTANCE AND APPROVAL

Kırşehir Ahi Evran University, Institute of Health Sciences, Department of Physiotherapy and Rehabilitation Master's thesis study titled Comparison Between Two Different Treatment on Carpal Tunnel Syndrome prepared by your graduate student Mortadha Saeed Altalkane with the number 201211150 was on 10/10/2022 by the following jury and Rehabilitation Department of Physiotherapy His master's thesis was accepted as a letter.

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THESIS STATEMENT

I declare that all the information in the thesis is obtained and presented within the framework of ethical behavior and academic rules, and in this study, which is prepared in accordance with the thesis writing rules, all kinds of statements that do not belong to me are fully cited to the source of the information.

MORTADHA AL-TALKANE

In accordance with Articles 9/2 and 22/2 of the Postgraduate Education and Training Regulation published in the Official Gazette dated 20.04.2016; A report in accordance with the criteria determined by the Institute of Health Sciences was obtained by using the plagiarism software program for this postgraduate thesis.

Preface

I thank God first, after patiently and diligently completing my study.

I would like to extend all my thanks to my professor, advisor Assoc. Dr. Öznur BÜYÜKTURAN, who taught me and accompanied me on this journey, without sparing any effort in helping me. I also took the opportunity to express my thanks to Dr. Buket BÜYÜKTURAN and Dr. Ismail CEYLAN, whom did not hesitate to advise me on the correction of my work.

And I never forget my mother, with her prayers I completed the road in peace. And my father who supports me with everything I do. And thanks to all my family members.

And my wife, who was patient and endured with me the hardships of the path of knowledge.

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MORTADHA AL-TALKANE

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LIST OF ICONS AND ABBREVIATIONS

CTS: Carpal tunnel syndrome

BCTQ: Boston carpal tunnel questionnaire

FSS: Functional Status Scale

SSS: Symptom Severity Scale

MRI: Magnetic resonance imaging

TCL**:** Transverse carpal ligament

ESWT: Extracorporeal shock wave therapy

FCR: Flexor carpi radialis

NSAIDs: Non-steroidal anti-inflamatory drugs

CTR: Carpal tunnel release

DASH: Disability of Arm, Hand and Shoulder score

Figure-of-Eight shape: Test for hand oedema

VAS: Analogue visual scale (pain scale)

ROM1: Wrist flexion range of motion

ROM2: Wrist extension range of motion

ROM3: Wrist ulnar deviation range of motion

ROM4: Wrist radial deviation range of motion

ABSTRACT

Master of Science Thesis

COMPARISON BETWEEN TWO DEFFIRENT TREATMENTS ON CARPAL TUNNEL SYNDROME

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Carpal tunnel syndrome (CTS) is defined as an entrapment of the median nerve in the carpal tunnel in the wrist, generally associated with an increase in carpal tunnel pressure. It is the most common peripheral neuropathy in the upper quadrant. CTS is characterized by pain and paresthesia in the distributions of the median nerve, including the palmar side of the first finger, the second and third finger and the radial half of the fourth finger; it also involves a loss of sensitivity, manual dexterity and functionality. High amplitude acoustic waves which focus on a region of the body are mentioned as extracorporeal shock wave therapy (ESWT). The shock waves are characterized by high positive pressure up to 100 Megapascals (MPa), fast peak duration (10 to 30 nano-sec), and short pulse duration (5 microsec). This study was conducted at Al-Najaf teaching hospital. 40 patients (male=9 and female=31) range of their ages (21-60) years with CTS voluntarily participated in the study. Participants were selected from orthopedic and rheumatology clinics in Al-Najaf teaching hospital and randomly divided into two groups, in each group 20 person. Visual analogue scale (VAS), disability of arm, shoulder and hand score (DASH), figure-of-eight shape for hand oedema, Boston carpal tunnel questionnaire (BCTQ), wrist joint range of motion in 4 directions (ROM) and hand grip strength (JAMAR) are used as outcome measurements. A group were treated with ESWT for five sessions (single session per week) and B group were had oral medical treatment (pregabalin, nerubion NISIDs), the follow up has been made after two weeks of interventions. In statistical analysis, there was a highly significant improvement in A group of: DASHS, FSS of BCTQ, SSS of BCTQ, VAS

and JAMAR P= 0.001. There were no significant differences in ROM and figure-of-eight shape for hand oedema. In this study we aimed to assess the pain, functional status, symptoms and hand grip strength, we found that there is an improvement in patients whom treated with ESWT more than patients whom took pharmacotherapy.

Keywords: Carpal tunnel syndrome, functional status, pain, hand grip strength, shock wave therapy.

ÖZET

Yüksek Lisans Tezi

KARPAL TÜNEL SENDROMUNDA İKİ FARKLI TEDAVİ ARASINDAKİ KARŞILAŞTIRMA

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Karpal tünel sendromu (KTS), median sinirin el bileğinin karpal tünelinde sıkışması olarak tanımlanır ve genellikle karpal tünel basıncındaki artış ile ilişkilidir. Üst kadranda en sık görülen periferik nöropatidir. KTS, birinci parmağın palmar tarafı, ikinci ve üçüncü parmaklar ve dördüncü parmağın radyal yarısı dahil olmak üzere median sinirin dağılımlarında ağrı ve parestezi ile karakterizedir; aynı zamanda hassasiyet, el becerisi ve işlevsellik kaybını da içerir. Vücudun bir kısmına odaklanan yüksek genlikli akustik dalgalara vücut dışı şok dalgası tedavisi (ESWT) denir. Şok dalgaları, 100 Megapaskal'a (MPa) kadar yüksek pozitif basınç, hızlı tepe süresi (10 ila 30 nanosaniye) ve kısa darbe süresi (5 mikrosaniye) ile karakterize edilir. Bu çalışma Al-Necef eğitim hastanesinde yapılmıştır. Çalışmaya kendi yaşları (21-60) arasında KTS'li 40 hasta (erkek=9 ve kadın=31) gönüllü olarak katıldı. Katılımcılar Al-Necef eğitim hastanesindeki ortopedi ve romatoloji kliniklerinden seçildi ve her grupta 20'şer kişi olacak şekilde rastgele iki gruba ayrıldı. Görsel analog skala (VAS), kol, omuz ve el sakatlığı skoru (DASH), el ödemi için sekiz şekli şekli, Boston karpal tünel anketi (BCTQ), bilek eklemi 4 yönde hareket açıklığı (ROM) ve el kavrama gücü (JAMAR) sonuç ölçümleri olarak kullanılır. Bir gruba beş seans (haftada tek seans) ESWT, B grubuna oral medikal tedavi (pregabalin, nerubion NISID'ler) uygulandı, iki haftalık müdahalelerin ardından takip yapıldı. İstatistiksel analizde, DASHS, BCTQ'nun FSS'si, BCTQ'nun SSS'si, VAS ve JAMAR P= 0,001'den oluşan A grubunda oldukça anlamlı bir gelişme vardı. El ödemi için ROM ve sekiz

rakamı şeklinde anlamlı bir fark yoktu. Ağrı, fonksiyonel durum, semptomlar ve el kavrama kuvvetinin değerlendirilmesini amaçladığımız bu çalışmada, ESWT ile tedavi edilen hastalarda farmakoterapi alan hastalara göre daha fazla iyileşme olduğunu bulduk.

Anahtar Kelimeler: Karpal tünel sendromu, fonksiyonel durum, ağrı, el kavrama kuvveti, şok dalgası tedavisi.

1. INTRODUCTION

Median nerve entrapment in the carpal tunnel of the wrist causes carpal tunnel syndrome (CTS), which manifests itself clinically as an increase in carpal tunnel pressure (1). It's the most common kind of upper-limb neuropathy. CTS occurs in 3.8% to 4.9% of the population, with females being three times more likely to be affected than males (1, 3). The rising cost of treating this condition is having a significant impact on the economy (4).

CTS is characterized by pain and paresthesia in the median nerve regions, including the palmar side of the first finger, the second and third fingers, and the radial half of the fourth finger, as well as a loss of sensitivity, manual dexterity, and functioning. However, the indications and symptoms vary and are not proportional to the severity of the condition (1, 5). In extreme situations, it is possible to characterize median nerve-innervated muscle weakness and the extension of symptoms to the forearm, upper arm, and sometimes the shoulder. Atrophy of the thenar eminence and decreased thumb abduction and opposition seem to be the most prominent symptoms (1, 6).

Due to the increased intraneural pressure in the carpal tunnel or vascular deficits, some clinical disorders such as obesity, diabetes, and hypothyroidism are associated with a doubled chance of developing CTS (7). Different explanations have been postulated: decreased microvascular circulation for type 1 and type 2 diabetes (8); mucopolysaccharide complex depot for thyroid disorders (9); hormonal modification and oedema for menopause and pregnancy (6); and alteration of the body's fluid balance for obesity (10).

Mild and moderate CTS are amenable to conservative therapy, but severe CTS is more amenable to surgical intervention (11). Nonsurgical treatment options include splinting, steroid injections, pharmacological anti-inflammatory drugs, vitamin B6 supplements, electrical stimulation, contrast baths, and workouts for the tendon and nerve gliding (11). Extracorporeal shock waves (ESW) are a series of acoustic pulses characterized by a high peak pressure (100 MPa), rapid pressure rises (10 ns), short duration (10 MS), and energy density ranging from 0.003 to 0.89mJ/mm2. 6 Multiple studies have established the usefulness of ESWT in the treatment of a variety of musculoskeletal ailments (12). There have been reports of both direct and indirect impacts of shock waves. High stress has a direct influence on material surfaces due to positive pressure and a rapid rising time,

whereas tensile waves have an indirect effect. (cavitation). By enhancing tissue (neovascularization) and the vulnerability of the neuron cell membrane, these waves may hasten cell regeneration. Free radical damage to cell membranes, inhibition of sensory nerve activation, and central control of sensory input have all been proposed as analgesic mechanisms (13). The impact of ESWT on peripheral nerves has lately garnered more interest. Two, four, and seven days after the administration of low-energy ESWT to rat skin, the intracutaneous nerve fibers degenerated almost completely. Two weeks following therapy, reinnervation achieves a non-significant difference (14). Shock wave technology has used non-focused, low-energy radial-ESWT as a simpler and more successful way. It is applicable for the treatment of superficial tendinopathies and muscular diseases (15). In addition to its widespread use for conditions like lateral elbow tendonitis, nonunions, calcific tendinitis, Calf muscle tendinitis, plantar fasciitis, and patellofemoral tendinitis, ESWT has recently emerged as a novel treatment option for individuals suffering from chronic tenosynovitis syndrome (CTS) (2).

Our aim of this study is to compare the effects of using extracorporeal shock wave therapy and pharmacological treatment on patients with mild to moderate CTS, and see the differences in pain, symptoms, and functional status according to the following hypotheses:

H0: ESWT has more efficacy in reducing the severity of signs, symptoms, and functional status in patients with mild to moderate CTS than pharmacological treatment.

H1: ESWT and pharmacological treatment have the same efficacy in reducing the severity of signs, symptoms, and functional status in patients with mild to moderate CTS.

2. GENERAL INFORMATION

2.1 Anatomy

As a consequence of variations in anatomy, CTS symptoms tend to differ. In 1% to 3.3% of instances, for instance, there is a bifid median nerve due to the high division of the nerve (16, 17). This is due to the tenacity of the median artery or a further split of the superficial flexor of the third finger. The motor branch of the median nerve has an additional variant. In this form, the thenar division has five distinct sorts of beginning places and routes. The extraligamentous type of variation occurs in over half of all cases (46%), followed by the subligamentous type (31%) and the transligamentous type (23%). (16, 18). It is possible that the thenar branch nerve bundles are situated on the radial, anterior, or central aspect of the median nerve. In certain cases, the thenar branch enters the thenar muscles after passing via a tunnel. These variations reflect the inconsistent motor impact in situations of severe median nerve compression. The median nerve's palmar cutaneous branch has a second variant. Thus, the palmar cutaneous division often starts 4–7 centimeters above the wrist crease and runs 1.6–2.5 centimeters in volume along the median nerve. Innervation of the thenar eminence skin is provided by a branch that travels from the median border of the Musculus flexor carpi radialis (FCR) via a fascial tunnel and emerges 0.80 cm above the wrist flexion wrinkle. When the transversal ligament of the carpus is not in the way, the palmar epidermal branch travels to the ulnar side of the median nerve. Ulnar nerve intratunnel implantation is a less frequent but nonetheless possible alternative. When present, the anomaly exhibits signs typical of both the median and ulnar nerves (19). The shape and size of the carpal tunnel are also influenced by the activities of the wrist joint. The bony walls of the tunnel are flexible, so the carpal bones may relate back to each other when the wrist is in its normal range of motion (20). Additionally, flexion and extension increase carpal tunnel pressure. In contrast, when the wrist joint flexes, the cross-section of the proximal aperture of the carpal tunnel shrinks. This happens when the distal end of the capitates bone shifts and the transverse carpal ligament (TCL) undergoes circular changes. While being forced towards the tunnel's center, extreme extension causes the *os lunate's* path to become compressed. The TCL is the dense, narrow, and wide important component of the flexor retinaculum, with dimensions of 2 to 4 mm in thickness, 25 mm on average in breadth, and 31 mm in length (20, 21). It consists of interwoven bundles of fibrous connective

tissues to produce a solid band. In addition, it extends from the distal radius to the distal metacarpal base. The average distance from the capitate-lunate joint to the central section is 11 mm, but the average distal limit of the distal portion is 10 mm distal to the carpometacarpal joint of the third metacarpal (20).

