T.C.
YEDİTEPE UNIVERSITY
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COMPARISON OF EFFECTS OF DEEP FRICTION MASSAGE AND MILLS MANIPULATION ON PATIENTS WITH LATERAL EPICONDYLITIS

MASTER THESIS

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ONAY

Bu tez Yeditepe Üniversitesi Lisansüstü Eğitim-Öğretim ve Sınav Yönetmeliğinin ilgili maddeleri uyarınca yukarıdaki jüri tarafından uygun görülmüş ve Enstitü Yönetim Kurulu'nun 18../12./2019.. tarih ve 2019/19-16..... sayılı kararı ile onaylanmıştır.

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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.

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Saltuk Gazi SESİGÜZEL

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LIST OF SYMBOLS AND ABBREVIATIONS

BMI: Body-mass Index

DHI: Duruöz Hand Index

DFM: Deep Friction Massage

ESWT: Extracorporeal Shock Wave Therapy

Hz: Hertz

MHz: Megahertz

NSAID: Non-steroid Anti-Inflammatory Drug

TENS: Transcutaneous Electrical Nerve Stimulation

US: Ultrasound

VAS: Visual Analog Scale

ABSTRACT

Sesigüzel, S.G. (2019). Comparison of Effects of Deep Friction Massage and Mills Manipulation on Patients with Lateral Epicondylitis. Yeditepe University Institute of Health Sciences, Department of Physical Therapy and Rehabilitation, Msc Thesis. İstanbul.

The aim of this study is to compare the effects of Mills manipulation and deep friction massage on patients with lateral epicondylitis. There are 40 volunteers with lateral epicondylitis (F/M=22/18, 41,50 ±8,49 years) who met the inclusion criteria were included in the study. Structured forms including height, weight, age, and gender of patients were filled out. The patients were randomized by computer assisted randomization method and divided to Deep friction massage group (n = 20, F / M = 13/7, 42,80 ± 9,21 years) and Mills group (n = 20, F / M = 9/11, 40,20 ± 7,73 years). Deep friction massage was performed transversely to the tendon on patients who are in DFM (Deep friction massage) group for 10 minutes every other day. Mills manipulation was performed to the patients who are in Mills group every session. Both groups received TENS (Transcutaneous Electrical Nerve Stimulation) on the elbow joint (100 microseconds pulse duration-80Hz - 20 minutes), US (Therapeutic ultrasound) in circular motions (1 MHz - 5 minutes), additionally wrist stretching exercises (in the direction of flexion and extension for 1 minute- 3 repetitions) and strengthening exercises (10 repetitions-3 sets with free weights) were performed for the wrist extensor muscles. The treatments were performed for 3 weeks, 5 days per week for all patients. All patients were evaluated with Visual Analogue Scale (VAS) for pain assessment, Duruöz Hand Index (DHI) for functional assessment and Short Form-36 (SF-36) for quality of life assessment, besides grip strength and wrist joint range of motion measurements were taken at the beginning and end of the study. In both groups, significant improvement was observed in grip strength, wrist joint ranges, VAS and Duruöz Hand Index measurements and all subscales except the “social functioning” subscale of SF-36 questionnaire after the treatment. ($p<0,05$) The post-treatment scores of the “social functioning” subscale of SF-36 questionnaire did not show a significant difference in both groups. ($p>0,05$) When the groups were compared for the amount of improvement, any significant difference was not observed between the groups. ($p>0,05$) As a result of this study, it was not found any superiority between deep friction massage and Mills manipulation methods on lateral epicondylitis treatment.

Keywords: Lateral Epicondylitis, Deep Friction Massage, Mills Manipulation, Duruöz Hand Index

ÖZET

Sesigüzel, S.G. (2019). Lateral Epikondilitli Hastalarda Derin Friksiyon Masajı ve Mills Manipülasyonun Etkisinin Karşılaştırılması. Yeditepe Üniversitesi Sağlık Bilimleri Enstitüsü, Fizyoterapi ve Rehabilitasyon ABD, Yüksek Lisans Tezi. İstanbul.

Bu çalışmanın amacı; lateral epikondilitli hastalar üzerinde Mills manipülasyonu ve derin friksiyon masajının etkilerini karşılaştırmaktır. Çalışmaya dahil edilme kriterlerini sağlayan 40 gönüllü (K/E=22/18, 41,50 ±8,49 yaş) çalışmaya dahil edildi. Hastaların boy, kilo, yaş ve cinsiyet bilgilerini içeren formlar dolduruldu. Hastalar bilgisayar destekli randomizasyon yöntemi ile randomize edilerek Derin friksiyon masajı grubu (n=20, K/E=13/7, 42,80 ±9,21 yaş) ve Mills grubu (n=20, K/E=9/11, 40,20±7,73 yaş) olmak üzere iki gruba ayrıldı. Derin friksiyon masajı (DFM) grubuna dahil edilen hastalara; tendonun uzanış yönüne transvers şekilde olmak üzere 10 dakika boyunca iki seansta bir kez olacak şekilde derin friksiyon masajı yapıldı. Mills grubuna ise her seansta bir kere olmak üzere Mills manipülasyonu uygulandı. Her iki gruba da dirsek eklemi üzerine 100 mikrosaniye atım süresi ve 80 Hz frekansta 20 dakika Transkutanöz Elektrik Sinir Stimülasyonu (TENS) ve 1 MHz frekansta dairesel hareketlerle 5 dakika tedavi edici ultrason (US) uygulaması, 1er dakika ve 3er tekrar fleksiyon ve ekstansiyon yönünde el bileği germe egzersizleri ve serbest ağırlıklarla 10 tekrar – 3 set şeklinde el bileği ekstansör kasları için güçlendirme egzersizleri yapıldı. Uygulamalar bütün hastalar için haftada 5 gün olmak üzere 3 hafta boyunca yapıldı. Bütün hastalar çalışma başlangıcında ve bitiminde ağrı değerlendirmesi için Vizüel Analog Skala (VAS), fonksiyonel değerlendirme için Duruöz El İndeksi, yaşam kalitesi için Kısa Form-36 (SF-36) ile değerlendirildi ve kavrama kuvveti ile el bileği eklem hareket açıklıkları ölçümleri alındı. Her iki grupta kavrama kuvveti, fleksiyon ve ekstansiyon açıları, VAS ve Duruöz El İndeksi değerlerinde ve SF-36 anketinin "sosyal işlevsellik" alt başlığı hariç diğer bütün alt başlıklarında tedavi sonrasında tedavi öncesine göre anlamlı iyileşme saptandı. ($p<0,05$) SF-36 anketinin "sosyal işlevsellik" alt başlığı açısından ise her iki grubun da tedavi sonrası skorları anlamlı bir fark göstermemiştir. ($p>0,05$) Gruplar iyileşme miktarları açısından kıyaslandığında ise gruplar arasında anlamlı fark gözlenmemiştir. ($p>0,05$) Çalışmamızın sonucunda lateral epikondilit tedavisinde derin friksiyon masajı ve Mills manipülasyonu metotlarının birbirine üstünlüğü tespit edilmemiştir.

Anahtar kelimeler: Lateral Epikondilit, Derin Friksiyon Masajı, Mills Manipulasyonu, Duruöz El İndeksi

1. INTRODUCTION and PURPOSE

People, undoubtedly, use their hands and arms too much in order to continue their daily life activities. A hand-arm, which is subject to excessive use or trauma during daily life and is therefore painful and whose movements are restricted, will reduce the individual's quality of life. Since the elbow is exposed to intense stress, lateral epicondylitis cases are frequently encountered in the community.

Lateral epicondylitis, also known as tennis elbow, is a painful, inflammatory and restrictive condition that occurs in the tendon area on the lateral epicondyle as a result of frequent, repetitive and compelling movements of the wrist and forearm. (1)

This disease may limit the professional activities or adversely affect the performance of an athlete, as well as difficulties in the society due to pain, restlessness and daily life activities.

In the treatment of lateral epicondylitis, methods such as anti-inflammatory drugs, braces, injection, hot-cold applications, TENS (Transcutaneous Electrical Nerve Stimulation) are used. (2)

In addition, deep transverse friction massage is known to reduce inflammation in the muscles, tendons and tendon sheaths. (3)

On the other hand, Mills manipulation has long been used on lateral epicondylitis. (4)

The aim of this study is to compare the effectiveness of deep friction massage and Mills manipulation in the treatment of lateral epicondylitis.

2.GENERAL INFORMATION

2.1. Anatomy of the Elbow Joint

2.1.1. Bones

Elbow joint consists of a combination of humerus, Radius and ulna bones. The proximal humerus has two joint surfaces (condyle) at the distal end. These are trochlea and capitulum. The medial trochlea articulates with the ulna and the lateral capitulum with the radius. (5)

The surface of the trochlea humeri in the distal part of the humerus is covered with a cartilage of 300 degrees. There is an olecranon fossa in the posterior part of the trochlea and a coronoid fossa in the anterior part. They articulate with the coronoid and olecranon protrusions of the ulna.

In the anterior part of the capitulum, there is a radial fossa, which articulates with the radius head. (5,6)

2.1.2. Joints

The elbow joint consists of three joints: humeroulnar, humeroradial and proximal radioulnar joints. (6)

Humeroulnar joint is a hinge joint between the humerus and ulna bones and allows flexion-extension movements.

Humeroradial joint occurs between the fovea capitals of the radius and the capitulum of the humerus. It allows flexion-extension and supination-pronation movements along with the movement of the ulna.