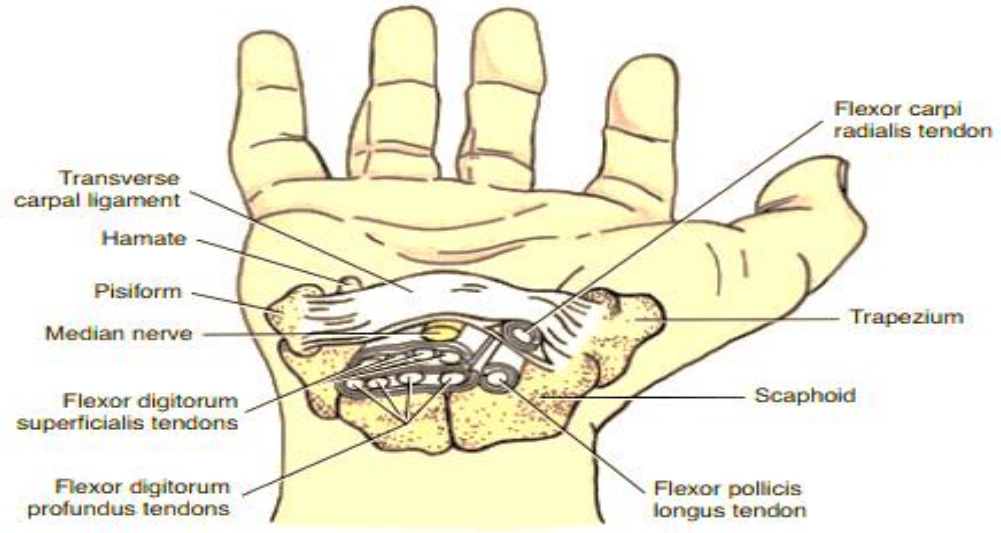

Figure 1. Carpal Tunnel Anatomy (22)

2.2 Epidemiology

According to the diagnostic criteria employed in various research, the denounced propagation and incidence of CTS quite significantly. Clinically, it is believed that 1 in 10 persons will evolve CTS at some time (23). Using clinical criteria for diagnosis yields a larger estimate than using electrophysiological criteria. (24). Even when clinical appearance is used sole to establish CTS, the use of broad (history or Phalen's test) or rigorous (sensory or motor impairments) criteria results in variable prevalence findings (3, 25, 26). CTS has been apprised to afflict predominantly women (Typically diagnosed between the ages of 50 and 60), nonetheless, this information is inherently biased since Patients who voluntarily sought out the services of a neurophysiology clinic or laboratory are the source material for these studies (27, 28). Overall, three times more women than males suffer with CTS (29). However, the largest frequency was among women over the age of 65 had a prevalence rate more than 4 times that of men (3).

2.3 Clinical features

The long-accepted gold standard for diagnosing CTS is a detailed and precise medical record-keeping, combined with the elimination of another probable malady. This demonstrates the significance of manifestations of CTS in patients. The condition is first characterized by intermittent, nocturnal paresthesia and dysesthesias that occur more often during waking hours (30). In the latter stages of the illness, severe axonal degeneration causes a loss of feeling, as well as weakening and atrophy of the thenar muscles. This pattern of symptoms is extremely usual, appearing seldom in conditions other than CTS (30).

In extreme cases, CTS symptoms may move from the hand to the forearm, upper arm, and shoulder. When questioned about the precise location of their pain and sensory symptoms, persons with CTS often say that pain, and not numbness, tingling, or other sensory abnormalities, characterizes the proximal symptoms. For a lengthy period of time, only hand-related symptoms related to the median nerve were considered valid in the literature's sensory diagnostic criteria. When working with patients, however, the application of more general sensory criteria, which did not limit the first 3 digits only, but there are other symptoms instead included the whole palmar surface. That often-observed manner of sensory deficits may originate in the peripheral nerve system (concurrent ulnar involvement) or the central nervous system (central sensitization), or both (31–34). According to the current information, more severe abnormalities in nerve conduction velocity are linked to disease clustering along the path of the median nerve (35). Therefore, If the treatment and diagnostic plan are to be made accurately, a detailed description of the symptom location is essential (31). As though, sensory function testing is worthless unless if action is taken meticulously using definitive devices (e.g., monofilament or static two-point discrimination).

Pain is a common complaint among people who seek medical attention for CTS, but it is seldom studied and is generally dismissed as just one of several symptoms. While neuropathic sensory abnormalities (such as paraesthesias, numbness, or tingling) may also be noted, they should not be confused with the pain that may or may not be present. Chronic pain may alter cortical hand somatotopy in a manner distinct from that of paraesthesias (32). Pain was detected in 52% of 1123 individuals in a multicenter trial with CTS (30).

Tinel's and Phalen's tests are common CTS diagnostic tests. Positive consequences are determined when manifestations are elicited by percussion of the median nerve at the wrist or by a one-minute position of the wrists that is either forced or compressive (36). Although these tests are commonly utilized due to their simplicity of administration, their sensitivity and specificity are hotly contested. Phalen's test has a sensitivity range of 42% to 85% and Tinel's test has a sensitivity range of 38% to 100%; specificity varies from Ratios (in hundred percentage) of 54 to 98 and 55 to 100, respectively (36).

The power of the abductor pollicis brevis muscle may give important notification on functional morbidness caused by CTS, but clinical examination alone is not a reliable method for quantifying this information (37). Hand dynamometry may be superior than clinical evaluation, but it is seldom employed in clinical practice due to time constraints and the necessity for specialized equipment (38). In addition, hand dynamometry needs standardization with social standards modified for age and gender in order to outfit relevant data (38, 39). The optimal technique for measuring hand muscle power following carpal tunnel release is still a topic of discussion (39).

2.4 Diagnosis

Two articles of the Quality Subcommittee of the American Academy of Neurology (AAN) outlined the recommendations for clinical and neurophysiologic diagnosis. Guidelines for clinical and neurophysiologic diagnosis of CTS were outlined in two papers by the Quality Standards Subcommittee of the American Academy of Neurology, American Association of Electrodiagnostic Medicine, American Academy of Physical Medicine and Rehabilitation, and American Academy of Neurology. The beginning of symptoms is the most important aspect of the case history to describe (Initially, nighttime paraesthesias are more common than daytime ones.), causes of agitation (positions, continual motion), do some labor (Use of Instruments, vibrating equipment), localization and propagation of pain (inside the median nerve of the skin, with irradiation either upward (occasionally to the shoulder) or downward.), maneuvers that reduce discomfort (shifts in posture and shaking of hands), and the presence of predisposing factors (Diseases such as diabetes, obesity, arthritis, myxedema, acromegaly, and pregnancy), Sporting events (baseball, body building (40).

2.4.1 Differential diagnosis

CTS must to be distinguished from:

• Cervical disorders (especially C6–C7)

• Brachial plexopathy (in particular of the upper trunk)

• Proximal median nerve defect (specifically, at the level of the pronator teres)

• Thoracic outlet syndrome

• General nervous system faults (multiple sclerosis, small cerebral infarction).(41)

2.4.2 Instrumental diagnosis and its evaluation

In order to determine the extent of demyelination and axonal loss, a patient with suspected median nerve dysfunction might benefit greatly from an electrophysiological evaluation (nerve conduction investigations), which is very sensitive (28). Since the results of a diagnosis of CTS might have an effect on prognosis, it is helpful to evaluate nerve activity and the measurement of nerve damage. Needle electromyography is not very helpful for many patients, although sensory and motor nerve conduction investigations are often performed to evaluate the nerve's capacity to convey an electrical stimulation (28). Needle electromyography is not emphasized in the current recommendations for practice and is instead seen as a test that is best used to rule out other possible explanations of the patient's symptoms (such as cervical radiating pain) rather than to increase sensitivity of diagnostic tests (28).

Axonal loss may be shown by needle electromyography; however, typically, one may conclude this by analyzing abductor pollicis brevis weakness during a diagnostic procedure (42 ,43). Sensory fibers' reduced conduction velocity in the nerve's digital segments may be observed before that of motor fibers or the whole nerve (28). As of yet, we don't know why sensory fibers become involved so quickly (28).

Since median nerve entrapment results some factors that may reduce the sensitivity of electrophysiological testing for focal slowing of nerve conduction velocity in mild demyelination include: inter-individual variability of nerve conduction velocity; inter-nerve variability that limits sensitivity; and currently averaging of nerve conduction slowing along the wrist-finger segment (the total conduction velocity is normal since the affected nerve segment is short.). Since CTS often affects both sides of the heart,

comparing the two sides electrophysiologically (or by imaging) does not improve diagnostic sensitivity (24).

The American Academy of Neurology, the American Association of Electrodiagnostic Medicine, and the American Academy of Physical Medicine and Rehabilitation have done extensive effort to offer clinicians with guidelines for electrophysiological testing. If the Conductivity of the Median Nerve for Sensory and Motor Impulses investigations at the wrist come back normal, the guidelines advise moving on to the high specificity and sensitivity have been seen in comparative, segmental, and comparative and segmental tests (between 80% and 90% and <95%, respectively; [Figure 2]). Disease is considered functionally moderate despite potentially severe symptoms when there are clinical indicators but no electrophysiological abnormalities (44).

Patient-centered assessments that have been shown to be valid (such as the Boston CTS Questionnaire [BCTQ]) may provide quantitative data on symptoms and impairment. Both clinical and nerve conduction studies correlate with impairment level (30). Ultrasonography has just reached the determination necessary to be effective in the diagnosis of CTS thanks to recent technological advancements, such as the creation of cheap high-frequency probes (30).

Nerves (fascicles, epineurium, and perineurium) and their accompanying structures may now be captured in stunning detail by ultrasonography (Figure 2[B]). The median nerve's morphology is likely to change in CTS due to compression from the surrounding squishy components. As a consequence, the compressed nerve is smaller, while the nerves position relative to the compression's proximal and distal are enlarged. Electrophysiological proof of reduced the rate of nerve conduction at the point of entrapment focally has traditionally been used to validate the clinical diagnosis of CTS. Ultrasound imaging has advanced to the point that it may see the nerve's enlarged cross-sectional area right before it is compressed. Using clinical presentation as the gold standard, a recent meta-analysis of 35 studies found that the approach had a sensitivity of 77.6% and a specificity of 86.8% for diagnosis of CTS. Guidelines based on evidence suggest that screening for structural problems of the wrist should also take into account ultrasonography assessment of the median nerve cross-sectional area at the wrist (Figure 2[A])(45). Not much is known about whether ultrasonography may serve as a viable alternative to electrophysiology, despite its promising diagnostic sensitivity and the

possibility of additional uses in the evaluation of nerve function. Because of methodological inconsistencies across several research, we lack clear diagnostic cutoffs for either methodology, and a comprehensive head-to-head comparison of the two has not been conducted (46).

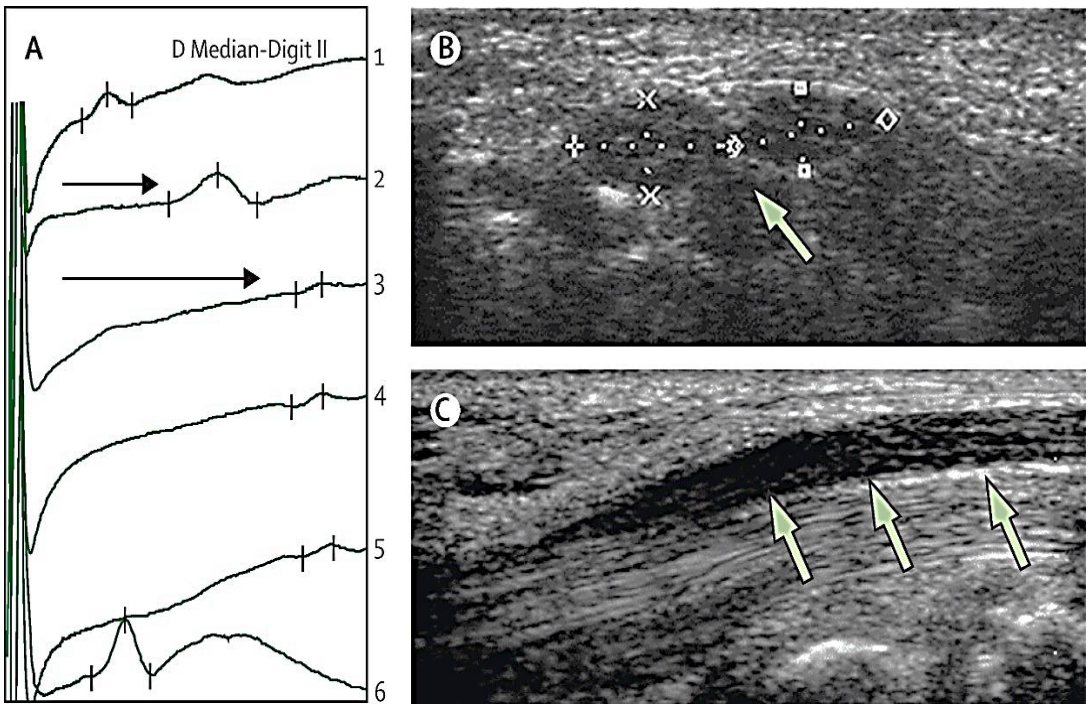

Figure 2. Electrophysiological and ultrasound features of CTS. (A Nerve conduction study. B Transverse ultrasound image of bifid d median nerve. C Longitudinal ultrasound image of median nerve).

MRI tractography is a novel method for visualizing nerves. Using this method, researchers have found that they may learn more about disruption of structure and inflammation, with preliminary research suggesting that the findings of nerve conduction tests and apparent diffusion coefficient and fractional anisotropy are in agreement (46, 47). However, the high price prevents widespread use despite the method's superior imaging quality; as with ultrasonography, further study is needed to demonstrate that the technique's additional therapeutic benefit is worth the investment (24).

2.5 Risk Factors

There are risk factors for developing CTS, despite the fact that it is classified as an idiopathic illness. Extended postures in excesses of repeatedly bending or straightening the wrist activation of the flexor muscles, and insinuation to vibration are all major environmental risk factors (49). Health variables associated with CTS, in contrast to environmental ones, may be broken down into four distinct groups. Variables external to the tunnel that enlarge its interior, factors inside to the tunnel that enlarge its interior, factors external to the tunnel that modify its shape, and neuropathic factors all contribute to tunnel compression (48, 49). The rising prevalence of risk factors including diabetes and pregnancy also contribute to the rising incidence of CTS incidents in the working population. Circumstances altering the fluid homeostasis inside the body are examples of outer variables that increase tunnel dimensions. Conditions that fall within this category include, but are not limited to, pregnancy, menopause, obesity, renal illness, underactive thyroid, use of oral contraceptives, and chronic cardiac disease. Intrinsic nerve stressors, such as growths and tumors, increase the amount of space needed to accommodate the nerve. Fractures of the distal radius may cause these either immediately or later on as a result of posttraumatic arthritis. Conditions including diabetes, alcoholism, vitamin deficiency, and toxic overload, and toxic exposure can contribute to neuropathy. The median nerve is affected without increasing carpal tunnel interstitial pressure, making these considerations important.

Patients with diabetes are more likely to develop CTS because of the delayed start of their nerve damage. While the estimated the occurrence, incidence is 2% among pregnant women, the incidence rate is as high as 30% in individuals with diabetic neuropathy and 14% in people without diabetes (51).

2.6 Pathophysiology

The causes of CTS include mechanical stress, increased pressure, and ischemic damage to the median nerve within the carpal tunnel. When it comes to hypertension, the average range is between 2-10 mm Hg. Fluid pressure in the tunnel at the carpal may fluctuate significantly depending on the patient's wrist posture. That's why when you extend your

wrist, the pressure seems like it's ten times more than when you flex your wrist, and vice versa (52). As a result, activities involving repeated wrist movements pose a substantial threat of developing CTS. Demyelination is a significant stage in the progression of median nerve damage in cases of nerve injury, and it happens as a result of repeated exposure to automatic stresses on the nerve (11). Over time, breakdown of myelin sheath around nerve occurs at point of compression and extends to the intermodal section, where axons are protected. Endoneurial edema develops when the blood-nerve barrier is disrupted as a result of persistent compression, cutting off blood supply to the endoneurial capillary system. Vein congestion, ischemia, and metabolic changes at the site of the congestion form a vicious cycle (11, 52). Due to the quick improvement in symptoms after carpal tunnel release surgery, ischemic damage is also considered a key component in CTS. Paraesthesias in carpal tunnel sufferers are exacerbated by limb ischemia. There are three stages to this process: first, there is a rise in intrafunicular pressure; second, the capillaries are injured, causing leakage and edema; and third, the patients' arterial flow is blocked (11).

2.7 Treatment

2.7.1 Surgical treatment

In order to change the relationship between the median nerve and the tendons trapped in the carpal tunnel, surgery to release the content of the tunnel (carpal tunnel release) by transection of the transverse carpal ligament is the gold standard of care.

Traditional open surgery (including a lengthy longitudinal incision at the wrist and direct view of the transverse carpal ligament), minimally invasive surgery (using a shorter incision at the wrist), and endoscopic surgery may all be used to do a surgical decompression. Researchers have found no remarkable difference between open and endoscopic release in terms of long-term functional outcome (53).

Other distinctions may be made as well. Endoscopic surgery has been shown to have less complications, less scar soreness, and a quicker time to recovery from surgery and go back to work than undergoing open surgery (53). Notwithstanding, surgical release has a larger risk of temporary and nerve injury and comes at a higher cost (54). A meta-analysis found that endoscopic and open carpal tunnel releases both had equal rates of significant problems (mostly complicated regional pain syndrome), but that endoscopic releases

have a lower risk of minor difficulties (issues including scar discomfort and infection) (55). The skill of the operating surgeon may make a difference in the final result (54).

2.7.2 Non-Surgical & Conservative Interventions

- Splinting

The digital paresthesia associated with CTS is often treated by splinting the wrist (56). As splinting has been documented in the plurality of the research on therapies of CTS that would come under the realm of physical treatment, it is the focus of this article. An appropriately sized splint, in the author's view, may help with CTS symptom management and should be provided to most patients as a first treatment option. Recurring problems may also be treated with splints. It has been suggested by Gerritsen et al. (57) that there are two prognostic indications that indicate improvement with splint usage are included that CTS symptoms of less than 1 year's duration, and rating of 6 out of 10 or below for intensity of Paresthesia that occurs at night. Conventional wisdom suggests that splinting the wrist in a position of zero degrees of flexion and extension rotation is the best option (57). These recommendations are supported by in vivo studies whereby indwelling catheters were used to measure carpal tunnel pressure before and after a change in wrist position. Carpal tunnel pressure is thought to be at its lowest when the wrist is in a neutral (0°) posture (58).

Also using imaging of the wrists using axial ultrasonography in 17 individuals who had no signs of CTS, Kuo and et al (59) discovered, throughout most cases (13 patients), the median nerve is under the least amount of compression when the wrist is in a neutral position, though for some patients, the lowest stress was at flexion in 15º. Pre - fabricated splints with a changeable angle bar or a custom-made plastic splint or insert may be used to achieve neutral rotation of the wrist (Figure 3). This illustration depicts a widely recommended splint that incorrectly positions the wrist in extension rather than neutral.

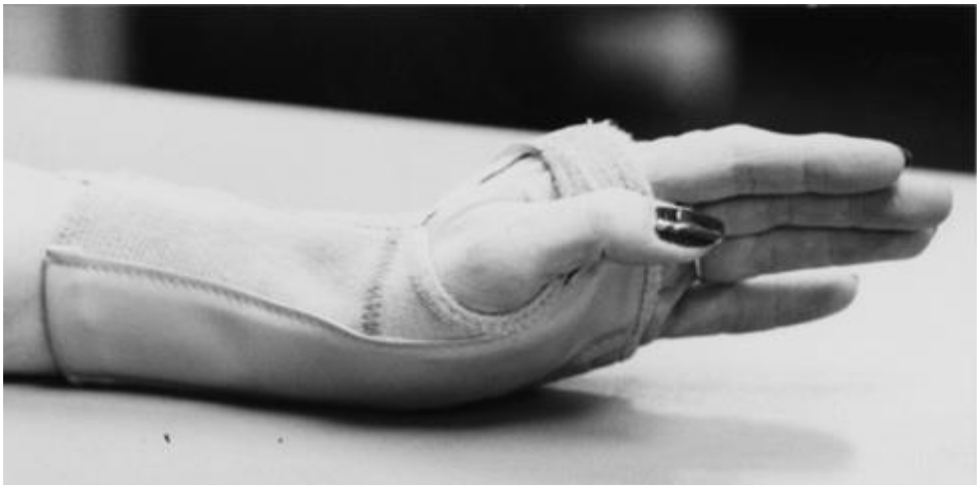

Figure 3. Commercial wrist splint extends wrist

Patients with CTS symptoms for an average of 2 years were studied by Burke et al (60), who evaluated the effects of a wrist-equal splint vs a wrist extended in 20° splint worn for 2 months. Schedules for when items were worn were not mentioned. Telephone interviews were conducted at 2 weeks and 2 months to assess symptoms that are felt alone by the patient alleviation providing details verbally (never, somewhat, significantly, and entirely). Neutral angle splints were preferred by patients (n = 20) over extension splints (n = 6), with the former group reporting "a lot" or "full" relief. When comparing the groups using neutral angle splints (n = 22) and extension splints (n = 22), there was no significant difference in the proportion of those who had little or minimal alleviation. The splint was most effective when worn at night, and several patients complained of discomfort during the day. Contrary to what may be expected, the severity of alleviation did not seem to be connected to the length of time that participants had CTS symptoms.
For a group of patients with CTS, night splinting is preferred to no splinting, according to a study by Manente et al (61), at the very least in the immediate aftermath. Scores on the SSS and FSS decreased from 2.75 to 1.54 (p0.001) and 1.89 to 1.48 (p0.001), respectively, in the splint group after 4 weeks, whereas the control group showed no significant change. No information suggesting a follow-up period beyond 4 weeks was provided.

-Pharmacotherapy

Injections of local corticosteroid medication are a frequent method of treating CTS. The use of this medication is justified because corticosteroids may decrease oedema, hence enhancing the spatial connectedness of the median nerve and tendons to the carpal tunnel. Methylprednisolone (80mg and 40mg options) was more effective than a placebo in relieving carpal tunnel symptoms when injected directly into the tunnel and surgical procedures percentage after one year in a randomized study involving 111 patients (62). However, in this trial, three-quarters of patients underwent surgery within a year, therefore the usefulness of the efficacy of corticosteroid injections in preventing the progression of illness was restricted. It has been determined where exactly in the body local corticosteroid injections are most effective. When comparing distal (palmar) and needle insertion close to the wrist, palmar technique was found to be less painful from the patient's perspective (Visual Analog Scale (VAS) for Pain), but there was no significant variation in objective metrics like nerve conduction results (63). Even though it costs more, corticosteroid injection under assistive ultrasound technology is preferable to blind administration and speeds up the healing process (64). An investigation on the relative efficacy of dexamethasone sodium phosphate administration using phonophoresis and iontophoresis, two non-invasive techniques of local corticosteroid delivery, found that phonophoresis was more efficient in alleviating symptoms and restoring function of the hand (65). The combination of phonophoresis and splint use including dexamethasone has been shown to provide better symptom reduction than either iontophoresis and splint use or splint use solo. (66). There have been studies comparing corticosteroid treatment to other medications. Local treatment of corticosteroids by phonophoresis resulted in higher decreases in nerve diameters in individuals with CTS than did NSIDs and splint usage solo (67). Both triamcinolone acetonide and procaine hydrochloride injections were higher efficacious from placebo, with the latter being on par with the former (68). Both 17-a-hydroxyprogesterone caproate & corticosteroid were effective, however only those using 17-a-hydroxyprogesterone caproate saw sustained symptom alleviation for at least three months (69). EWST, which employs acoustic waves to induce brief pressure increases in tissues without harmful consequences, has been likened to corticosteroid injection.

Neither therapy produced any discernible improvement in symptoms nor electrophysiological results (70).

Non-steroidal anti-inflammatory medications (NSAIDs) have been considered as a potential CTS therapy option. Further research is required to confirm the favorable effects of Palmitoylethanolamide, an agonist of a nuclear factor, Tinel's sign positivity as a function of median nerve motor latency, and the severity of patients' reported pain contrasted with the control group (71). A randomized controlled experiment found that gabapentin wasn't any better than the control group in relieving pain, numbness, paresthesia, clumsiness, or the waking up of the night (72). Compared to a single injection, repeated local lidocaine injections alleviated symptoms and improved electrophysiology (73).

-Therapeutic Ultrasound

The findings provide credence to therapeutic ultrasonography's potential for easing CTS symptoms. Pulsed ultrasound at 1 MHz, 1.0 W/cm2, for 15 minutes, twice daily for 2 weeks, and subsequently once weekly for 5 weeks was compared to sham ultrasound in a study by Ebenbicher et al. (74). Totaling 20 procedures, they were spread out over 7 weeks. All of the participants had idiopathic CTS, and the duration of symptoms ranged from moderate to severe, with the average being 8 months. Statistically substantial improvements in symptoms, sensation, and nerve conduction were seen in the group that received pulsed ultrasound.

The experiment results by Oztas (75) the usage of ultrasonography is not supported by technologies that work with continuous waves. This study's participants had symptoms for a mean duration of seven years., suggesting that continuous ultrasonography, rather than pulsed ultrasound, was to blame for their health problems. Perhaps contrasting ultrasound and splinting with splinting alone might help elucidate the role of ultrasonography in treating CTS.

-Low-Level Laser Therapy

There is some evidence that Low-Level Laser Therapy may have beneficial benefits by causing biophysical changes inside tissues. Low-Level Laser therapies have been shown to have a stimulatory impact on nerve regeneration and neurotransmission in animal

studies, suggesting they may hasten the healing of a compressed neuron. Potential benefits of Low-Level Laser on CTS therapy include anti-inflammatory processes, improved circulation, and myelin formation in the median nerve, which all might lead to nerve rebuilding. (76).

-Activity Modification and Patient Education

Modifying tasks may help prevent the wrist from leaving the neutral position as much as possible and lessen the need for repeated, strong grasping and pinching. Examining the effects of fingertip stress on carpal tunnel pressure (active loading of the flexor tendons, like in the case of key depressing, is one example.) (77). The pressure in the carpal tunnel rises when the wrist is pulled out of neutral during fingertip loading. While it is still up for debate whether or not typing on a keyboard causes CTS, it is advisable to recommend activity moderation for keyboard users who already have CTS. Taking frequent pauses to undertake exercising the nerves and tendons to glide smoothly and switching to keyboard layout that splits the keys in half to avoid pronation are all examples of what may be done to alleviate the strain on the wrist and hand. Because of the increased strain on the carpal tunnel, activities requiring a steady grip should be avoided (78). Gripping causes stress on the carpal tunnel and may lead to a condition called lumbrical invasion (79). As part of physical therapy, the therapist should instruct the patient to avoid certain positions that put pressure on the median nerve, restrict blood flow to the area, or both. A short postural instruction program improved posture (According to the results of the video analysis) and health status (based on the abbreviated version of the report) among those suffering from musculoskeletal disorders brought on by their jobs and regular users of video display terminals (80). One 60-minute ergonomic education session and a 15-minute follow-up session were provided as part of the program.

- Exercise Therapy

Patients who have experienced pain and functional loss from CTS often indicate that they have tried several treatments without success, a physical therapist's first response may be to prescribe pain medication and a series of mobility and strength exercises. Symptoms of mild and severe CTS, such as joint stiffness, muscular weakness, and decreased muscle function, are frequently not the predominant concerns voiced by the patient. Working in

uncomfortable positions and engaging in grip and strengthening exercises might make symptoms worse, not better.

Conservative treatment for CTS symptoms includes activities like nerve gliding of the median nerve (Figure 4) and tendon gliding of the finger flexor tendons (81).

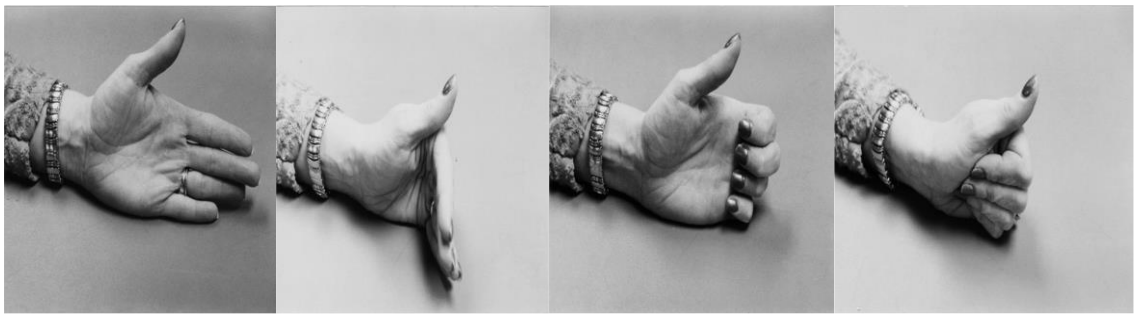

Figure 4. Sequence of tendon- and nerve-gliding for CTS.