Proximal radioulnar joint formed between the ulna and the radius head and allows rotation of the radius head. (5)

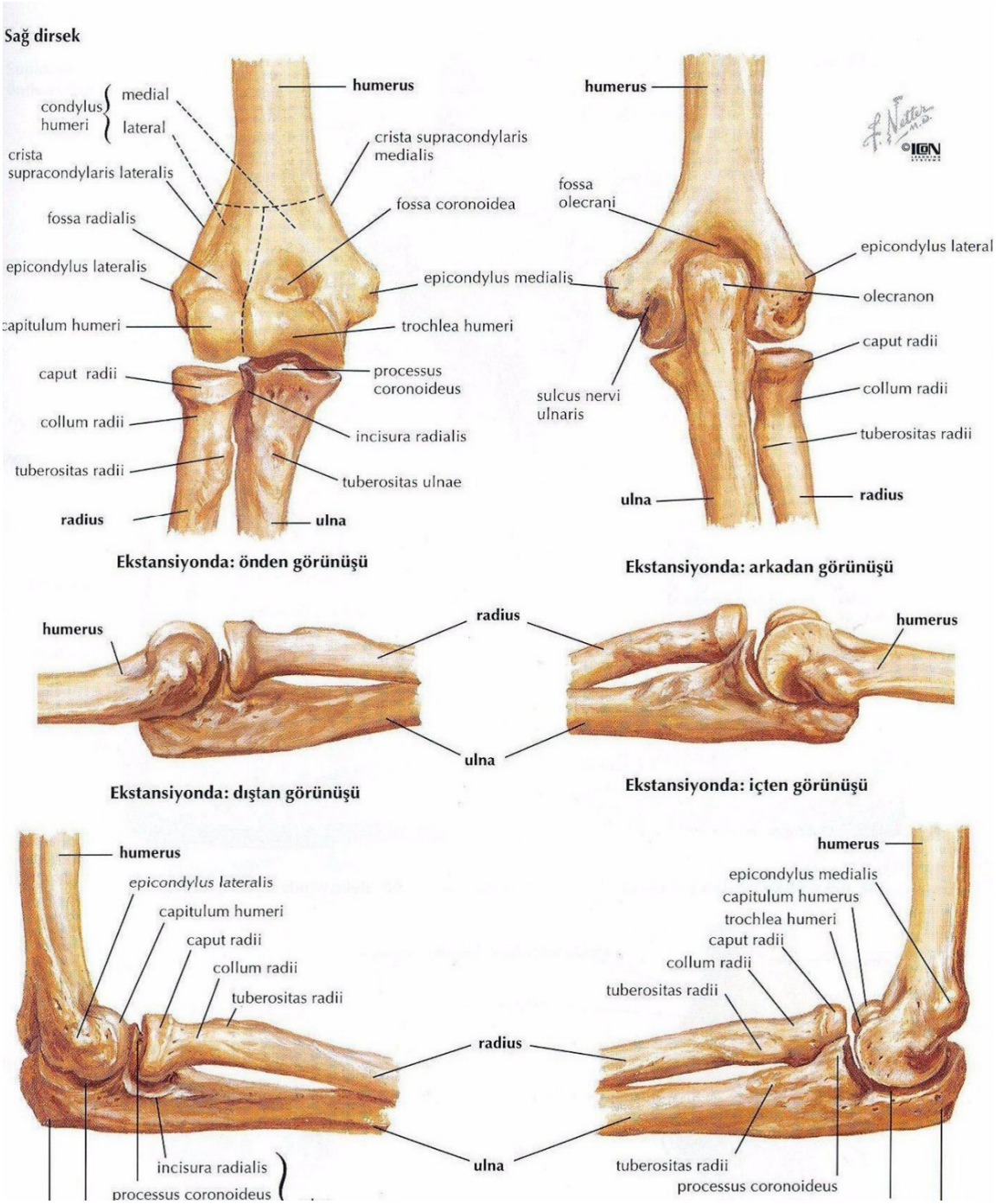


Figure 2.1. Elbow joint (Extracted from Netter)

2.1.3. Joint Capsule

The elbow joint is surrounded by a large capsule that includes all three joint structures. The front of this capsule is thin. The capsule attaches to the upper edge of the medial coronoid fossa and radial fossa at the top, and to the annular ligament with the

anterior edge of the coronoid process at the bottom. On the side, it joins the structure of collateral ligaments. (6)

The inner surface of the joint capsule is covered with a synovial membrane. It is protected by muscles in the anterior and posterior, and supported by ligaments in the medial and lateral parts. (5,7)

The position where the joint capsule is loose is the half-flexion position. With the flexion, the posterior part of capsule is stretched and the anterior part with the extension and makes plicas. (6)

2.1.4. Ligaments

Medial collateral ligament complex: It is the most important stabilizer of the joint. Because the fibers form in three different directions, they are examined in three sections: anterior, posterior and transverse. The anterior part is the most important part of the medial ligament complex. The posterior part is joined to the joint capsule. The anterior and posterior parts together play an important role in elbow stability. The effect of the transverse part on the stabilization is thought to be minimal. (5,6)

Lateral collateral ligament complex: Provides stabilization against varus stress. The radial collateral ligament extends from the lateral epicondyle to the annular ligament. The ulnar collateral ligament begins at the lateral epicondyle and ends at the tubercle of the ulnar crista muscular supinatoris. The annular ligament surrounds the radial head in a circular manner and provides stability of the radioulnar joint. It's a strong ligament. (5,6)

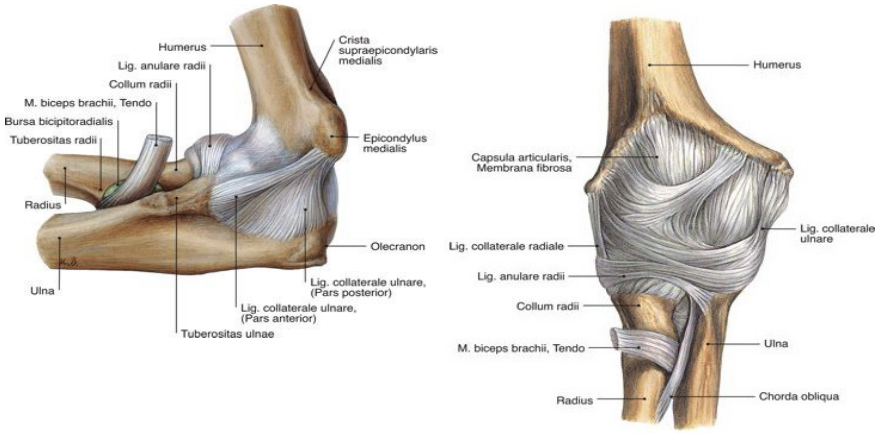


Figure 2.2. Ligaments of elbow joint and the joint capsule (Extracted from Sobotta)

2.1.5. Muscles

There are forearm extensors in the posterior part of the elbow joint, forearm flexors in the anterior part, wrist and finger extensors and supinators in the lateral part, and flexor and pronator muscle groups in the medial. (8)

Muscles originated from the lateral epicondyle

Extensor carpi radialis longus: Inserted on dorsal face of 2nd metacarpal bone.

Extensor carpi radialis brevis: Inserted on dorsal face of 3rd metacarpal bone. It is covered by extensor carpi radialis longus muscle. These two muscles extend the wrist. They also participate in deviation movements.

Extensor carpi ulnaris: Inserted on dorsal face of 5th metacarpal bone and extends the wrist and participates in the deviation movement.

Extensor digitorum communis: Inserted on aponeurosis which on the dorsal face of 2.-5. phalanxes and extends these phalanxes.

Extensor digiti minimi: Inserted on the dorsal aponeurosis of the 5th phalanx and extends the 5th finger. (25,32)

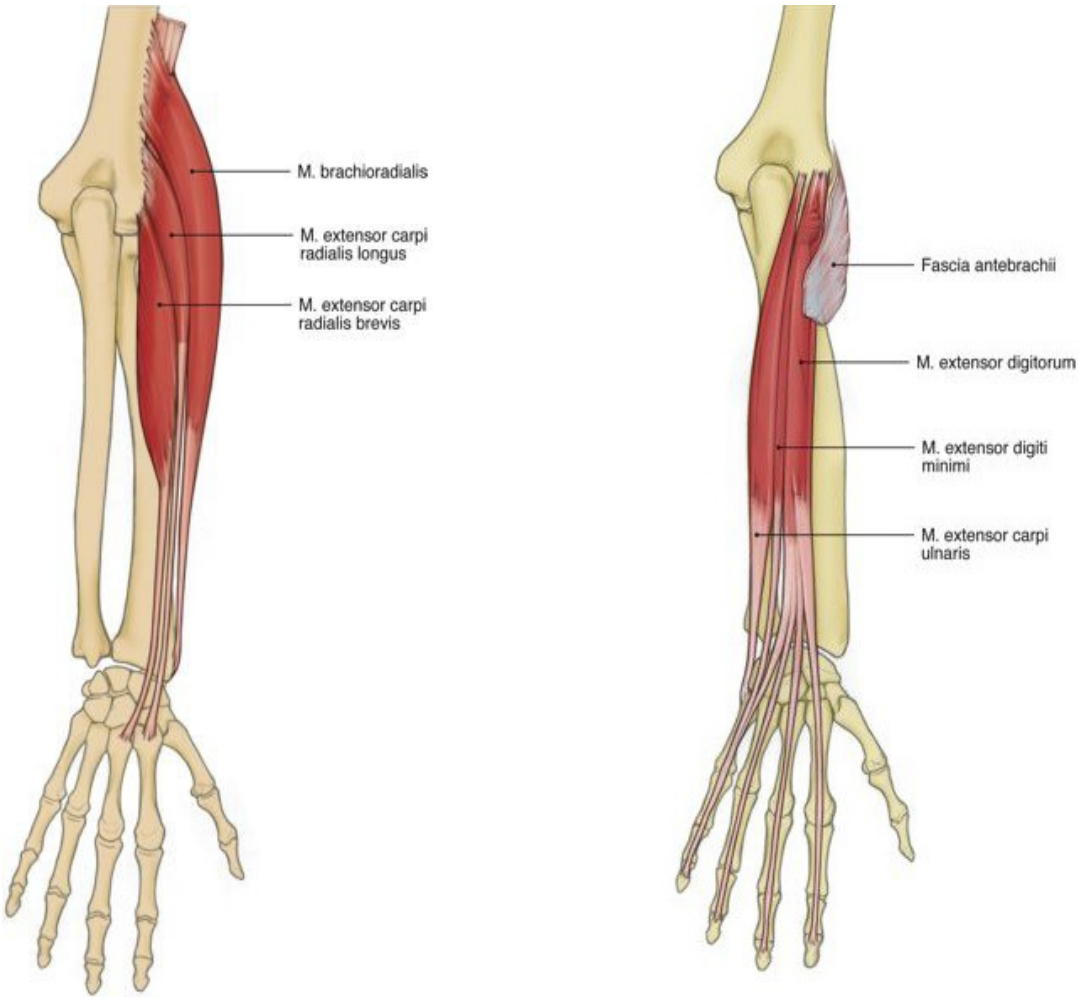


Figure 2.3. Muscles originated from lateral epicondyle (Extracted from Sobotta)

2.1.6. Nerves

The most important nerve in the lateral part of the elbow is the radial nerve. The radial nerve exits the posterior cord of brachial plexus, advances laterally to the humerus, and extends towards the lateral epicondyle. (9)

The ulnar nerve extends behind the arm and comes to the sulcus nervi ulnaris in the medial epicondyle of the humerus. Enters to the forearm by passing between the two heads of the flexor carpi ulnaris muscle. (10)

The median nerve crosses the elbow joint. It passes through the muscles and innervates the front of the elbow and the pronator teres. (9)

2.1.7. Arteries

The superior and inferior ulnar collateral arteries, as well as the ulnar recurrent arteries, feed the medial part of the elbow joint. The lateral part is fed by the radial artery and the radial and interosseous recurrent arteries. (9)

2.2. Biomechanics of the Elbow Joint

The elbow joint is a strong joint in terms of stabilization. Passive stabilizers of the elbow are bones and soft tissues and ligaments between them. Active stabilizers are muscle structures. (5)

The elbow joint allows two types of movement: pronation-supination and flexion-extension.

The flexion-extension movement of the elbow occurs when the humero-ulnar and humero-radial joints work together, and the range of motion is 150 degrees. This movement is provided by the hinge-type structure in the condyle.

The movement of the elbow in the direction of pronation-supination occurs in the proximal radioulnar joint. The circular structure of the radial head allows this movement to occur and is complemented by the involvement of the distal radioulnar joint in the wrist region. The range of movement in the direction of supination is about 75 degrees.

During daily activities, an average of 30 to 130 degrees of flexion-extension range and 50 degrees of pronation-supination range are used for the elbow.

Since the medial part of the trochlea humeri is larger than the lateral part, a valgus angle of about 6 degrees is formed on the joint surface with respect to the epicondylar axis and this is called the carrying angle. This angle is 5 degrees in men and 10-15 degrees in women. (5,6,9)

Due to the biomechanical properties of the elbow joint, structures in the lateral part are subjected to compression-type loads, while structures in the medial part are subjected to traction forces. (9)

The elbow joint is affected by problems with wrist movements, both because it is a bridge within the kinetic chain and because most muscles that provide wrist movement adhere to this area. Therefore, the most affected muscle structures in this region are those that adhere to humerus condyles. (5,9,11)

2.3. Lateral Epicondylitis

Lateral epicondylitis is a condition of tendinitis that occurs at the site of insertion of tendons of the wrist extensor muscles in the elbow region. (12)

In society it is most commonly seen in individuals between the ages of 40-50, between 1% and 3%. (13) Lateral epicondylitis is often reported to occur in manual workers, tennis players and men. (14)

Lateral epicondylitis is also known as the tennis elbow. Gruchow and Pelletier found signs of lateral epicondylitis in 39.7% of the athletes in their study on 500 tennis players. (15)

Lateral epicondylitis is also seen in industrial workers due to repetitive movements and frequent loads. (9)

Although the etiology cannot be clearly determined, overuse, frequent exposure to recurrent extension movements of the wrist, and overload are thought to trigger lateral epicondylitis. It has been shown that when the extensor carpi radialis brevis and the working extensor muscles, which act as stabilizers during wrist movements, are exposed to excessive stress and usage, cell matrix structures deteriorate and the process goes into degeneration. (16)

When the injured tissue is examined, there is an increase in vascularization ofthe region and the collagen structure of the tendon is filled with cross and weak fibers which are not parallel to the extension of the fibers. The tendon of this structure is weak and fragile against the loads to be formed. (17)

Cyriax has proposed 26 different mechanisms in which lateral epicondylitis may be involved. It is possible to classify these mechanisms as mechanisms of nerve irritations, pain and tendon damage. (18)

When the formation stage of lateral epicondylitis is examined, changes in tissue can be examined in four stages: (19)

- Stage 1: Onset of acute inflammation
- Stage 2: The emergence of irregular collagen structure
- Stage 3: Rupture of the tendon if the factors persist
- Stage 4: Ossification of irregular collagen structure

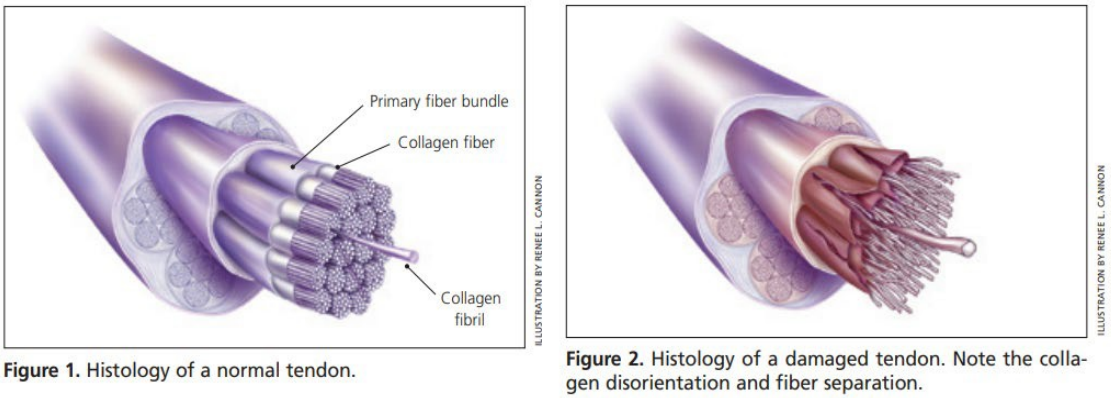


Figure 1. Histology of a normal tendon.

Figure 2. Histology of a damaged tendon. Note the collagen disorientation and fiber separation.

Figure 2.4. The comparison of the normal and damaged tendon (20)

Tendons are known to have less blood supply than muscles. Too much muscle contraction may cause damage to the tendon. Especially in the extensor carpi radialis muscle, this type of overuse may cause lateral epicondylitis. (16,19)

Since tissue flexibility and durability decreases with age, the incidence of lateral epicondylitis and the severity of the clinical picture increase with age. (9)

2.3.1. Symptoms and Signs of Lateral Epicondylitis

Lateral epicondylitis usually is seen in the clinic with the person complaining of pain.

The main area where the pain is felt is lateral of the elbow and may spread to the forearm. Patients express that the pain becomes apparent with Grasp and increases when pressed on it. It is also stated that wrist movements increase pain against resistance. (14)

Complaints related to lateral epicondylitis may affect the daily activities of individuals. Pain may increase in activities such as carrying books, holding cups, carrying bags. In addition, athletes suffer from weakness and pain during sports activities. (21)

Previous studies have shown that wrist extensor muscles are effective in grip movements. Therefore, injury and pain in the extensor muscles can have a negative effect on the function of these axes. Studies have shown that painful lateral epicondylitis reduces grip strength. (22)

In lateral epicondylitis, although the range of motion is generally unaffected, limitations may occur due to tension and pain in the tissues. (17,19)

2.3.2. Clinical Evaluation of Lateral Epicondylitis

When evaluating lateral epicondylitis; reflected pain from other areas, the possibility of a traumatic tendon rupture, ulnar collateral ligament damage, structural problems in the joint, the presence of potentially misleading conditions such as radial tunnel syndrome should be examined and firstly the arm-shoulder region should be evaluated in detail. (23)

Radiology can also be used for the distinction of some other conditions that may mislead the clinician.

2.3.2.1. Inspection

Whether the right and left arms of the patient have symmetrical posture and the presence of swelling and discoloration of the affected part of the arm should be examined.

2.3.2.2. Palpation

The tendon insertion region of the extensor muscles on the affected side a few centimeters distal of the lateral epicondyle is markedly painful and sensitive in palpation.

Figure 2.5. Palpation of lateral epicondyle (24)

2.3.2.3. Evaluation of Pain

When evaluating pain in Lateral epicondylitis, tests that provoke pain help us identify the pain.

When the patient is performing wrist extension, the clinician applies resistance to the movement and during this time the pain on the lateral epicondyle is checked. (24)

Figure 2.6. Resisted extension test. This test creates stress on extensor carpi radialis brevis muscle (24)

In the other test, the patient's wrist is forced to maximum flexion and stretched. When the extensor muscles are stretched, there is pain on the lateral epicondyle. (24)

Figure 2.7. Stretching test on extensor muscles (24)

2.3.2.4. Evaluation of Strength

Since lateral epicondylitis affects the grip strength of the patient, painless grip strength should be evaluated. When evaluating, the other side should be compared with the limb.

2.3.2.5. Evaluation of Range of Motion

Wrist goniometric measurements should be performed since joint range of motion may be limited due to pain and tension in soft tissues.

2.3.3. Treatment of Lateral Epicondylitis

In cases of Lateral epicondylitis, patients are most often admitted to clinics due to pain and loss of function. Over time, the patient's pain may increase to a level that will affect the quality of life.

The treatment approach is primarily to reduce the pain of the patient and to provide a strong and flexible joint movement in the healing process of the tissues.

There are also publications in the literature claim that lateral epicondylitis is a condition showing spontaneous improvement within a year. (21)

In the first phase of the non-surgical treatment approach, the aim should be to control pain, edema and inflammation. Medical treatment, hot-cold applications, use of

brace, rest, stretching and strengthening exercises at the pain limit can be used for this. The intensity of the exercises should be increased with the reduction of pain in the middle phase. In the last phase, education, daily living activities and if any return to sports activities, should be applied. (24)

2.3.3.1. Medical Treatment

The administration of topical non-steroid anti-inflammatory drugs (NSAID) was found to be more effective in the short term on pain and symptoms compared to placebo. (21)

2.3.3.2. Injection

Steroid injection has been found to be more effective than NSAID (Non-steroid anti-inflammatory drugs) and is used in these cases. (21) However, one study indicated that symptoms reappear in 50% of cases within six months of administration. (23) There are also those who claim that corticosteroid injection has side effects and should be delayed as much as possible. (21)

2.3.3.3. Surgery

In patients with lateral epicondylitis, the majority of patients recover with the conventional treatment methods. Surgery can be used in patients who do not respond to rehabilitation, medication and injection methods. In surgery, various methods such as denervation, nerve compression, debridement can be applied for the purposes of removing damaged tissue, correcting tendon mobility, reducing pain. (21,23,24)

2.3.3.4. Patient Training

Patients should be given the necessary training during, before and after treatment. Patients should be informed about the movements, habits that should be avoided, rest, home program and treatment process. The goal is to reduce fear and anxiety, to eliminate risks as much as possible, and to help patients to improve the effectiveness of the treatment.