Carpal tunnel pressure in vivo studies performed by Seradge et al. (78) show that active 1-minute intervals of wrist and finger mobility may reduce carpal tunnel pressure. As a result of his study, he suggests breaking up the day with many sets of vigorous activity lasting only one minute. This may provide the foundation for the tendon and nerve gliding activities that are often used to treat CTS. These movements may help reduce CTS symptoms by improving circulation or reducing swelling around the median nerve. 10

Measurements taken at the outset, 1, 2, and 18 months into an exercise regimen for a group of persons with CTS to establish a baseline and evaluate the causal effect were measured using the Boston SSS and FSS questionnaires by Seradge et al. (82). Carpal tunnel decompression exercises were performed, which comprised gliding motions of the tendons and nerves in the upper extremities. Patients also took oral methyl prednisolone for the first week, followed by nonsteroidal anti-inflammatory drugs for the next month. For the first month, Patients were required to wear custom-made volar wrist splints for eight hours every day and night., and for the second month, patients wore the splints just at night. Success was shown by lower mean total scores on the SSS and FSS questionnaires, as reported by the researchers. At the 18-month mark, over 65% of the original research participants were still involved. Seven were deemed surgical candidates. It is impossible to determine the relative effectiveness of the various treatment modalities.

The exercise program was also used by Seradge et al. (83) as part of a plan to reduce the risk of CTS at a meat processing industry. They claimed that CTS reporting inside the corporation dropped by 45% as a direct consequence of the initiative. Definitely, this is a novel idea that might be used in other fields where CTS is prevalent. Further research into whether or not this exercise regimen may prevent CTS recurrence in individuals who have reacted well to conservative treatment is warranted.

Patients with CTS were evaluated by Akalin E et al. (84) compared the effects of wrist-neutral splinting with those of a control group who wore the same splint but also participated in a regimen of tendon- and nerve-gliding activities. Four weeks of day-and-night splint wear resulted in improved wrist mobility. Physical measurements (such as and 2-point discrimination, grip and pinch strengths, provocative movements), as well as a telephonic patient satisfaction survey after care is provided, and the Boston SSS and FSS questionnaires were used to calculate final results. All measures, excluding 2-point discrimination, improved across both groups, although the changes were not statistically significant. Patients who were taught gliding movements for their tendons and nerves seemed to make the most progress. It would be fascinating to determine whether the same results could be achieved with a bigger sample size, and to compare the effectiveness of splinting and tendon- and nerve-gliding activities in this population to that of a group who had surgical decompression.

For CTS, Cesar et al. (85) compared manual physical therapy to surgery. In addition to include women, they made no mention of how severe CTS was in their comparison between manual physical treatment and surgery. Further, functional status was a supplementary indicator of success. All patients in Tomasz et al. (86) got 20 sessions of therapy, and the effectiveness of manual therapy, which included neurodynamic approaches, was compared to that of electrophysical modalities for the treatment of CTS. Patients with CTS were investigated by Kamran et al. (87) to determine the dose-dependent effects of low-level laser treatment and high-intensity laser therapy on pain and electrophysiological. Using a quantitative pain rating scale, Muhammad Junaid Ijaz,

et al. (88) analyze the effectiveness of physical therapy and a technique called median nerve neuromobilization at the wrist.

For the purpose of treating CTS, Dingli Xu et al. (89) compared extracorporeal shock wave therapy to local corticosteroid injection. Thirty patients were treated with ESWT and another twenty-five were treated with local corticosteroid injections in this randomized controlled experiment.

The efficacy of radial extracorporeal shock wave treatment vs local corticosteroid injections for individuals with CTS was compared by Durmaz et al. (90). In all, 72 individuals with confirmed cases of carpal CTS were included in the analysis. Radial extracorporeal shock wave treatment (ESWT) was administered to one group, local corticosteroid injections were administered to another group, and a resting hand splint served as the only intervention for the third group.

To our knowledge, the majority of the aforementioned studies only assessed the efficacy of different types of physical therapy, ignoring the possibility of a synergistic impact between physical therapy and pharmaceutical interventions. Additionally, there is no ignoring of functional status or hand grip power as outcome measures for the included patients.

Our research focused on the effects of ESWT and other forms of physiotherapy on patients' pain, hand grip strength, and functional status, and compared these results to those obtained from pharmaceutical treatment alone.

3. METHOD

3.1 Patients & Study design

The purpose of this research was to evaluate the efficacy of ESWT vs medicinal therapy for individuals with CTS by measuring the degree to which their symptoms and functional abilities improved after interventions.

This study was found medically appropriate by the Clinical Research Ethics Committee of the health ministry in Iraq (code: 7070 in 2022/13/2). It was conducted at Al-Najaf teaching hospital. 44 voluntarily participated in the study. Participants were selected from orthopedic and rheumatology clinics in Al-Najaf teaching hospital.

Samples randomly collected, one of patients went after one week to the surgery, two patients did not come for follow-up, and one female patient was excluded from the study because she was diagnosed with lymphatic oedema in the middle of the treatment procedure. The 40 patients (male=9 and female=31) with a range of their ages (21-60) years finally included in the statistical analysis. The participants were randomly divided into two groups, A and B, with every group having 20 patients. A group was the ESWT intervention group, containing (male=4 and female=16). B was medical treatment intervention, containing (male=5 and female=15).

Inclusion and Exclusion Criteria

Patients were recruited in the research if they had symptoms and signs characteristic of CTS, including a positive Tinel's or Phalen's test; numbness or tingling in at least two of the first, second, or third digits; and a CTS diagnosis validated by an electrophysiological study.

While exclusion criteria:

- A patient with symptoms similar to those of CTS but really caused by another ailment, such as cervical radiculopathy, brachial plexopathy, polyneuropathy or thoracic outlet syndrome.
- the patient who has had prior hand surgeries or steroid injection for wrist pain.
- Systematic diseases which affecting on the wrists or nerves system.
- Patient who taking medical treatment in last three month.
- Patients who undergo into one or more of physiotherapy approaches.
- Recent trauma.

- Pregnancy.
- After healing from recent fractures at wrist or metacarpal bons (91).

3.2 Treatment Procedure

Demographic information and the first assessment were given to all patients in both groups (BCTQ, DASH, JAMAR, VAS, FIGURE-OF-EIGHT SHAPE, and ROM) after the patients were split up.

A group was submitted with ESWT for five sessions, meeting once a week. The approach of ESWT was: patient sitting in a comfortable chair, the hand was placed in a pronated position on a couch (a medical couch), and all hand fingers were extended. ESWT was used on each patient with 1500 shots, 1.5 bar, and a frequency of 6 HZ using a shock wave device manufactured by BTL in 2010. The prop of ESWT was placed on the palmar side of the affected hand, and the prop was moved across the wrist joint, through the median nerve tunnel (longitudinal and transverse movement) and metacarpals. And a gel used as a conductive medium (92).

The B group has been taking an oral medical treatment (pregabalin, nerubion, and NSAIDs), Pregabalin was administered for one and a half months at night (one per day), nerubion was administered for two months (one per day), and NSAIDs for three weeks (one per day) (93), with frequent visits to their physicians to ensure their condition (according to ethical roles). After two weeks, the final assessment is made for all patients in both groups (A and B).

Figure 5: ESWT application

3.3 Outcome measurements

Boston carpal tunnel questionnaire (BCTQ)

An original scale for CTS, BCTQ was created. As it relates to CTS, it is the gold standard for measuring patient-reported outcomes. Previous studies have shown that when it comes to detecting the clinical improvement brought on by Carpal tunnel release CTR, standardized questionnaires like the BCTQ are more sensitive than clinical examination and electrodiagnostic testing. The scale has two parts: the 11-item Functional Status Scale (FSS) and the 8-item Symptom Severity Scale (SSS) (Appendix 2) (94).

Disability of arm, hand and shoulder score (DASH)

Patients with musculoskeletal diseases of the upper limb may have their physical function and symptoms assessed using the DASH score, which is based on a 30-item questionnaire filled out by the patient themselves. Use this score to evaluate the severity of symptoms and track improvement or decline over time in individuals with hand and wrist problems. This score may be utilized in both research and therapeutic settings, and it has been found to perform well in both (Appendix 2) (95).

Figure-of-eight shape test for hand oedema

The edema or swelling over the hand is measured using a figure-of-eight measurement of the hand. Calculated using the "Figure-of-Eight shape" In contrast to circumferential tape measures, which miss the accumulation in the dorsal hand, utilizing a tape measure on the wrist and hand may accurately capture all of the swelling (96).

Measuring tape with adjustable tension is the preferable approach.

Step1: Starting at the end of the ulnar styloid process, the finger is positioned.

Step2: Then, the distal portion of the radial styloid process is measured, starting just anterior to the wrist.

Step3: The tape is then crossed across the fifth metacarpophalangeal joint line, which is located on the hand's dorsum, before being brought back across the palm.

Step4: The tape is then carried from the palm side of the hand to the fourth metacarpophalangeal joints, across the dorsum of the hand in a diagonal motion (to the opposite side), and back to the palm side (distal to ulnar styloid process).

Step5: Always examine the afflicted side beside the healthy side for comparison.

Figure 6: Figure-of-eight test for hand oedema

Visual Analogue Scale

An example of a non-direct measuring tool is the Visual analogue scale (VAS), which attempts to quantify a trait or opinion that is thought to span a continuum of values. A patient's perception of pain, for instance, might vary from completely absent to excruciatingly intense along a continuum. Pain does not seem to increase or decrease in distinct steps, as would be suggested by a scale from "none" to "mild" to "moderate" to "severe." The VAS was developed in order to measure this underlying continuum (97).

Pain is measured along a horizontal line that is 10 cm in length. On a scale from 0 (no pain) to 10 (extreme pain), 10 being the worst. Resting and active pain levels were recorded.

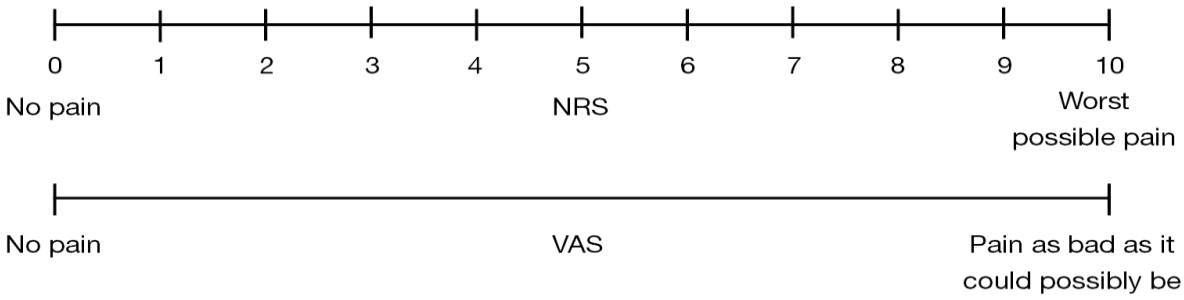

Figure 7: 10 cm horizontal axis Visual analogue scale (pain scale)

Hand-grip strength test

Measurement of grip strength is often employed in clinical settings since it is a simple, rapid, and affordable approach to evaluate muscular health. Because pain and neuropathy may cause a loss of grip strength, measuring grip strength is an essential part of assessing hand function in the area of hand surgery. Patients CTS, a clinical disease characterized by tingling, aching, and compressed median nerve in the wrist, resulting in thumb opposition dysfunction, have been demonstrated to have reduced grip strength (98). For this test, we found that sitting on a chair without an armrest and holding the electronic Jamar for three seconds at its longest recording time yielded the most accurate results.

Figure 8: Hand-grip strength test (Hand Jamar)

Range of motion measurement (ROM)

In CTS, the severity of the condition may be gauged by the examination of motor functions. Hand dynamometers make it simple to assess the motor function of the upper limbs by measuring grip strength. The use of a dynamometer to assess the patients' thenar muscles is beneficial for monitoring their CTS. Measures of hand function that include wrist range of motion and grip strength (99).

The goniometer was mounted on the styloid with the radial side serving as the movement axis to measure wrist flexion. When the elbow was bent ninety degrees, the wrist was in a posture of neutrality. The goniometer was used to measure the range of motion of the second metacarpal bone while the radius was maintained stationary during wrist flexion. The goniometer and wrist were in a comparable position for measuring extension. Passive flexion motions of the fingers were tolerated while the wrist was moving towards the extension position.

The radial deviation was measured with the forearm supported in a pronated posture on the table and the goniometer positioned dorsally. The starting position had the wrist in a neutral position, or at zero. After positioning the goniometer's fixed arm on the midpoint of the forearm, the third metacarpal was chosen as the target for the movable arm. The radial deviation of the wrist was determined by adjusting the goniometer's arm across the third metacarpal bone.

The goniometer was set up in the same way as for measuring radial deviation, only this time the wrist was turned in the other direction, in the ulnar direction (99).

Figure 9: Wrist extension range of motion measurement

3.4 Statistical analysis

The collected data were analyzed by using IBM SPSS version 24. The normal distribution was tested with Kolmogorov-Smirnov and Shapiro-Wilk test. Descriptive analysis was shown through number, percent, mean and standard deviation. The two way mixed designed ANOVA used for the compare the groups in baseline and the after the treatment. The significance level of $p< 0.05$ was set.

4. RESULTS

The 40 patients (male=9 and female=31) with CTS were finally included in the statistical analysis. The participants were randomly divided into two groups, A and B, with every group having 20 patients. A group was the ESWT intervention group, containing (male=4 and female=16). B was medical treatment intervention, containing (male=5 and female=15).

The demographic information of patients was for age, affected side, and sex. A group there was 37.9 ±8.3, while B group was 40±11.09. in A group the affected side was left side: 6 (30%), right side: 14 (65%). In B group, the affected sides were the left side: 2 (10%) and the right side: 15 (75%). The gender in the A group was male 4 (20%) and female 16 (80%). While in the B group, the gender was male 5 (25%) and female 15 (75%) (Table 2)

Table 1. patient characteristics

parameter		**A Group (n=20)**	**B Group (n=20)**
Age years (mean ± S.D)		37.9 ±8.3	40±11.09
Effected side n (%)	Left	6 (30%)	2 (10%)
	Right	13 (65%)	15 (75%)
Gender n (%)	Male	4 (20%)	5 (25%)
	female	16 (80%)	15 (75%)

Two-way mixed design ANOVA, baseline DASH scores the difference was not significant, A group baseline DASH score was 77.43±13.47 while B group was 72.74±15.85. DASH score shows significantly high difference group*time interaction ($p<0.001$) in which the improvement of DASH in A group was (39.91±2.84) from the

bassline score, compared to B Group which shows a mean difference of (11.22±2.71) from the baseline as seen in (figure 10) and (Table 3).

Table 2: Baseline and post-intervention and change scores of CTS patients

Score	Group	Baseline (mean±S.D)	Intervention (Mean ±S.D)	mean difference within group (Mean ±S.D)	mean difference between group (baseline) (Mean ±S.D)	mean difference between groups (intervention) (Mean ±S.D)	main effect (group) P1	main effect (time) P2	group*time interaction P3	η^2
DASH	A	77.43±13.47	37.52±10.07	39.91±2.84	4.69±4.46	24±4.79	0.026	<0.001	<0.001	0.112
	B	72.74±15.85	61.52±19.69	11.22±2.71						
BCTQ function	A	20.76±4.61	10.1±3.1	10.67±0.84	0.06±1.5	-6.6±1.4	0.02	<0.001	<0.001	0.121
	B	20.83±5.36	16.7±6.11	4.13±0.8						
BCTQ symptoms	A	26.86±5.39	14.57±5.05	12.29±1.23	1.73±2.06	-5.39±2.29	0.367	<0.001	<0.001	0.019
	B	25.13±7.93	19.96±9.29	5.17±1.17						
VAS at rest	A	6.52±1.99	1.05±1.43	5.48±0.34	0.13±0.5	-3.21±.54	0.002	<0.001	<0.001	0.209
	B	6.39±1.27	4.26±2.05	2.13±0.32						
VAS at activity	A	8.52±1.4	1.86±2.15	6.66±0.75	-0.17±0.4	-6.1±0.54	<0.001	<0.001	<0.001	0.608
	B	8.7±1.26	7.96±1.36	0.74±0.1						
8-SHAPE	A	42.07±3	41.76±3.25	0.3±.25	0.42±0.87	-0.48±0.9	0.605	0.116	0.849	0.006
	B	41.59±2.94	41.34±2.52	0.24±0.24						
ROM1	A	68.48±14.2	72.14±11.14	-3.67±1.7	0.87±3.67	1.53±3.21	0.919	0.042	0.321	0.0002
	B	69.35±9.97	70.61±10.18	-1.26±1.63						
ROM2	A	63.43±13.34	62.19±10.83	1.24±1.45	1.04±3.5	-1.85±2.9	0.894	0.837	0.156	0.0003
	B	62.39±9.7	64.04±8.04	-1.65±1.38						
ROM3	A	32.48±9.82	36.05±7.69	-3.57±1.81	-2.18±2.46	-0.96±1.91	0.74	0.117	0.217	0.003
	B	34.65±6.26	35.09±4.8	-0.44±1.73						
ROM4	A	16.95±8.36	19.43±8.52	-2.48±.99	4.13±2	6.34±2	0.008	0.052	0.113	0.156
	B	12.83±4.49	13.09±4.21	-0.26±0.95						
JAMAR	A	17.1±5.36	21.94±5.76	-4.84±0.84	-0.5±1.64	4.01±1.78	0.279	<0.001	<0.001	0.028
	B	17.58±5.49	17.93±6.01	-0.36±0.8						

DASH: disability of arm, shoulder and hand, BCTQ: Boston carpal tunnel questionnaire, VAS: visual analogue scale, 8-shape: Figure-of-eight shaped test for hand oedema, ROM1: Range of motion of wrist flexion, ROM2: Range of motion of Wrist extension, ROM3: Range of motion of wrist ulnar deviation, ROM4: Range of motion of wrist radial deviation, JAMAR: hand grip strength measurement.p1: T test, p2: two wat mixed ANOVA, p3: two way mixed ANOVA

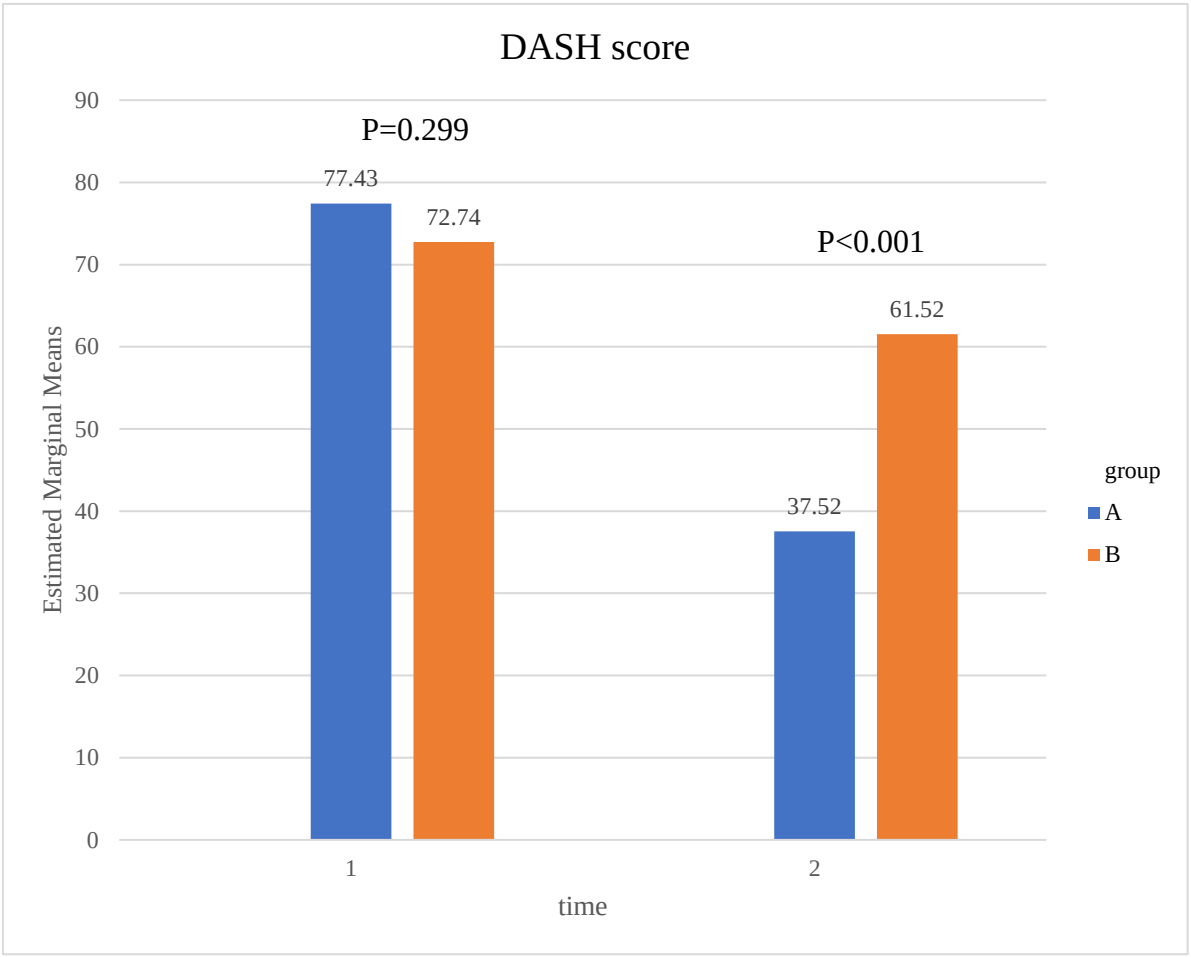

Figure 10: DAHS score chart

In FSS BCTQ, in baseline there is no significant differences. Function as well as symptoms score of BCTQ also shows a significant group*time interaction ($p<0.001$). A group function improvement was (10.67±0.84) compared to (4.13±0.8) in B group from the baseline scores as (Figure 11) and (Table 2) shows.

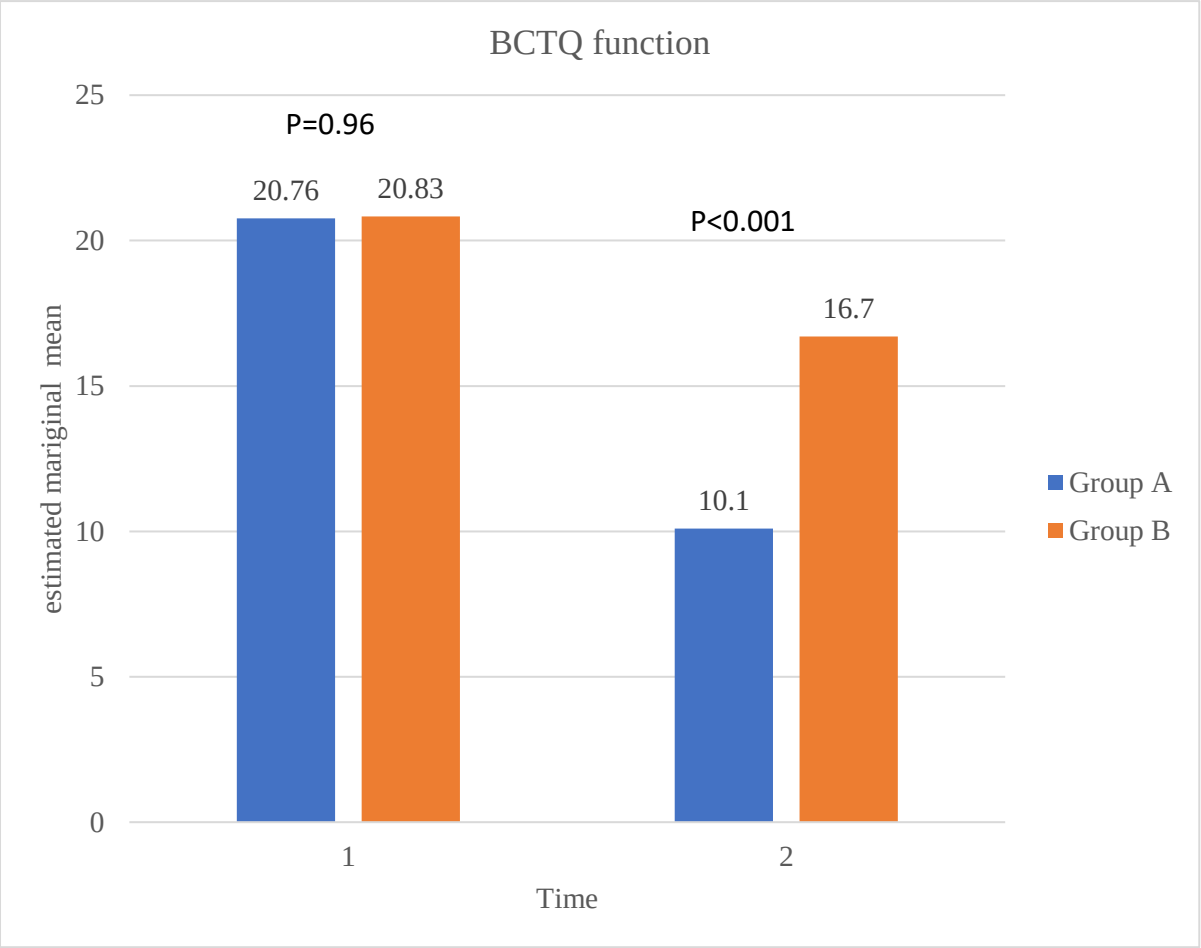

Figure 11: Functional status score of BCTQ chart

In the symptom score of BCTQ, the baseline scores were not significant. The symptom score of BCTQ was (12.29±1.23) from the bassline. However, the main effect of groups was not significant (P= 0.367). as (Figure 8) shows, there is a difference between groups A and B after intervention and a highly significant group*time interaction (p<0.001) in which there is an improvement in SSS in A group (Table 2).

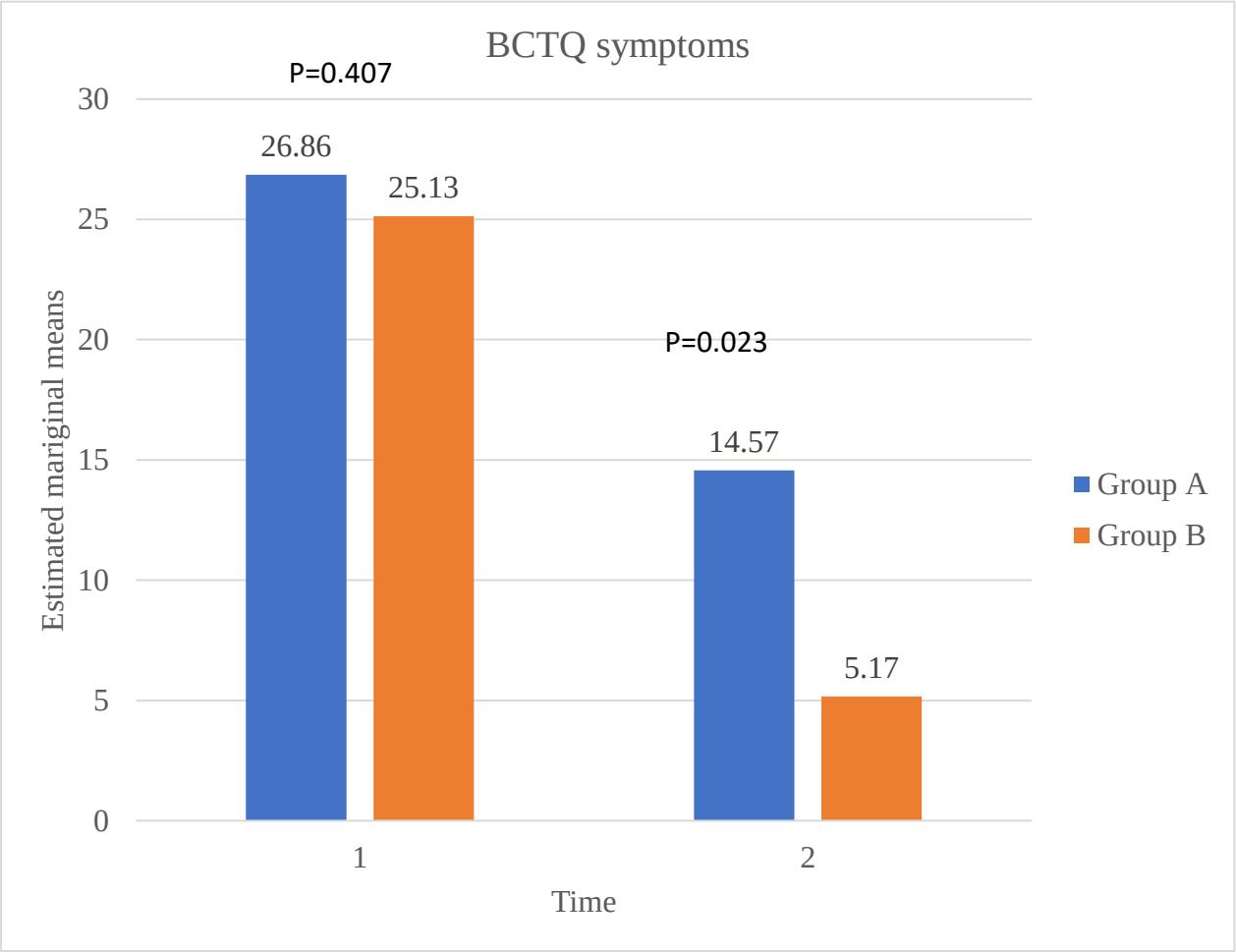

Figure 12: Symptoms severity scale of BCTQ chart

In VAS at rest and at activity, there is no significant difference in baseline for both groups A and B. Within A group, there is a significant mean difference (5.48±0.34), while mean difference in B group from baseline was (2.13±0.32). there is significant improvement in main effect group= 0.002 between both groups and a highly significant difference in group*time interaction ($p<0.001$) at rest, shown in (Figure 13) and (Table 2).