2.3.3.5. Usage of Brace

Usage of brace in lateral epicondylitis; it will provide opportunities for rest and therefore recovery, prevent overloads and facilitate daily living activities. (21)

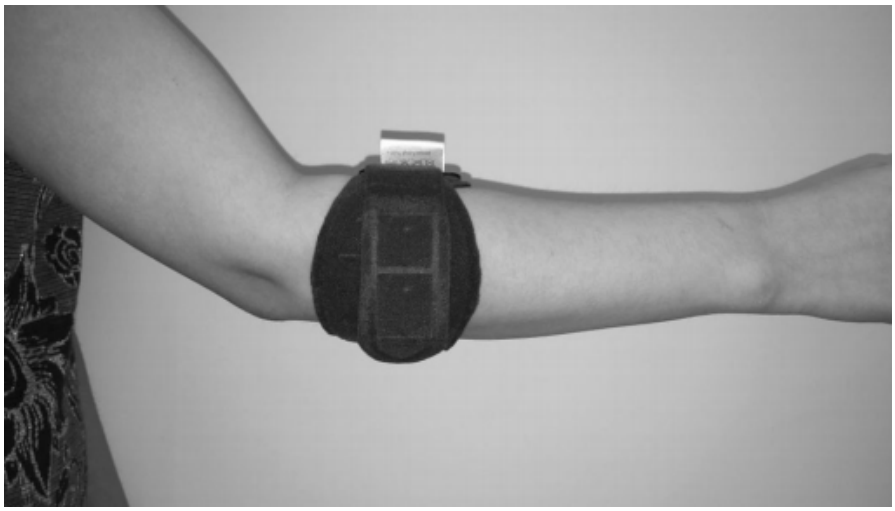


Figure 2.8. Usage of brace

2.3.3.6. Electrotherapy

In order to reduce inflammation and initiate tissue healing process; therapeutic ultrasound (US), phonophoresis, TENS and laser agents can be used to treat lateral epicondylitis. (21,23,28)

Although there is no consensus on its effectiveness, Extracorporeal Shock Wave Therapy (ESWT) is used in the treatment of lateral epicondylitis because it stimulates tissue healing and provides pain inhibition. (21)

2.3.3.7. Exercises

Using exercises in the treatment of lateral epicondylitis will increase tissue strength, increase flexibility and endurance, and increase muscle strength. (23) It was reported that eccentric contractions during activity stimulate the process of collagen production in tendon cells, reducing pain and inflammation by reducing neovascularization. (26)

Exercise therapy is widely used in lateral epicondylitis due to its low risk and cost and patient specificity.

Studies have shown that exercise treatments applied in lateral epicondylitis reduce pain, facilitate activities and increase grip strength. (27)

2.4. Deep Friction Massage

Classical superficial massage is insufficient for lesions of soft tissues such as deep tendons. The massage applied in order to relieve the inflammation signs in this area, to reduce the pain, to ensure that the formed fibrils become regular, to increase the blood supply in the area, has to reach deep enough of the tissue. It is aimed to provide this with deep friction massage. (10,13)

Deep friction massage is thought to reduce pain and inflammation when applied regularly to the area of the lesion in the tendon. (3)

With the application, it is thought that pain is reduced as described by the gate-control theory at the spinal cord level by stimulating the nociceptors. In addition, vasoconstriction in the tissue is prevented by deep friction massage, local circulation is increased and the area is more blooded and mediators provoking pain are removed.

Another mechanism that is thought to have an effect on deep friction massage is to provide analgesia as a result of increased endogenous opiate release. (13,29)

In cases of lateral epicondylitis, irregular scar tissue and adhesions on the lesion area delay healing, limit movements, and cause pain and tenderness. In this regard, deep friction massage dissolves adhesions by breaking the cross-links between the fibers in the lesion tendon tissue during the healing process. (13,30,31)

Deep friction massage should be performed transversely to the direction of tendon extension. The pressure exerted by the therapist should be applied as deep as the patient can withstand. (13)

During the application, the therapist's fingers should move in full contact with the patient's skin, not rub on the skin or bend the skin. (30)

Cyriax says that the administration should be about 15 minutes, causing hyperemia in the tissue. (32) According to the general opinion, the application time should be approximately 10 minutes. In order to allow physiological changes in the tissue after the application and to make the tissue ready for re-application, it is considered appropriate to take a break of 48 hours until the next application. (13)

In addition, deep friction massage must be applied over the damaged area to be fully effective. For this, the patient should sit in the appropriate position and the muscles should be relaxed. (32)

Deep friction massage should not be applied to areas of active infection, on wounded skin tissue, to individuals using anticoagulants. (13)

2.5. Mills Manipulation

Mills manipulation is a technique used by physiotherapists on lateral epicondylitis for years. (33,34) It was described in 1928 by Mills. (4)

The aim of this technique is to dissolve connective tissue adhesions caused by inflammation at the tendon insertion site, thereby increasing flexibility, reducing pain, and initiating the recovery process. (4, 23)

Mills often found a sensitive point around the lateral epicondyle in patients with lateral epicondylitis. He observed that patients were painful in full extension movements. He thought the cause of this pain was tension and developed a manual technique to solve this tension in soft tissue. (4)

During the Mills manipulation, small tears are created in the painful scar tissue, thereby reducing tension in the tissue. (23)

In later years, Mills stated that he had detected sensitivities at the point where the radius head and extensor muscles were bulged, except for the lateral epicondyle, and Cyriax, who later performed studies on this subject, confirmed this. (34)

The clinical condition of lateral epicondylitis was thought to be the formation of a tear between the extensor carpi radialis brevis muscle and the periosteum on the lateral epicondyle of the humerus, and this view is widely accepted. (34)

During the inflammation and healing process that begins after the injury, the gap between the two ends of the ruptured structure develops and expands over time. In time, scar tissue fill this opening. The developing scar reduces the elasticity of the soft tissue.

Pain and tenderness occur because the scar tissue is loaded during movement within normal range of motion. Moreover, the presence of scar tissue makes it difficult to repair the torn structure normally. As a result, signs and symptoms such as limitation of motion, pain, tenderness and loss of power after some time appear.

Mills manipulation is thought to break these developing scar tissue connections, increasing mobility in the area and bringing the two ends of the tear closer together. (13,32-34)

The effectiveness of this technique has been demonstrated in some controlled studies. (13)

The patient is placed on a chair while Mills manipulation is performed. The arm of the patient is brought to 90 degrees of abduction and internal rotation and forearm pronation. Maximum wrist flexion is performed and the other hand is firmly gripped proximal to the elbow joint. After the patient is relaxed, a sharp and low amplitude maneuver is performed in the direction of elbow extension. (4,13)

In this way, adhesions in the irregular developing connective tissue at the tendon insertion site are removed. (23)

Mills manipulation should be performed once in a treatment session. (34)

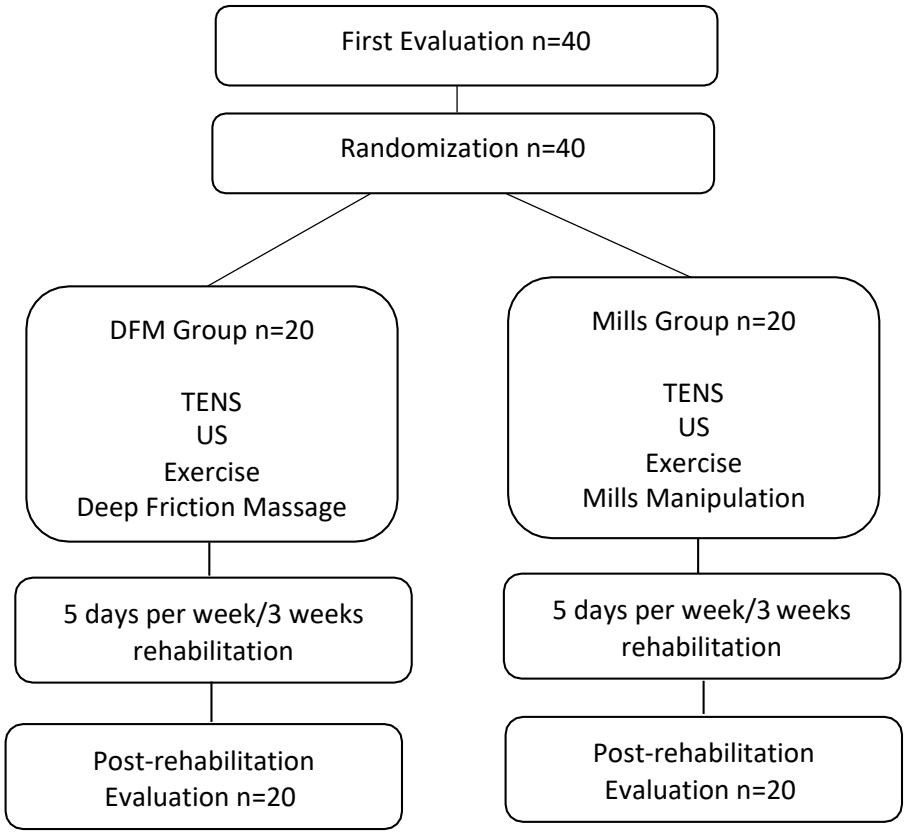
3.MATERIALS and METHODS

Our study was performed to compare the effectiveness of deep friction massage and Mills manipulation methods applied together with classical physiotherapy methods on patients with lateral epicondylitis.

The study protocol was approved by the Yeditepe University Clinical Research Ethical Committee at the date of 13.06.2019 and issue number was 37068608-6100-15-1691. (Appendix 1) The study was performed at the "Özel Artroklinik Sporcu Sağlığı Merkezi" with 40 volunteer patients who were diagnosed and met the criteria for inclusion. Participants included in the study were treated between 17.06.2019 and 05.11.2019.

The participants were informed about the purpose of the study, the duration of the treatment, the assessment methods to be performed during the treatment and the questionnaires. Participants were read the "informed written consent form" which was prepared in accordance with the standards determined by Yeditepe University Clinical Research Ethical Committee and their approval was obtained by their signatures. (Appendix-2) Number of patients and groups are showed at Table 3.1.

Table 3.1. Flow chart of clinical study



3.1. Participants

Volunteer patients who met the inclusion criteria were randomized using random numbering software and divided into two groups as “Deep Friction Massage (DFM)” and “Mills” group.

Inclusion criteria:

1) Diagnosed of subacute lateral epicondylitis
2) Tenderness during palpation at the tendon insertion site in the lateral epicondyle
3) Pain in resistant wrist extension movements
4) 18-60 age

Exclusion criteria:

1) Other problems such as fracture in elbow area, tendon rupture, skin problems
2) Bilateral symptoms
3) Not cooperating patient or refusing to participate in the study
4) Pregnancy, malignancy, pacemaker
5) Neurological deficit
6) Cervical spine or other upper limb problems
7) Analgesic usage

3.2. Evaluations

All patients in both groups were evaluated before and after treatment with the following methods:

3.2.1. Structured Forms

It contains age, gender, weight, height information. (Appendix-3)

3.2.2. Visual Analog Scale

VAS (Visual Analog Scale) consists of a horizontal or vertically positioned line that extends from 0 to 10 on a page. The number “0” on this line indicates that the patient has no pain, while the number “10” represents the worst pain that the patient has

experienced in their own experience. The patient is asked to mark any place he wishes on this straight line, numbered between 0 and 10, to show the pain he/she had at the time the test was administered. (Appendix-4)

3.2.3. Hand Grip Strength Measurement

The hand grip strength of the patients was measured with the help of JAMAR hand dynamometer. Measurements were made so that the elbow was 90 degrees flexion while the patient was sitting, and 3 times each time, the average score was taken. Results were recorded in kg-force. (Appendix-5)

3.2.4. Range of Motion Measurement

The active range of motions of the patients were measured by goniometer. These measurements were performed on wrist flexion-extension. (Appendix-6)

3.2.5. Duruöz Hand Index

The Duruöz Hand Index (DHI) is a questionnaire that measures the degree of ability of hand and wrist activities. This study was used to measure patients' hand and wrist functionality. (Appendix-7)

3.2.6. Short Form-36 (SF-36)

The Turkish version of "Medical Outcomes 36 - Item Short Form Health Survey (SF-36) was used as Kısa Form-36 (SF-36) to evaluate the quality of life of the patients. SF-36, consists of 36 questions in total and physical function, physical role limitation, emotional role limitation, pain, social functioning, energy/vitality, general health and mental health, including 8 sub-scales and assesses the quality of life. (Appendix-8)

After the patients were randomly divided into two groups, pre-treatment evaluations were applied to both groups. Then treatment sessions were started.

3.3. Treatment Protocol

3.3.1. TENS

It was applied on the elbow joint at 100 microsecond pulse duration and 80 Hz frequency for 20 minutes with the intensity of the withstanding of patient.

3.3.2. Therapeutic Ultrasound

Ultrasound(US) was applied on lateral epicondyle for 5 minutes with circular movements at 1 MHz frequency.

3.3.3. Exercises

Stretching exercises were applied to the wrist joint on flexion and extension direction when the elbow joint is in extension position. It was performed with 1-minute stretching and 3 repetitions in both directions. In addition, strengthening exercises were performed for the wrist extensor muscles in the form of 10 repetitions - 3 sets with appropriate weights for the patients with the forearms placed on the table.

3.3.4. Deep Friction Massage

Patients were seated and positioned for application. Forearms were placed on the table and the patients were allowed to relax. While the patient's forearm was in the pronation position, a deep friction massage was performed for 10 minutes in the transverse direction to the extension of the fibers. The therapist's thumb and other fingers grasped the tissue. During the application, pressure was applied so that the patient's pain did not exceed 7 points on the VAS scale. Deep friction massage was performed every other day according to the accepted appropriate application method.

Figure 3.3.1. Deep friction massage

3.3.5. Mills Manipulation

Patients were seated and positioned for application. The patient's arm was brought to 90 degrees abduction and internal rotation and forearm pronation. Maximum wrist flexion was performed and stretched in such a way that there was no space in the wrist joint. The patient was relaxed. After a few small stretching movements in the elbow extension direction. Then, sudden and low amplitude extension maneuver was carried out towards the final degrees of movement, and the limb was slowly released. This application was made once in each session.

Figure 3.3.2. Mills manipulation

3.4. Statistical Analysis

Statistical analyzes were performed using IBM SPSS 22 (IBM Corp., Armonk, NY, USA). Shapiro-Wilk test was used to test the normal distribution. The data showed normal distribution. Independent t-test was used to compare the measurement results of the groups. Paired samples t-test was used to compare pre-treatment and post-treatment

measurements of the groups. In all analysis results, $p < 0.05$ (bidirectional) values and statistical significance level were accepted as $p < 0.05$.

4.RESULTS

After the completion of the treatment sessions in both groups, final measurements and analyzes were performed on 40 volunteers.

4.1. Physical Features of Participants

Table 4.1. Comparison of physical features

	DFM Group	Mills Group	p
Gender =n (Female/Male)	13/7	9/11	
Age=year (Mean±Sd)	42,80±9,21	40,20±7,73	0,34
Height=cm (Mean±Sd)	169,35±7,71	171,65±7,97	0,36
Weight=kg (Mean±Sd)	66,05±11,21	72,60±10,14	0,60
BMI=kg/m^2 (Mean±Sd)	22,92±2,81	24,56±2,42	0,55

BMI: Body-mass Index Sd: Standard deviation kg: Kilogram cm: Centimeter m: Meter

4.2. Comparison of Evaluated Parameters Before the Treatment

Comparison of pre-treatment measurement and questionnaire results for both groups shown on Table 4.2.1. and Table 4.2.2.

There was no significant difference between pre-treatment measurement and questionnaire scores ($p > 0.05$).

Table 4.2.1. Comparison of pain, grip strength, functionality measurement and range of motion parameters between the two groups before treatment

	DFM Group (Mean±Sd)	**Mills Group (Mean±Sd)**	**p**	**t**
Visual Analog Scale	6,75±1,11	6,95±1,23	0.594	0.537
Duruöz Hand Index	47,85±6,39	48,80±5,40	0.615	0.507
Hand Grip Strength	20,60±4,88	21,70±3,64	0.424	0.808
Wrist flexion angle	73,25±3,52	72,75±2,97	0.630	0.485
Wrist extension angle	64,85±3,26	64,95±2,91	0.919	0.102

Sd: Standard deviation

Table 4.2.2. Comparison of SF-36 sub-scales between two groups before treatment

	DFM Group (Mean±Sd)	Mills Group (Mean±Sd)	p	t
SF-36 Physical Role Limitation	46,25±20,31	51,25±15,12	0.383	0.883
SF-36 Emotional Role Limitation	66,66±26,49	71,66±22,36	0.523	0.645
SF-36 Energy/Vitality	71,75±7,99	73,00±8,17	0.628	0.489
SF-36 Mental Health	71,40±7,14	71,80±9,03	0.877	0.155
SF-36 Social Functioning	88,75±12,09	90,00±12,56	0.750	0.320
SF-36 Pain	61,00±14,15	65,37±15,52	0.358	0.931
SF-36 General Health	64,00±10,95	66,50±12,25	0.501	0.680
SF-36 Physical Functioning	70,75±9,35	75,50±6,66	0.072	1.849

Sd : Standard deviation

4.3. Comparison of Pre-treatment, Post-Treatment Results and Change Values of Groups for Evaluated Parameters

Pre-treatment-post-treatment comparisons for all evaluation parameters shown on the Table 4.3.1., Table 4.3.2., Table 4.3.3. , Table 4.3.4. and change value comparisons between groups shown on the Table 4.3.5. with Table 4.3.6.

The results showed no significant difference in the post-treatment scores of both groups in terms of the “social functioning” sub-scale of the SF-36 questionnaire. ($p>0.05$)

In both groups, there was significant difference in post-treatment scores of hand grip strength, wrist flexion and extension angles, VAS and Duruöz Hand Index scores

and in all sub-scales of the SF-36 questionnaire except the “social functioning” sub-scale. ($p<0.05$)

When the groups were compared in terms of change values between them, no significant difference was found in any parameter. ($p> 0.05$)

Accordingly, when VAS, Duruöz Hand Index, hand grip strength, wrist flexion and extension angles and SF-36 questionnaire were examined, no superiority of the two methods was found.

Table 4.3.1. Comparison of pre-treatment and post-treatment scores of pain, hand grip strength, functionality measurement and wrist range of motion parameters for the DFM group

DFM Group	Pre (Mean±Sd)	Post (Mean±Sd)	p	t
VAS	6,75±1,12	2,60±0,99	**0.000**	21.208
DHI	47,85±6,39	33,80±5,00	**0.000**	15.055
HGS	20,60±4,88	22,20±4,32	**0.000**	-7.193
WFA	73,25±3,52	76,15±2,43	**0.000**	-8.542
WEA	64,85±3,26	66,25±2,46	**0.000**	-4.765

VAS: Visual Analog Scale DHI: Duruöz Hand Index HGS: Hand grip strength WFA: Wrist flexion angle WEA: Wrist extension angle Sd: Standard deviation Pre: Pre-treatment Post: Post-treatment

Table 4.3.2. Comparison of pre-treatment and post-treatment scores of SF-36 sub-scales for the DFM group

DFM Group	Pre (Mean±Sd)	Post (Mean±Sd)	p	t
SF-36 Physical Role Limitation	46,25±20,31	60,00±12,56	**0.000**	-4.819
SF-36 Energy/Vitality	71,75±7,99	75,75±5,68	**0.004**	-3.238
SF-36 Social Functioning	88,75±12,09	90,00±10,41	0.163	-1.453
SF-36 General Health	64,00±10,95	68,75±7,23	**0.001**	-4.046
SF-36 Emotional Role Limitation	66,66±26,49	79,99±19,94	**0.002**	-3.559
SF-36 Physical Functioning	70,75±9,35	78,25±6,74	**0.000**	-6.381
SF-36 Pain	61,00±14,15	79,25±9,73	**0.000**	-7.317
SF-36 Mental Health	71,40±7,14	72,40±6,34	**0.021**	-2.517