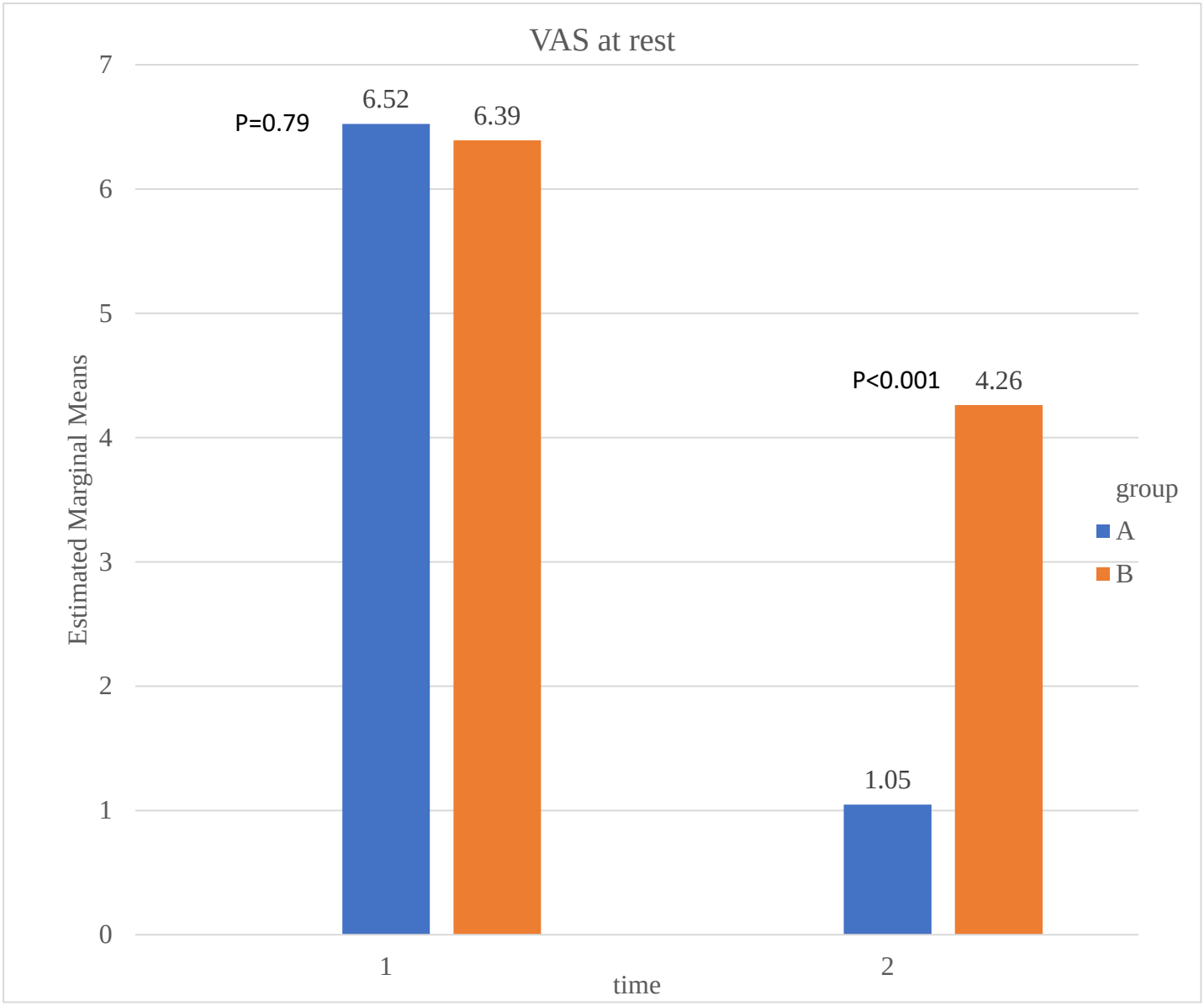

Figure 13: VAS at rest chart

On the other hand, VAS at activity within the A group, the mean difference was (6.66±0.75) while the mean difference within the B group was (0.74±0.1). There is a high difference in group*time interaction and also a high difference in the main effect group between both groups ($p < 0.001$). (Figure 14) (Table 2)

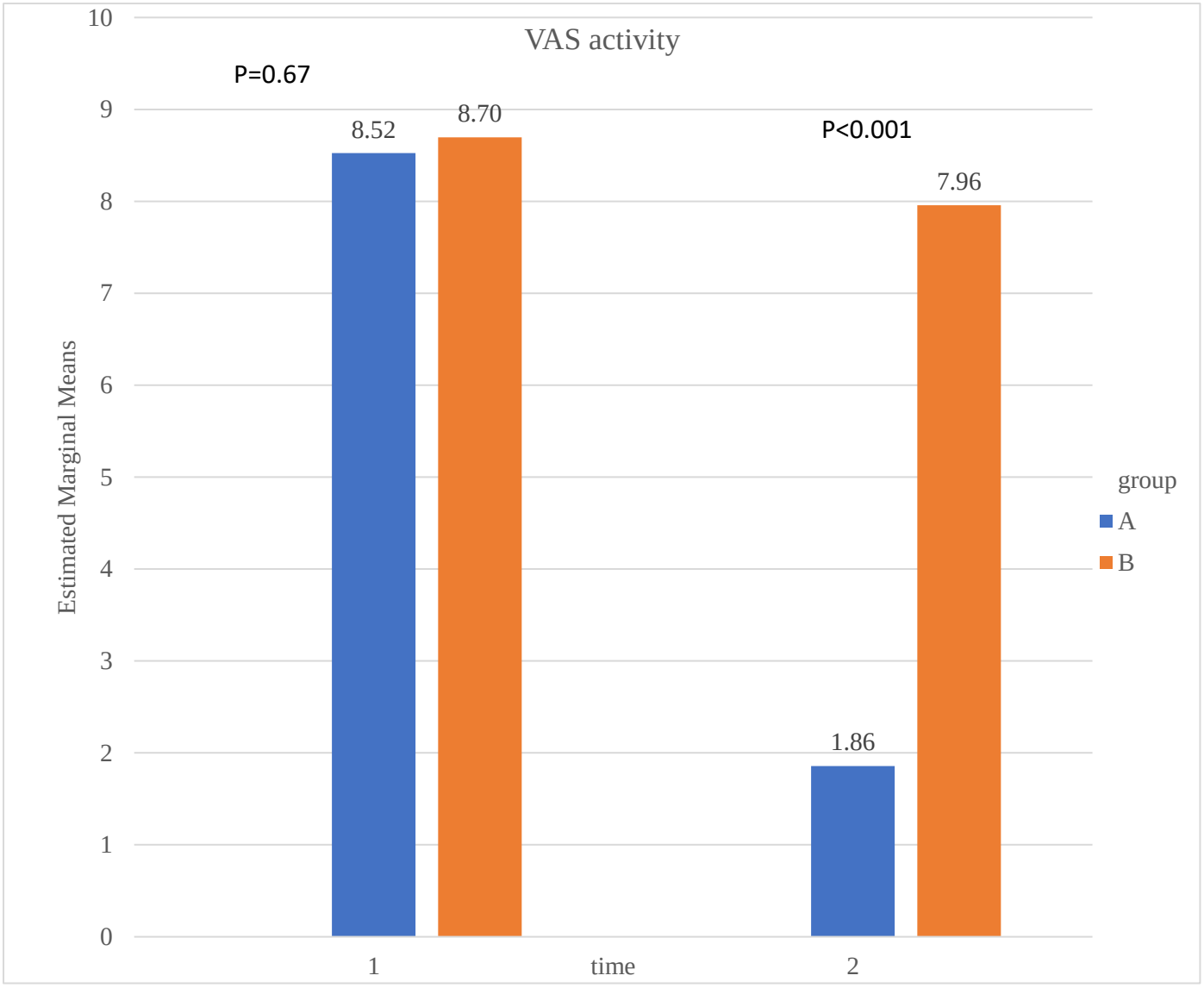

Figure 14: VAS at activity chart

Figure-of-Eight shape test show no significant group effect (P=0.605) and no significant group*time interaction (P=0.849) and as seen in (Figure 15, After the intervention, we find no statistically significant changes between both the groups (Table 2).

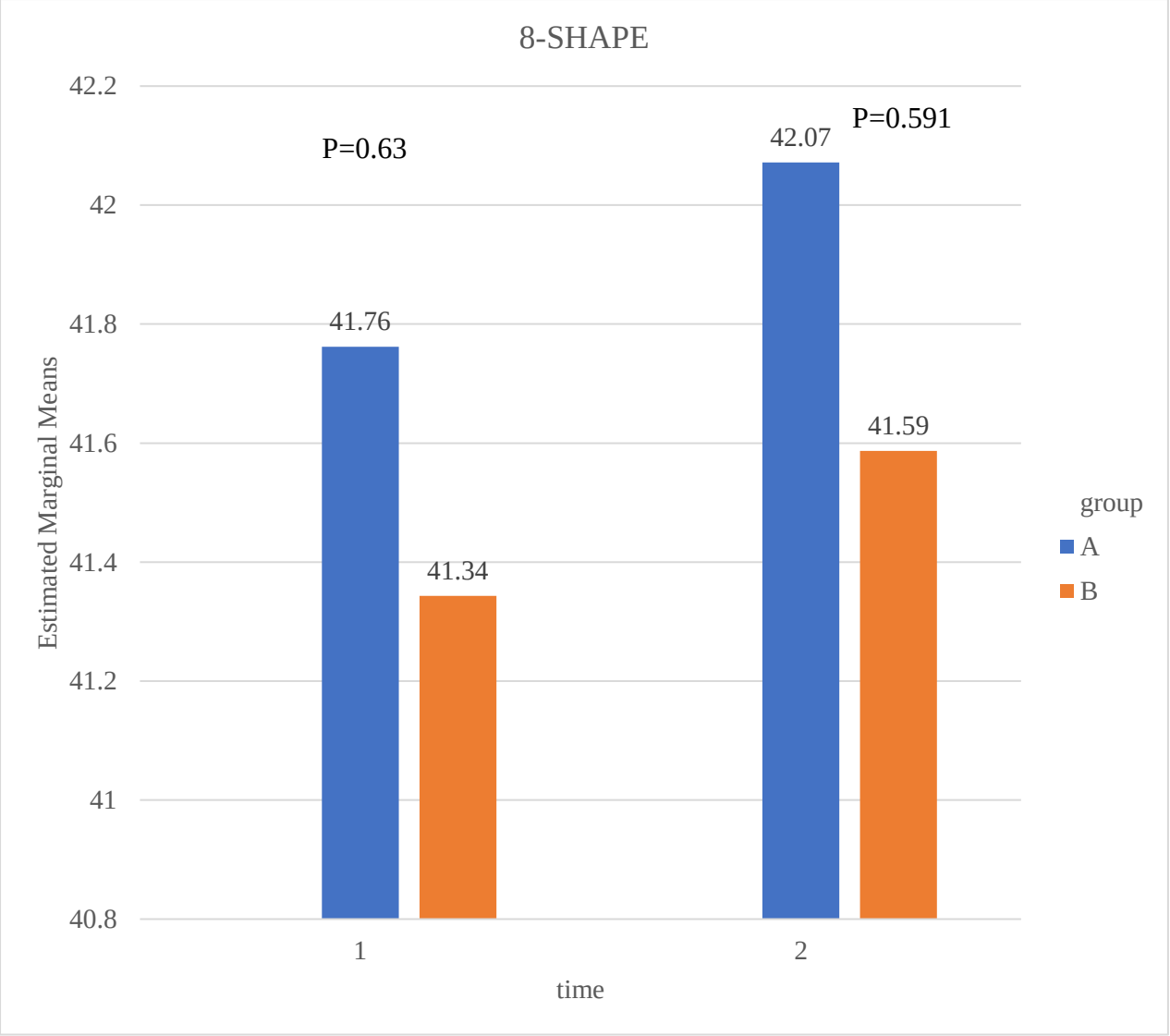

Figure 15: (Figure-of-eight test) chart

ROM score in all four directions, found to have no significant group*time interaction in ROM1, ROM2, ROM3, and ROM4 (P=0.321,0.156,0.217, and0.113 respectively) among the ROM scores. Only ROM4 in A group shows a significant main effect of group (P=0.008) in which the mean difference in score after intervention was (6.34±2) and according (Figure 16) and (Table 2).