Sd: Standard deviation Pre: Pre-treatment Post: Post-treatment

Table 4.3.3. Comparison of pre-treatment and post-treatment scores of pain, hand grip strength, functionality measurement and wrist range of motion parameters for the Mills group

Mills Group	Pre (Mean±Sd)	Post (Mean±Sd)	p	t
VAS	6,95±1,23	2,40±0,94	**0.000**	26.804
DHI	48,80±5,40	35,20±4,59	**0.000**	14.710
HGS	21,70±3,64	23,15±3,08	**0.000**	-7.310
WFA	72,75±2,97	76,10±1,86	**0.000**	-8.005
WEA	64,95±2,91	66,60±1,87	**0.000**	-4.355

VAS: Visual Analog Scale DHI: Duruöz Hand Index HGS: Hand grip strength WFA: Wrist flexion angle WEA: Wrist extension angle Sd: Standard deviation Pre: Pre-treatment Post: Post-treatment

Table 4.3.4. Comparison of pre-treatment and post-treatment scores of SF-36 sub-scales for the Mills group

Mills Group	Pre (Mean±Sd)	Post (Mean±Sd)	p	t
SF-36 Physical Role Limitation	51,25±15,12	66,25±14,67	**0.000**	-5.339
SF-36 Energy/Vitality	73,00±8,17	76,25±6,46	**0.002**	-3.577
SF-36 Social Functioning	90,00±12,56	91,87±9,31	0.083	-1.831
SF-36 General Health	66,50±12,25	71,50±8,75	**0.000**	-3.446
SF-36 Emotional Role Limitation	71,66±22,36	84,99±17,01	**0.001**	-3.559
SF-36 Physical Functioning	75,50±6,66	81,25±5,09	**0.000**	-5.205
SF-36 Pain	65,37±15,52	78,75±7,88	**0.000**	-5.403
SF-36 Mental Health	71,80±9,03	73,20±7,57	**0.031**	-2.333

Sd: Standard deviation Pre: Pre-treatment Post: Post-treatment

Table 4.3.5. Comparison of change values in pain, hand grip strength, functionality measurement and wrist range of motion parameters between groups

	DFM Group change (Mean±Sd)	**Mills Group change (Mean±Sd)**	**p**	**t**
VAS	-4,15±0,87	-4,55±0,75	0.131	1.544
DHI	-14,05±4,17	-13,60±4,13	0.734	-0.343
HGS	1,60±0,99	1,45±0,88	0.618	0.503
WFA	2,90±1,51	3,35±1,87	0.409	-0.835
WEA	1,40±1,31	1,65±1,69	0.605	-0.521

VAS: Visual Analog Scale DHI: Duruöz Hand Index HGS: Hand grip strength WFA: Wrist flexion angle WEA: Wrist extension angle Sd: Standard deviation

Table 4.3.6. Comparison of change values of SF-36 sub-scales between groups

	DFM Group change (Mean±Sd)	**Mills Group change (Mean±Sd)**	**p**	**t**
SF-36 Physical Role Limitation	13,75±12,76	15,00±12,56	0,757	-0.312
SF-36 Energy/Vitality	4,00±5,52	3,25±4,06	0,628	0.489
SF-36 Social Functioning	1,25±3,84	1,87±4,57	0,643	-0.467
SF-36 General Health	4,75±5,25	5,00±6,40	0,513	-0.134
SF-36 Emotional Role Limitation	13,33±16,75	13,33±16,75	0,999	0.000
SF-36 Physical Functioning	7,50±5,25	5,75±4,94	0,285	1.085
SF-36 Pain	18,25±11,15	13,37±11,07	0,173	1.387
SF-36 Mental Health	1,00±1,77	1,40±2,68	0,582	-0.556

Sd: Standard deviation

4.4. Distribution of Evaluations by Gender

The comparisons of the change values between male and female participants for both groups shown on Table 4.4.1. and Table 4.4.2.

Table 4.4.1. Comparison of measurement and questionnaire scores of male and female participants for DFM group

DFM Group	Pre difference (Mean)	Pre (p)	Post difference (Mean)	Post (p)
Visual Analog Scale	0,27	.614	0,70	.135
Duruöz Hand Index	2,85	.356	0,35	.885
Wrist flexion angle	-0,05	.975	0,01	.993
Wrist extension angle	**-3,53**	**.017***	**-2,69**	**.015***
Hand Grip Strength	**-6,99**	**.001***	**-6,07**	**.001***
SF-36 Physical Functioning	-1,04	.819	1,70	.604
SF-36 Physical Role Limitation	5,22	.597	-1,10	.858
SF-36 Energy/Vitality	0,49	.899	2,25	.413
SF-36 Social Functioning	-9,07	.112	**-9,89**	**.039***
SF-36 Pain	4,84	.481	1,04	.826
SF-36 Emotional Role Limitation	-21,98	.076	-16,12	.084
SF-36 General Health	-0,44	.935	-3,02	.387
SF-36 Mental Health	5,23	.121	**5,89**	**.044****

Pre: Pre-treatment Post: Post-treatment *: Male participants better **: Female participants better

Table 4.4.2. Comparison of measurement and questionnaire scores of male and female participants for Mills group

Mills Group	Pre difference (Mean)	Pre (p)	Post difference (Mean)	Post (p)
Visual Analog Scale	0,09	.875	-0,12	.783
Duruöz Hand Index	-1,05	.677	-2,99	.153
Wrist flexion angle	1,67	.221	-0,18	.835
Wrist extension angle	0,29	.830	0,12	.890
Hand Grip Strength	**-4,10**	**.008***	**-3,71**	**.004***
SF-36 Physical Functioning	1,11	.721	0,76	.751
SF-36 Physical Role Limitation	-2,27	.748	-4,29	.530
SF-36 Energy/Vitality	-6,46	.078	**-7,32**	**.008***
SF-36 Social Functioning	-4,55	.436	-2,90	.503
SF-36 Pain	-9,27	.191	-2,27	.536
SF-36 Emotional Role Limitation	-2,36	.822	0,34	.966
SF-36 General Health	-0,71	.902	-0,71	.863
SF-36 Mental Health	2,79	.507	2,67	.449

Pre: Pre-treatment Post: Post-treatment *: Male participants better **: Female participants better

When the results were examined, in the DFM group, the scores in the “hand grip strength” and “wrist extension angle” parameters showed significant difference between male and female participants both before and after treatment, and in both these parameters, male participants achieved higher scores than female participants. In the “social functionality” and “mental health” sub-scales of the SF-36 questionnaire, there

was no difference between pre-treatment scores and no significant difference between the genders in post-treatment measurements. Male participants scored higher in the sub-scale "social functionality" and women scored higher in the sub-scale "mental health".

When the results were analyzed for the Mills Group, significant difference was found in both pre-treatment and post-treatment scores between male and female participants in terms of "hand grip strength" parameter. This difference is due to the higher scores of male participants in pre-treatment and post-treatment measurements. In the "energy/vitality" sub-scale of the SF-36 questionnaire, there was no significant difference between the two genders in pre-treatment scores, while there was no significant difference in post-treatment scores. In this sub-scale, male participants achieved higher scores in post-treatment scores.

5.DISCUSSION

In this study, we compared the effects of “deep friction massage” and “Mills manipulation” techniques, two methods used in the treatment of lateral epicondylitis.

Lateral epicondylitis is characterized by pain complaint on the lateral epicondyle and is found in 3% of the society. (27) according to D'vaz, it is observed equally in men and women. (35)

In cases of Lateral epicondylitis, a complaint of pain at the tendon insertion site on the lateral epicondyle is observed. Although this pain is felt at rest, it is often increased by the resistant movements of the wrist. It can also be seen that joint movement ranges are restricted in cases due to pain.

Inflammation on the muscle/tendon causes scar tissue formation, tension and therefore movement restriction and pain in the region after a while.

As this process of disease gets longer, the patient may lose some of the grip strength of the hand due to the problems mentioned. Since these losses can affect the daily activities of the patients with their hands and their work activities, loss of hand function can occur at different rates in the patient's daily life. Physical or mental health perceptions of patients may change due to loss of function and the pain.

In our study, visual analog scale was used to evaluate pain. Visual analog scale (VAS), a subjective measurement tool, can be used for pain measurement in cases of lateral epicondylitis. (36)

In this study, we measured the wrist joint movement ranges of patients with goniometers in the direction of flexion and extension, due to the possibility of restriction due to pain and loss of flexibility in tissue.

Again, the use of lateral epicondylitis caused by pain should be restricted, and due to physiological changes in the tissue, the grip strength of the patients can be reduced. For this reason, we measured the grip strength of the patients with hand dynamometer.

As a result, the condition caused by lateral epicondylitis affects the patients’ physical skills, mental status, and daily life activities. The SF-36 questionnaire, developed to evaluate all these parameters in 8 sub-scales, is also used in patients with lateral epicondylitis. (37,38) In our study we used Turkish version the SF-36 questionnaire (Kısa

Form-36), and consists of 11 questions on physical function, physical role limitation, emotional role limitation, pain, social functioning, energy/vitality, general health, and mental health, including 8 sub-scale evaluated. Scores range from 0-100, and low scores indicate low quality of life.

In this study, functional evaluations of the patients were performed with a Duruöz Hand Index. The Duruöz Hand Index (DHI) is a questionnaire that measures loss of hand and wrist function.

Therapeutic ultrasound (US), which is one of the methods used to treat lateral epicondylitis, increases flexibility in soft tissue and reduces spasm, increases protein synthesis in tissue and accelerates tissue healing. (1,39)

In a controlled study conducted with 60 patients in 2009, Akın et al. Compared the 3-week effects of 5-minute therapeutic ultrasound at 1 MHz frequency in patients with lateral epicondylitis to placebo and found therapeutic ultrasound effective in terms of improvement in VAS scores. (40)

In our study, we applied therapeutic ultrasound to both groups at a frequency of 1 MHz for 5 minutes.

Transcutaneous electrical nerve stimulation (TENS), another agent we use in our study, is a noninvasive, inexpensive, safe and easily accessible method. With the application of TENS, the transport of pain through the spinal cord is inhibited. Accordingly, the recovery process is expected to be easier. (41)

In their controlled study, Dilekçi et al. Randomly divided 60 patients with lateral epicondylitis into two groups and applied TENS with 200 Hz frequency and 100 μs pulse duration to only one. They observed a significant decrease in VAS scores in the TENS group compared to the placebo group. (42) In our study, we performed TENS application with similar parameters to both groups.

Therapeutic exercises are also actively used in the rehabilitation of lateral epicondylitis. (43) Stretching exercises and eccentric strengthening exercises together with tissue collagen production increases, flexibility, endurance increases and inflammation decreases. (23,26) Cullinane et al showed the effects of eccentric exercises on lateral epicondylitis. (27)

In their study, Martinez-Silvestrini et al applied eccentric strengthening, concentric strengthening and stretching exercises to the three treatment groups, respectively, and found that in the post-treatment evaluations, all three groups improved significantly on pain and function compared to pre-treatment. (44) In our study, all patients underwent one-minute stretching exercises in the direction of flexion and extension in each session and strengthening exercises with 3 sets - 10 repetitions with appropriate weights.

Some physiotherapy approaches regarding lateral epicondylitis include traditional physiotherapy agents to eliminate pain and inflammation at the site of injury. In order to minimize the limitations that may occur due to this tension, we see that manual techniques applied directly to affect soft tissue are included in the therapy programs. For this reason, such a kind of technique was compared in this study.

In the literature, Özçoban applied deep friction massage to patients with lateral epicondylitis in her controlled study and examined the results. In his study, she divided 54 patients into two groups; she applied only classical physiotherapy agents to the control group and deep friction massage in addition to these applications and found a significant difference in rest and activity pain and grip strength in favor of the experimental group. (10)

In their study, Yi et al. divided 34 patients with lateral epicondylitis into three groups and performed deep friction massage, steroid injection and splinting, respectively. Long-term (6 months) measurements of deep friction massage group showed significant improvement in VAS and grip strength compared to other groups. (45)

In their study, Wiswas et al. used deep friction massage and Mills manipulation in patients with lateral epicondylitis, but compared these methods to therapeutic exercise using a combination of the Cyriax concept. In this study, 20 lateral epicondylitis patients were divided into two groups, stretching exercises and eccentric strengthening exercises to the extensor carpi radialis muscle, Mills manipulation and deep friction massage were applied to the other group, and VAS scores showed a significant decrease in both groups after treatment. ($p > 0.05$) (46)

In the studies of Olaussen et al, 177 patients were divided into three groups and no applications were made to the control group. Both of the other two groups underwent Mills manipulation, deep friction massage, and exercise; one of these groups underwent

steroid injections and the other underwent a placebo injection. In this study, both methods were used together. (47)

As can be seen, Mills manipulation and deep friction massage are the methods used in studies on cases of lateral epicondylitis. However, when we look at the literature, these studies are compared with other methods by using either alone or together. With this study, we wanted to show whether these two methods were superior to each other.

For this reason, we divided 40 patients with lateral epicondylitis into groups of 20. We performed wrist stretching and strengthening exercises, therapeutic ultrasound and TENS practices on all 40 patients. In addition, we applied deep friction on the tendon in the lateral epicondyle region to the DFM group and Mills manipulation to the Mills group.

When we examined the results of the study, it was observed that there was no significant difference between the groups in terms of height, weight, age averages and all the parameters initially evaluated.

After 3 weeks of treatment, when we compared the group's measurements with those before treatment, both groups showed significant improvement in terms of pain (VAS), hand grip strength, hand functionality (Duruöz Hand Index), wrist flexion and extension angle parameters compared to the pre-treatment measurements. The SF-36 questionnaire showed significant improvement in physical function, physical role limitation, emotional role limitation, pain, energy/vitality, general health and mental health sub-scales in both groups compared to before treatment. However, in the “social functioning” sub-scale of the SF-36 questionnaire, post-treatment scores in both groups showed no significant change compared to pre-treatment. The two questions used to calculate the score of the questionnaire's “social functioning” sub-scale measure patients’ social environmental impacts over the past 4 weeks. We believe that the reason why there was no significant difference in this sub-scale was that the group of patients we worked with thought that their relationship with the social environment had not deteriorated due to lateral epicondylitis.

No significant difference was found in any of the parameters when the improvement amounts of the groups were compared.

When examined according to the gender of measurements; DFM group “grip strength” and “extension point” in the parameters between male and female participants in both pre-treatment and post-treatment there was a significant difference between female and male subjects achieved higher scores than participants in these two parameters. In the “social functioning” and “mental health” sub-scales of the SF-36 questionnaire, there was no difference between pre-treatment measurements and no significant difference between the genders in post-treatment measurements. Male participants scored higher in the sub-scale “social functioning” and women scored higher in the sub-scale “mental health”. We think that the reason for this situation is that the questions used in the two sub-scales mentioned in the questionnaire are suitable for participants to receive relatively different answers according to their professional groups and their daily lives. In the Mills Group, significant difference was found in both pre-treatment and post-treatment scores between male and female participants in terms of “hand grip strength” parameter. This difference is due to the higher scores of male participants in pre-treatment and post-treatment measurements. We think that “hand grip strength” and “wrist extension angle” parameters are higher in male participants because of the structural differences of male participants compared to female participants. In the “energy / vitality” sub-scale of the SF-36 questionnaire, no significant difference was found between the pre-treatment scores between the two genders, but a significant difference was found in the post-treatment scores. In this sub-scale, male subjects had higher scores in post-treatment scores.

In the light of these results, it can be said that the two physiotherapy methods used in cases of lateral epicondylitis, deep friction massage and Mills manipulation methods are not superior to each other over the parameters in our study.

One of the limitations of our study was that we used a subjective measurement tool to assess pain. Better quality data can be obtained if objective measurement tools are used. Other limitations are the relatively small sample size and the lack of long-term follow-up. These factors may have decreased the power of our study. Stronger results can be achieved with larger study groups and long-term patient follow-up and controls.

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7.APPENDICES

APPENDIX-1: ETHICAL COMITEE APPROVAL

T.C. YEDİTEPE ÜNİVERSİTESİ

Sayı : 37068608-6100-15- 1691 **13/06/2019**
Konu: Klinik Araştırmalar
Etik kurul Başvurusu hk.

İlgili Makama (Saltuk Gazi Sesigüzel)

Yeditepe Üniversitesi Sağlık Bilimleri Fakültesi, Fizyoterapi ve Rehabilitasyon Bölümü Dç. Dr. Rasmi Muammer'in sorumlu araştırmacı olduğu **"Lateral Epikondilitli Hastalarda Mills Manipülasyonu Ve Firiksiyon Masajının Etkinliğinin Karşılaştırılması"** isimli araştırma projesine ait Klinik Araştırmalar Etik Kurulu (KAEK) Başvuru Dosyası **(1665)** kayıt Numaralı KAEK Başvuru Dosyası), Yeditepe Üniversitesi Klinik Araştırmalar Etik Kurulu tarafından **12.06.2019** tarihli toplantıda incelenmiştir.

Kurul tarafından yapılan inceleme sonucu, yukarıdaki isimi belirtilen çalışmanın yapılmasının etik ve bilimsel açıdan uygun olduğuna karar verilmiştir (**KAEK Karar No: 1039**).

Prof. Dr. Turgay ÇELİK
Yeditepe Üniversitesi
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APPENDIX-2: INFORMED WRITTEN CONSENT FORM

BİLGİLENDİRİLMİŞ GÖNÜLLÜ OLUR FORMU

"Lateral epikondilitli hastalarda Mills manipulasyonu ve friksiyon masajının etkinliğinin karşılaştırılması" isimli yüksek lisans araştırma çalışması Artroklinik Sporcu Sağlığı Merkezi'nde yapılacaktır.

Araştırma, Yeditepe Üniversitesi Fizyoterapi ve Rehabilitasyon Anabilim Dalı tez çalışmasıdır. Bu çalışmanın amacı , lateral epikondilitli hastaların iyileşmesi üzerinde Mills manipulasyonu ve friksiyon masajının etkinliğinin karşılaştırılmasıdır.

Çalışmaya gönüllülük esasına dayanarak lateral epikondilit tanısı koyulmuş olan 18 ile 60 yaşları arasında 40 gönüllü katılımcı dahil edilecektir.

Tedavi kapsamında her iki gruba konvansiyonel fizyoterapi programının yanında bir gruba Mills manipulasyonu diğer gruba ise derin friksiyon masajı uygulanacaktır. Her iki gruba da haftanın 5 günü ve 3 hafta süreli toplamda 15 seans tedavi uygulanacaktır.

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: Doç.Dr.Rasmi MUAMMER

Yardımcı Araştırmacı: Fzt.Saltuk Gazi SESİGÜZEL

Danışman Öğretim Üyesi: Doç.Dr.Rasmi MUAMMER

"Lateral epikondilitli hastalarda Mills manipulasyonu ve friksiyon masajının 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. Saltuk Gazi SESİGÜZEL

APPENDIX-3: STRUCTURED FORM

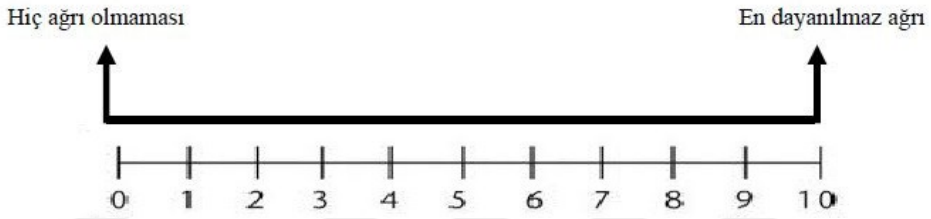
NAME	
GENDER (F/M)	
AGE (YEAR)	
HEIGHT (CM)	
WEIGHT (KG)	

APPENDIX-4: VAS (VISUAL ANALOG SCALE)

VİZUEL ANALOG SKALA (VAS)

Adınız Soyadınız: _____ Tarih: _____

Ağrı şiddetinizi aşağıdaki ölçek üzerinde işaretleyin.