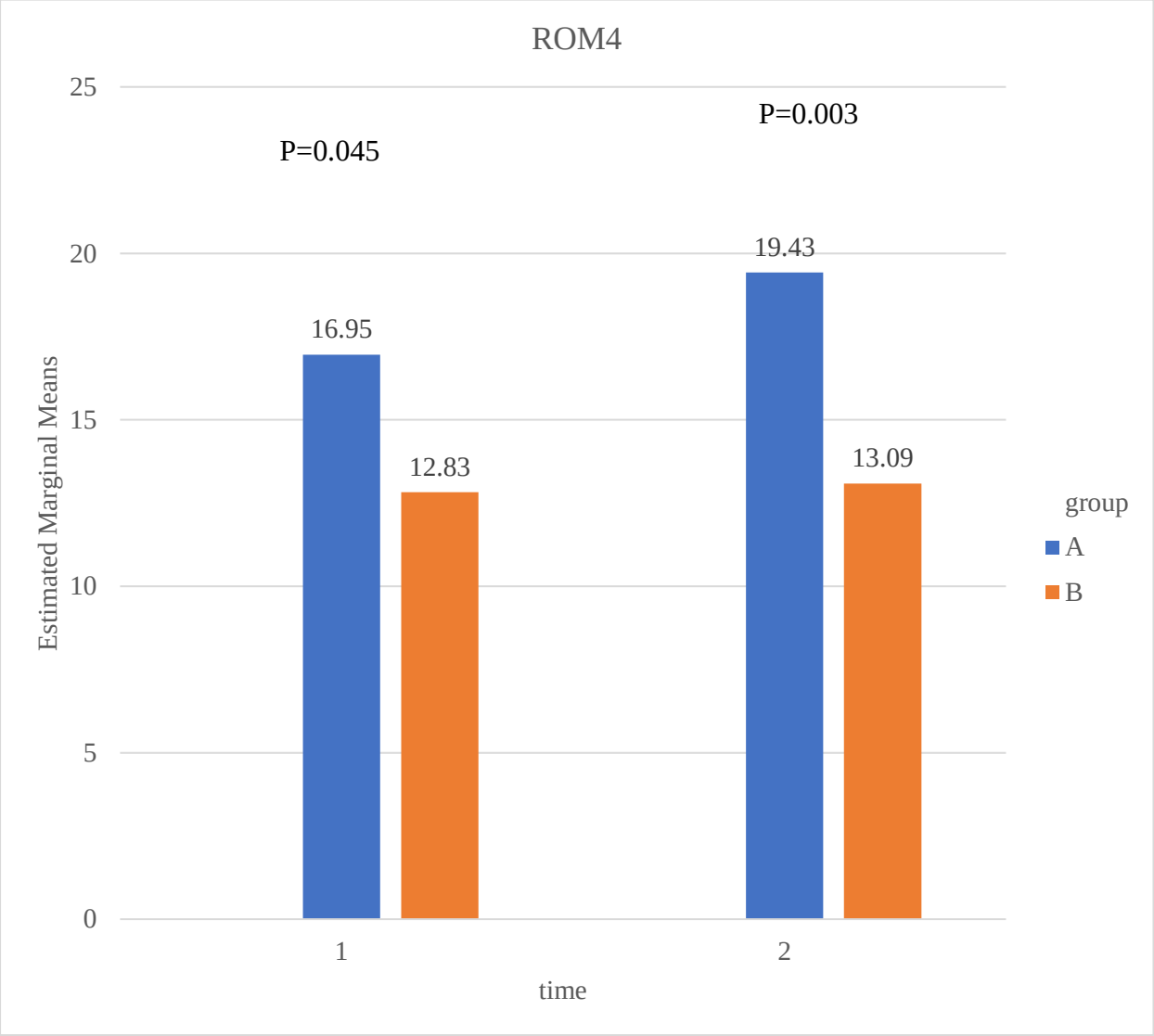

Figure 16: ROM4 (radial deviation ROM) chart

Jamar, on the other hand, shows a significant difference within the A group (-4.84±0.84), but there is no significance within the B group (-0.36±0.8) compared to A group. A highly significant group*time interaction (P<0.001) improvement of the score was seen to be (4.84±0.84) from the bassline in A group compared to (0.36±0.8) in B group (Figure 17) (Table 2).

Figure 17: JAMAR (grip strength measurement) chart

The main effect of the time was not significant only in Figure-of-Eight shape, ROM2, ROM3, and ROM4 (P=0.116,0.837,0.117, and 0.052 respectively) according (Table 2).

5. DISCUSSION

In this study, we focused in evaluation on the functional status, pain and grip strength of the hand in patients with CTS and it is the first study which comparing the ESWT with pharmacotherapy (oral medical treatment). This is the first study that compares the efficacy of ESWT and oral medical treatment in CTS. The results showed a significant improvement in the functional status and hand grip strength in patients treated with ESWT.

In pain at activity, there was also a significant decrease in the A group more than in the B group, but the pain at rest was significantly decreased in both groups of patients. Also, the final results of the figure-of-eight shape showed no significant changes in hand size or oedema in both groups. Our study did not find a significant difference in ROM in the A and B groups, just the redial deviation of the wrist joint. There is a slight improvement in patients underwent to ESWT. Generally, the results appeared a significant improvement in outcome measures in patients who underwent the ESWT more than patients who underwent the pharmacotherapy.

BCTQ in final results, showed there was a remarkable amelioration in the group of patients that were treated with ESWT more than patients treated with pharmacotherapy in both subscales of BCTQ FSS and SSS, especially in FSS. Wu YT et al (100) assessed BCTQ in their study, which according to their results, a comparison of the two groups (ESWT group and sham ESWT) indicated a significantly greater improvement in the BCTQ scores in the intervention group with ESWT throughout the study, their results of BCTQ are compatible with the results of our study. Ke MJ et al (101) show the differences in BCTQ score before and after treatment in each group. The differences in both BCTQ subscale scores in the group of patients who received ESWT for one session per week for three weeks (one session per week) were significantly larger than those in the groups who received sham ESWT or a single session of ESWT, and there was no significant difference in the BCTQ scores (severity or function) between the sham ESWT and the single session groups at all observed time-points. BCTQ in our study in matching to their findings because also we did 5 sessions of ESWT. Vahdatpour B et al (102) when comparing the two groups' mean BCRQ-based SSS scores, we found no notable

difference at the outset. A decrease in the mean score of symptoms severity was seen 3 months after therapy initiation, with statistical significance only in the treatment group. The FSS based on the BCTQ indicated no significant difference between the two groups before treatment, but after 3 months of therapy, the mean score of functional status decreased in both groups, with the decline being larger in the ESWT group. Chang CY et al (103) showed in their study that there is significant improvement in the BCTQ of the intervention group who submitted to the ESWT, but it's not statistically significant compared with the control group. It's the opposite of our result with BCTQ because they did just a single session on the subjects in the intervention group while we did five sessions respectively. Atthakomol P et al (104) indicated that there were substantial SSS of BCTQ at weeks 4, 12 and 24 in the ESWT group versus baseline, and that in the local corticosteroid injection group there was a significant decrease in terms of SSS of BCTQ at weeks 1 and 4 as well as at week 1 relative to baseline. They did not focus on the FSS of BCTQ in their study, and they included a single session of ESWT, which means our study is with logical results of BCTQ. Habibzadeh A et al (92) entitled FSS of at one week following the conclusion of the therapy, the BCTQ in all 3 groups showed a considerable decrease; however, there was no considerable variation among the groups. (sweep: group of ESWT along median nerve pathway, point: group of ESWT on the carpal tunnel). At the 4-week follow-up, the difference was only significant between both the Sweep group and control group; hence, the FSS substantially improved more in the Sweep group than in the control group. These contradictory results are because of conventional physiotherapy, which mostly uses modalities that affect the pain and inflamatory condition of the CTS. In addition, in additional their treatment procedure is not similar to our application for ESWT. Ulucaköy RK et al (105) shown a statistically significant increase in all four groups after one and three months, in comparison to the initial state, especially in the ESWT groups. That's a result congruent to our result in BCTQ improvement of the ESWT group in our study. Sağlam G et al (106) concluded that when the inter-group outcome values were analyzed, the reduction in SSS of BCTQ, FSS of BCTQ, were significantly higher in both groups who submitted to ESWT and splint and those who underwent other physiotherapy modalities, compared to the group of splints. Additionally, improvement in BCTQ of the patients included in ESWT was higher than in other groups. That definitely agreed with our findings.

In this study, the DASH score showed a significant improvement in the group of patients who were treated with ESWT more than in patients who used pharmacotherapy. According to our literature examination, we couldn't find any studies about ESWT on CTS using the DASH score. So, we discuss some of our outcome DASH scores with other studies on CTS that used different physiotherapy modalities or other scales for disability. Lewis KJ et al (107) mentioned there is improvement in DASH score in week 6 of their study, but it is weaker at the end of the study in both the physiotherapy group and the waitlist group. The DASH score had a better improvement because of the ESWT effect and the shorter time frame of our study. Ulucaköy RK et al (105) showed that ESWT was effective in reducing both pain and impairment. However, when ESWT was combined with the use of a wrist splint, the recovery in hand function and growth was greater than when either the splint or ESWT was used alone. These findings could be convenient for our results in patients who submitted to the ESWT. Sağlam G et al (106) showed that the disability in general improved obviously in patient whom included ESWT in their treatment. It is suitable for this study because the DASH score is remarkable improved in the ESWT group. Xu D et al (108) their study yielded satisfactory outcomes for disability in the group of patients subjected to the ESWT more than individuals with CTS that underwent the local corticosteroid injection. That result totally accommodates our outcome measurement in the DASH score.

In the Figure-of-Eight shape for hand oedema, there are no significant changes in hand size in patients for either group. According to our most reliable information, we are not aware of any studies. that includes Figure-of-Eight shape for hand oedema as a scale in treating CTS with ESWT or other physiotherapy approaches. In our opinion, the changes in hand size did not occur because we did not include patients with systematic conditions that affect the lymphatic system.

The VAS at activity is significantly improved in patients of the A group and not significant in patients of B group, while VAS at rest there is significant decrease in both groups. Gesslbauer C et al (109) titled that the VAS decreased over time in the ESWT group. The control group showed no clear direction of VAS over time. Their VAS results are the same as ours. Wu YT et al (100) published that a comparison of the two groups indicated a significantly greater improvement in the VAS in intervention group with

ESWT throughout the study. It also shows that there is a similarity with our VAS result. Xu D et al (89) indicated that there was a statistically significant improvement in the VAS scores at the three and nine-week follow-ups in both groups; however, the ESWT group showed a greater recovery in aspects of the VAS at the 9 and 12-week follow-ups when contrasted with the local corticosteroid injection group. This was the case when comparing the two groups at the three and nine-week follow-ups. As we observed, their results are nearly identical to ours in terms of pain reduction in the final stage. Vahdatpour B et al (102) Before (at the baseline) therapy, the results of the study Assessing the Pain Estimate based on VAS Score in the Control Group indicated that there was no significant change. After three months, compared to the baseline, a considerable decrease in the amount of pain was seen in both groups; however, the ESWT group saw a greater degree of success in achieving this reduction. As shown, our results from VAS confirm their study results. Haghighat S et al (110) The pain score at baseline in both groups was similar, but after 1 month in the ESWT group was less than the control group but not statistically significant. Their VAS results were not the same as our results because we applied ESWT after carpal tunnel release surgery, and it is known that the surgery mostly reduces the pain after a while of the surgery. Atthakomol P et al (104) cited showed there was a substantial decrease in VAS and functional scores in the ESWT class at weeks twelve and twenty-four compared to baseline, whereas there was no significant change in the local injection group. this was in contrast to the fact that there was no significant change in the local injection group. As shown, our results from VAS confirm Pichincha's results in VAS score. Habibzadeh A et al (92) claimed that there was a substantial reduction in pain in all three groups at 1 and 4 weeks following the completion of therapy; however, as compared to the control group, a considerably higher improvement was seen in the Point and Sweep groups. (sweep: group of ESWT along the median nerve pathway, point: group of ESWT on the carpal tunnel). These results correspond to our findings for VAS. Ulucaköy RK et al (105) indicated a substantial improvement in each of the four groups after one and three months compared to the initial state (baseline). especially in ESWT groups. That's a result congruent with our result in the pain measurement improvement of the ESWT group in our study. Sağlam G et al (106) indicted that there is a reduction in VAS in the group of ESWT and the group of physiotherapy modalities more than in the group of splints, and in addition, the VAS improvement in the ESWT

group is higher. As shown, our results from VAS confirm their findings in the ESWT group, and the improvement of physiotherapy modalities is a logical finding because of the effects of these modalities on carpal tunnel and median nerve.

The hand's grip strength Our final results showed a remarkable amelioration in the group of ESWT, while there was no marked increase in hand power in the group of patients treated with pharmacotherapy. Gesslbauer C et al (109) declared a significant improvement of hand grip strength in the ESWT group. It is obviously similar to our results of hand power measurement. Wu YT et al (100) enrolled that there was a significant improvement in finger pinch, but differences in the recovery of finger pinch findings were similar when comparing between both groups. The differences in hand strength was higher in intervention group of our study because we used hand JAMAR which need more power of the hand muscles while they included finger pinch which measures lesser muscles off hand (the thumb and index finger). Sağlam G et al (105) found that the improvements in finger pinch were higher in the group that used splints with ESWT in treatment and there were no significant differences among other groups at the end of the treatment. That explain the efficacy of ESWT in our study on hand grip strength and with splint can give better results.

In our study, the ROM of the wrist joint did not remarkably change in either patients who underwent ESWT or patients who submitted to the pharmacotherapy. Just in redial deviation, there was a slight improvement in the group of ESWT. To our best knowledge of literature, there are no previous studies that measured the ROM of the wrist joint.

CONCLUSION

According to the results of our study:

1- We found remarkable amelioration in the functional status in the group of patients ESWT.

2- Pain is reduced more in patients who received ESWT than in patients who received oral medical treatment.

3- The hand grip power was increased in the group that was subjected to the ESWT.

4- The DASH score was improved substantially in patients who submitted to the ESWT intervention.

5- More studies with larger sample sizes and comparing them with other pharmacotherapy or physiotherapy modalities are needed.