APPENDIX-5: HAND GRIP STRENGTH MEASUREMENT

GRIP STRENGTH MEASUREMENT CHART	
NAME:	**DATE:**
1.MEASUREMENT	
2. MEASUREMENT	
3. MEASUREMENT	
MEAN	

APPENDIX-6: WRIST RANGE OF MOTION MEASUREMENTS

GONIOMETRIC MEASUREMENT CHART	
NAME:	**DATE:**
WRIST FLEXION ANGLE	
WRIST EXTENSION ANGLE	

APPENDIX-7: DURUÖZ HAND INDEX (DHI)

Duruöz El İndeksi

Duruoz Hand Index (DHI)

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

Aşağıdaki günlük etkinlikleri hiçbir yardımcı alet kullanmadan (bir veya iki elinizle) gerçekleştirdiğinizde karşılaştığınız zorluk derecesini belirten cevabı lütfen işaretleyiniz.

		Hiç zorluk çekmeden	Çok az zorlukla	Biraz Zorlukla	Oldukça Zor	Neredeyse Hemen İmkânsız	İmkânsız
Mutfakta	1-Dolu bir kâseyi tutabiliyor musunuz?	☐0	☐1	☐2	☐3	☐4	☐5
	2-Dolu bir şişeyi tutup kaldırabiliyor musunuz?	☐0	☐1	☐2	☐3	☐4	☐5
	3-Dolu bir tabağı tutabiliyor musunuz?	☐0	☐1	☐2	☐3	☐4	☐5
	4-Şişedeki suyu bardağa boşaltabiliyor musunuz?	☐0	☐1	☐2	☐3	☐4	☐5
	5-Daha önce açılıp kapatılmış kavanozun kapağını açabiliyor musunuz?	☐0	☐1	☐2	☐3	☐4	☐5
	6-Bıçakla et kesebiliyor musunuz?	☐0	☐1	☐2	☐3	☐4	☐5
	7-Çatalı yiyeceklere etkili olarak batırabiliyor musunuz?	☐0	☐1	☐2	☐3	☐4	☐5
	8-Meyve soyabiliyor musunuz?	☐0	☐1	☐2	☐3	☐4	☐5
Giyim	9-Gömleğinizin düğmelerini ilikleyebiliyor musunuz?	☐0	☐1	☐2	☐3	☐4	☐5
	10-Fermuar açıp kapatabiliyor musunuz?	☐0	☐1	☐2	☐3	☐4	☐5
Temizlik	11-Yeni diş macunu tüpünü sıkabiliyor musunuz?	☐0	☐1	☐2	☐3	☐4	☐5
	12-Diş fırçanızı etkili olarak tutabiliyor musunuz?	☐0	☐1	☐2	☐3	☐4	☐5
İş Yerinde	13-Normal kurşun veya tükenmez kalemle kısa bir cümle yazabiliyor musunuz?	☐0	☐1	☐2	☐3	☐4	☐5
	14-Normal kurşun veya tükenmez kalemle mektup yazabiliyor musunuz?	☐0	☐1	☐2	☐3	☐4	☐5
Diğer	15-Yuvarlak kapı veya pencere tokmağını çevirebiliyor musunuz?	☐0	☐1	☐2	☐3	☐4	☐5
	16-Makasla bir parça kâğıt kesebiliyor musunuz?	☐0	☐1	☐2	☐3	☐4	☐5
	17-Masanın üzerindeki bozuk parayı alabiliyor musunuz?	☐0	☐1	☐2	☐3	☐4	☐5
	18-Anahtarı kilitte çevirebiliyor musunuz?	☐0	☐1	☐2	☐3	☐4	☐5

Duruöz MT, et al. (1996) J Rheumatol. 1996;23:1167–72.

Toplam Puan (0-90): _____

APPENDIX-8: TURKISH VERSION OF SHORT FORM-36 (KISA FORM-36)

SF-36 (Short Form 36)

Adınız Soyadınız: _____ Hasta # _____

Aşağıdaki sorular sizin kendi sağlığınız hakkındaki görüşünüzü, kendinizi nasıl hissettiğinizi ve günlük aktivitelerinizi ne kadar yerine getirebildiğinizi öğrenmek amacındadır. Her hangi bir sorunun yanıtı hakkında emin değilseniz bile size en uygun yanıtı verin. Ayrıca 10 uncu sorudan sonraki boşluğa yorumlarınızı yazabilirsiniz.

1-Genel sağlık durumunuz hakkında aşağıdaki tanımlardan hangisi doğrudur? Lütfen tek bir yanıt veriniz.

Mükemmel ☐
Çok iyi ☐
İyi ☐
Orta (fena değil) ☐
Kötü ☐

2-Bir yıl öncesi ile karşılaştırdığınızda genel sağlık durumunuzu nasıl değerlendirirsiniz?

Bir yıl öncesinden çok daha iyi ☐
Bir yıl öncesinden biraz iyi ☐
Hemen hemen aynı ☐
Bir yıl öncesinden biraz daha kötü ☐
Bir yıl öncesinden çok daha kötü ☐

SAĞLIK VE GÜNLÜK AKTİVİTELER

3-Aşağıdaki sorular bir gün içinde yapabileceğiniz işlerle (aktivitelerle) ilgilidir.

Sağlığınız bu aktiviteleri kısıtlıyor mu? Eğer kısıtlıyorsa, ne kadar?

	Evet, çok kısıtlı	Evet, biraz kısıtlı	Hayır, hiç kısıtlı değil
a)Zorlu aktiviteler; örneğin koşma, ağır eşyaları kaldırma, zor sporlara katılma vb	☐	☐	☐
b)Orta derecede aktiviteler; örneğin bir masayı kaldırma, elektrikli süpürgeyi itme, hafif sporlara katılma vb	☐	☐	☐
c)Ağır kaldırma ve yük taşıma	☐	☐	☐
d)Çok sayıda merdiven basamağını çıkma	☐	☐	☐
e)Tek bir merdiven basamağını çıkma	☐	☐	☐
f)Öne eğilme, çömelme veya diz çökme	☐	☐	☐
g)İlki kilometreden çok yürüme	☐	☐	☐
h)Bir kilometre yürüme	☐	☐	☐
i)100 metre yürüme	☐	☐	☐
j)Kendi başına banyo yapma ve giyinme	☐	☐	☐

1

4-Son 4 hafta içinde çalışma sırasında veya günlük aktiviteleriniz sırasında aşağıdaki problemlerden herhangi birini yaşadınız mı?

Her bir soruya evet veya hayır yanıtı verin.

	Evet	Hayır
a)Çalışma yaşamınızda veya diğer aktivitelerinizde geçirdiğiniz zamanı kısalttınız mı?	☐	☐
b)Arzu ettiğinizden daha az şey mi yaptınız?	☐	☐
c)Çalışma veya diğer yaptığınız işlerin çeşidinde kısıtlama yaptınız mı?	☐	☐
d)Çalışma yaşamınızda veya diğer aktivitelerinizi yapmakta güçlük çektiniz mi? (aşırı efor gösterdiniz mi?)	☐	☐

5-Son 4 hafta içinde çalışma sırasında veya günlük aktiviteleriniz sırasında duygusal sorunlar nedeniyle (depresyon veya sıkıntı gibi nedenlerle) aşağıdaki problemlerden herhangi birini yaşadınız mı?

Her bir soruya evet veya hayır yanıtı verin.

	Evet	Hayır
a)Çalışma yaşamınızda veya diğer aktivitelerinizde geçirdiğiniz zamanı kısalttınız mı?	☐	☐
b)Arzu ettiğinizden daha az şey mi yaptınız?	☐	☐
c)Çalışma veya diğer aktivitelerinizi her zamanki gibi dikkatlice yapabildiniz mi?	☐	☐

6-Son 4 hafta içinde fizik sağlığınız veya duygusal sorunlarınız sizin ailenizle, arkadaşlarınızla, komşularınızla olan sosyal ilişkilerinizi ne ölçüde etkiledi?

Lütfen tek bir yanıt veriniz.

Hiç etkilemedi ☐
Çok az ☐
Orta derecede ☐
Epeyce ☐
Çok fazla ☐

7-Son 4 hafta içinde ne kadar ağrınız oldu?

Lütfen tek bir yanıt veriniz.

Hiç olmadı ☐
Çok az ☐
Az ☐
Orta derecede ☐
Çok ☐
Pek çok ☐

8-Son 4 hafta içinde ağrınız sizin normal çalışmanızı ne kadar etkiledi (hem ev dışında, hem de ev işi olarak)?

Lütfen tek bir yanıt veriniz.

Hiç etkilemedi ☐
Biraz etkiledi ☐
Orta derecede etkiledi ☐
Epey etkiledi ☐
Çok etkiledi ☐

GENEL SAĞLIK

9-Aşağıdaki cümlelerin sizin için ne kadar doğru veya yanlış olduğunu belirtiniz.

Her bir soruya tek bir yanıt veriniz.

	Kesinlikle doğru	Çoğunluk la doğru	Emin değilim	Çoğunluk la yanlış	Kesinlikle yanlış
a)Ben diğer insanlara göre daha kolay hastalanıyorum	☐	☐	☐	☐	☐
b)Tanıdığım kişiler kadar sağlıklıyım	☐	☐	☐	☐	☐
c)Sağlığımın kötüleşmekte olduğunu sanıyorum	☐	☐	☐	☐	☐
d)Sağlığım mükemmel	☐	☐	☐	☐	☐

DUYGULARINIZ

10-Aşağıdaki sorular duygularınızı ve son bir ay içinde nasıl olduğunuzu anlamak için düzenlenmiştir. Her bir soru için lütfen size en uygun tek bir yanıtı işaretleyin.

	Sürekli	Çoğu zaman	Epey zaman	Bazen	Ara sıra	Hiç bir zaman
a)Kendinizi yaşam dolu olarak mı hissediyorsunuz?	☐	☐	☐	☐	☐	☐
b)Çok sinirli biri mi oldunuz?	☐	☐	☐	☐	☐	☐
c)Kendinizi lağım çukuruna düşmüş gibi hissettiğiniz ve hiçbir şeyin moralinizi düzeltemeyeceğini düşündüğünüz oldu mu?	☐	☐	☐	☐	☐	☐
d)Kendinizi sakin ve barışçı hissettiniz mi?	☐	☐	☐	☐	☐	☐
e)Çok enerjik oldunuz mu?	☐	☐	☐	☐	☐	☐
f)Kendinizi kalbi kırık ve üzgün hissettiniz mi?	☐	☐	☐	☐	☐	☐
g)Kendinizi yıpranmış hissettiniz mi?	☐	☐	☐	☐	☐	☐
h)Mutlu bir insan oldunuz mu?	☐	☐	