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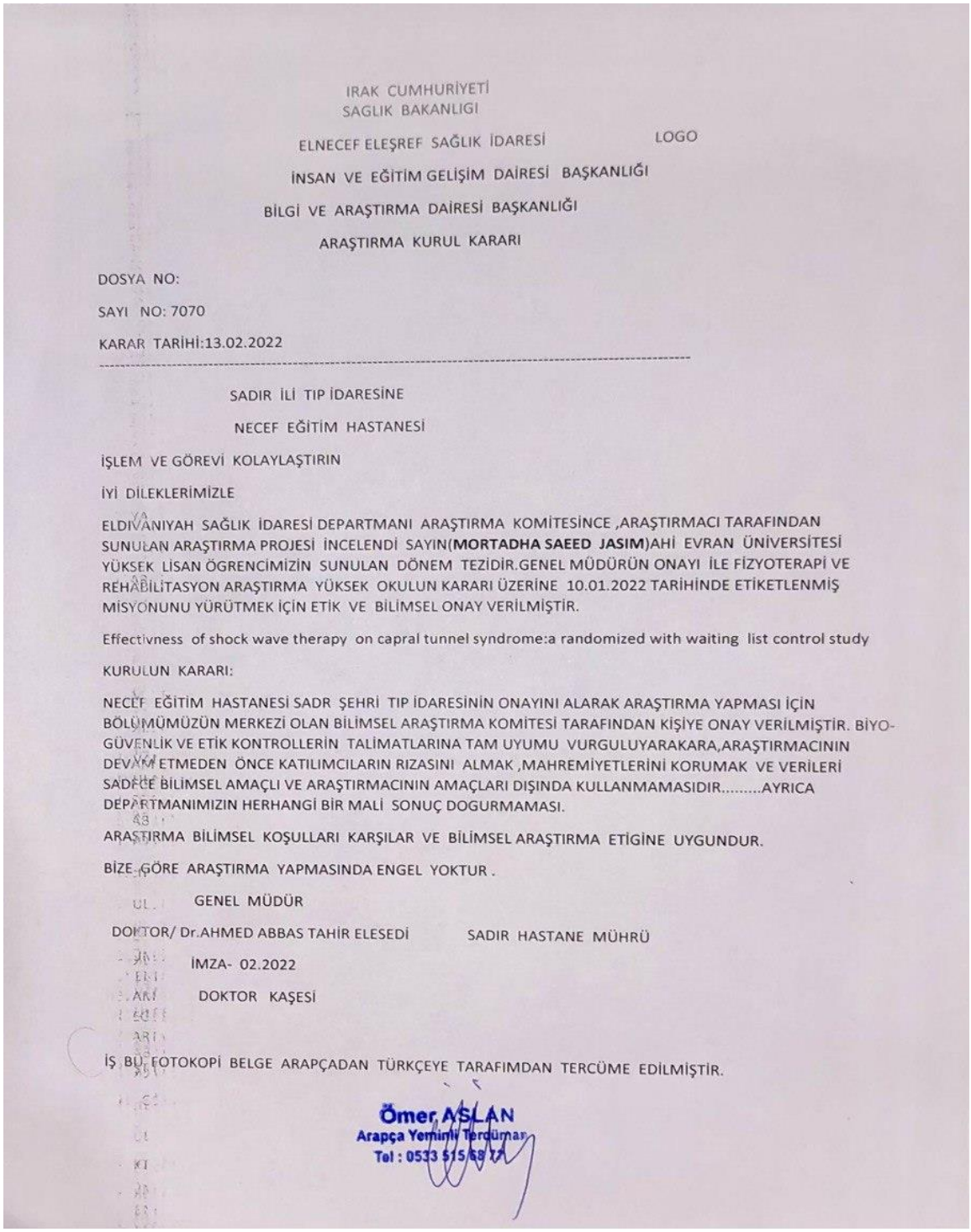
Appendixes

Appendix 1. Ethics Committee Approval



IRAK CUMHURİYETİ
SAGLIK BAKANLIGI

ELNECEF ELEŞREF SAĞLIK İDARESİ LOGO

İNSAN VE EĞİTİM GELİŞİM DAİRESİ BAŞKANLIĞI

BİLGİ VE ARAŞTIRMA DAİRESİ BAŞKANLIĞI

ARAŞTIRMA KURUL KARARI

DOSYA NO:

SAYI NO: 7070

KARAR TARİHİ:13.02.2022

SADIR İLİ TIP İDARESİNE

NECEF EĞİTİM HASTANESİ

İŞLEM VE GÖREVİ KOLAYLAŞTIRIN

İYİ DİLEKLERİMİZLE

ELDİVANIYAH SAĞLIK İDARESİ DEPARTMANI ARAŞTIRMA KOMİTESİNCE ,ARAŞTIRMACI TARAFINDAN SUNULAN ARAŞTIRMA PROJESİ İNCELENDİ SAYIN(**MORTADHA SAEED JASIM**)AHİ EVRAN ÜNİVERSİTESİ YÜKSEK LİSAN ÖGRENCİMİZİN SUNULAN DÖNEM TEZİDİR.GENEL MÜDÜRÜN ONAYI İLE FİZYOTERAPİ VE REHABİLİTASYON ARAŞTIRMA YÜKSEK OKULUN KARARI ÜZERİNE 10.01.2022 TARİHİNDE ETİKETLENMİŞ MİSYONUNU YÜRÜTMEK İÇİN ETİK VE BİLİMSEL ONAY VERİLMİŞTİR.

Effectivness of shock wave therapy on capral tunnel syndrome:a randomized with waiting list control study

KURULUN KARARI:

NECEF EĞİTİM HASTANESİ SADR ŞEHRİ TIP İDARESİNİN ONAYINI ALARAK ARAŞTIRMA YAPMASI İÇİN BÖLÜMÜMÜZÜN MERKEZİ OLAN BİLİMSEL ARAŞTIRMA KOMİTESİ TARAFINDAN KİŞİYE ONAY VERİLMİŞTİR. BİYO-GÜVENLİK VE ETİK KONTROLLERİN TALİMATLARINA TAM UYUMU VURGULUYARAKARA,ARAŞTIRMACININ DEVAM ETMEDEN ÖNCE KATILIMCILARIN RIZASINI ALMAK ,MAHREMİYETLERİNİ KORUMAK VE VERİLERİ SADECE BİLİMSEL AMAÇLI VE ARAŞTIRMACININ AMAÇLARI DIŞINDA KULLANMAMASIDIR.....AYRICA DEPARTMANIMIZIN HERHANGİ BİR MALİ SONUÇ DOGURMAMASI.

ARAŞTIRMA BİLİMSEL KOŞULLARI KARŞILAR VE BİLİMSEL ARAŞTIRMA ETİGİNE UYGUNDUR.

BİZE GÖRE ARAŞTIRMA YAPMASINDA ENGEL YOKTUR .

GENEL MÜDÜR

DOKTOR/ Dr.AHMED ABBAS TAHİR ELESEDİ SADIR HASTANE MÜHRÜ

İMZA- 02.2022

DOKTOR KAŞESİ

İŞ BU FOTOKOPİ BELGE ARAPÇADAN TÜRKÇEYE TARAFIMDAN TERCÜME EDİLMİŞTİR.

Ömer ASLAN
Arapça Yeminli Tercümanı
Tel : 0533 515 68 77

Republic of Iraq
Al-Najaf Al-Ashraf Governorate
Najaf Health Directorate
Training and Human Development Center

No.
Date:

جمهورية العراق
محافظة النجف الأشرف
دائرة صحة النجف

مركز التدريب و التنمية البشرية
العدد: ٧٠٧٠
التاريخ ١٢/ ٢٠٢٢/

الى/مدينة الصدر الطبية
مستشفى النجف التعليمي

م / تسهيل مهمة

تحية طيبة ...

بناءا على الطلب المقدم من قبل الباحث طالب الماجستير **مرتضى سعيد جاسم** في جامعة آهي افران التركية / كلية العلاج الطبيعي والتأهيل والمقترن بموافقة المدير العام بتاريخ ٢٠٢٢/١/١٠ للحصول على الموافقة الاخلاقية والعلمية لإجراء بحثه الموسوم:

Effectivness of shock wave therapy on capral tunnel syndrome :a randomized with waiting list control study

حصلت موافقة اللجنة العلمية للبحوث في مركز دائرتنا على إجراء البحث في **(مدينة الصدر الطبية/ مستشفى النجف التعليمي)** مع التأكيد على الالتزام الكامل بتعليمات السلامة الحيوية والضوابط الاخلاقية والحصول على موافقة المشاركين قبل الشروع بالبحث والحفاظ على خصوصيتهم وعدم افشاء البيانات او استخدام العينات لغير اغراض البحث العلمي .... على أن لا تتحمل دائرتنا أية تبعات مادية.

للتفضل بالاطلاع .....مع الاحترام.

الدكتور
احمد عباس طاهر الاسدي
المدير العام/وكالة
٢٠٢٢ / ٢ /

دائرة صحة النجف
الصادر

نسخة منه الى /
- مكتب المدير العام ..... التفضل بالعلم مع الاحترام .
- مركز التدريب و التنمية البشرية / مع الأوليات .
- الباحث /مرتضى سعيد جاسم ..... مع التقدير.

تسلسل الاستمارة ١٧

Appendix 2. BCTQ score

Boston Carpal Tunnel Syndrome Questionnaire (BCTQ)

(一) Symptom severity scale (11 items)

	1	2	3	4	5
1. How severe is the hand or wrist pain that you have at night?	Normal	Slight	Medium	Severe	Very serious
2. How often did hand or wrist pain wake you up during a typical night in the past two weeks?	Normal	Once	2 to 3 times	4 to 5 times	More than 5 times
3. Do you typically have pain in your hand or wrist during the daytime?	No pain	Slight	Medium	Severe	Very serious
4. How often do you have hand or wrist pain during daytime?	Normal	1-2 times / day	3-5 times / day	More than 5 times	Continued
5. How long on average does an episode of pain last during the daytime?	Normal	<10minutes	10~60 Continued	>60minutes	Continued
6. Do you have numbness (loss of sensation) in your hand?	Normal	Slight	Medium	Severe	Very serious
7. Do you have weakness in your hand or wrist?	Normal	Slight	Medium	Severe	Very serious
8. Do you have tingling sensations in your hand?	Normal	Slight	Medium	Severe	Very serious
9. How severe is numbness (loss of sensation) or tingling at night?	Normal	Slight	Medium	Severe	Very serious
10. How often did hand numbness or tingling wake you up during a typical night during the past two weeks?	Normal	Once	2 to 3 times	4 to 5 times	More than 5 times
11. Do you have difficulty with the grasping and use of small objects such as keys or pens?	Without difficulty	Little difficulty	Moderately difficulty	Very difficulty	Very difficult

(二) Functional status scale (8 items)：

	No difficulty	Little difficulty	Moderate difficulty	Intense difficulty	Cannot perform the activity at all due to hands and wrists symptoms
Writing	1	2	3	4	5
Buttoning of clothes	1	2	3	4	5
Holding a book while reading	1	2	3	4	5
Gripping of a telephone handle	1	2	3	4	5
Opening of jars	1	2	3	4	5
Household chores	1	2	3	4	5
Carrying of grocery basket	1	2	3	4	5
Bathing and dressing	1	2	3	4	5

Appendix 3. DASH score

DISABILITIES OF THE ARM, SHOULDER AND HAND

Please rate your ability to do the following activities in the last week by circling the number below the appropriate response.

	NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	UNABLE
1. Open a tight or new jar.	1	2	3	4	5
2. Write.	1	2	3	4	5
3. Turn a key.	1	2	3	4	5
4. Prepare a meal.	1	2	3	4	5
5. Push open a heavy door.	1	2	3	4	5
6. Place an object on a shelf above your head.	1	2	3	4	5
7. Do heavy household chores (e.g., wash walls, wash floors).	1	2	3	4	5
8. Garden or do yard work.	1	2	3	4	5
9. Make a bed.	1	2	3	4	5
10. Carry a shopping bag or briefcase.	1	2	3	4	5
11. Carry a heavy object (over 10 lbs).	1	2	3	4	5
12. Change a lightbulb overhead.	1	2	3	4	5
13. Wash or blow dry your hair.	1	2	3	4	5
14. Wash your back.	1	2	3	4	5
15. Put on a pullover sweater.	1	2	3	4	5
16. Use a knife to cut food.	1	2	3	4	5
17. Recreational activities which require little effort (e.g., cardplaying, knitting, etc.).	1	2	3	4	5
18. Recreational activities in which you take some force or impact through your arm, shoulder or hand (e.g., golf, hammering, tennis, etc.).	1	2	3	4	5
19. Recreational activities in which you move your arm freely (e.g., playing frisbee, badminton, etc.).	1	2	3	4	5
20. Manage transportation needs (getting from one place to another).	1	2	3	4	5
21. Sexual activities.	1	2	3	4	5

DISABILITIES OF THE ARM, SHOULDER AND HAND

	NOT AT ALL	SLIGHTLY	MODERATELY	QUITE A BIT	EXTREMELY
22. During the past week, *to what extent* has your arm, shoulder or hand problem interfered with your normal social activities with family, friends, neighbours or groups? *(circle number)*	1	2	3	4	5

	NOT LIMITED AT ALL	SLIGHTLY LIMITED	MODERATELY LIMITED	VERY LIMITED	UNABLE
23. During the past week, were you limited in your work or other regular daily activities as a result of your arm, shoulder or hand problem? *(circle number)*	1	2	3	4	5

Please rate the severity of the following symptoms in the last week. *(circle number)*

	NONE	MILD	MODERATE	SEVERE	EXTREME
24. Arm, shoulder or hand pain.	1	2	3	4	5
25. Arm, shoulder or hand pain when you performed any specific activity.	1	2	3	4	5
26. Tingling (pins and needles) in your arm, shoulder or hand.	1	2	3	4	5
27. Weakness in your arm, shoulder or hand.	1	2	3	4	5
28. Stiffness in your arm, shoulder or hand.	1	2	3	4	5

	NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	SO MUCH DIFFICULTY THAT I CAN'T SLEEP
29. During the past week, how much difficulty have you had sleeping because of the pain in your arm, shoulder or hand? *(circle number)*	1	2	3	4	5

	STRONGLY DISAGREE	DISAGREE	NEITHER AGREE NOR DISAGREE	AGREE	STRONGLY AGREE
30. I feel less capable, less confident or less useful because of my arm, shoulder or hand problem. *(circle number)*	1	2	3	4	5

DASH DISABILITY/SYMPTOM SCORE = $\left[\left(\frac{\text{sum of n responses}}{n}\right) - 1\right] \times 25$, where n is equal to the number of completed responses.

A DASH score may <u>not</u> be calculated if there are greater than 3 missing items.

Appendix 4: Demographic informations questionnaire

استبيان العينات المشاركة بالدراسة

الاسم الكامل: العمر: الجنس:

اليد المسيطرة: ايمن ☐ أعسر ☐

الحالة الزوجية: متزوج ☐ غير متزوج ☐

التدخين: مدخن: ☐ غير مدخن ☐

الوزن: ☐ كغم الطول: ☐ سم

هل تعاني من امراض مزمنة؟ نعم ☐ لا ☐

يرجى ذكر المرض المزمن ان وجد:.....

هل خضعت لعملية جراحية سابقا في الذراع او اليد؟ نعم ☐ لا ☐

هل تعرضت سابقا لكسر في اليد او الرسغ؟ نعم ☐ لا ☐

هل تعاني من مشاكل في الرقبة؟ نعم ☐ لا ☐

هل تعاني من حالة مرضية في الجهاز العصبي؟ نعم ☐ لا ☐

أوافق على المشاركة في هذه الدراسة لما لها من تأثير وفائدة علمية في الحقل الطبي وتحسين الخدمة المقدمة للمضى في مجال العلاج الطبيعي والتأهيل.

توقيع المشارك: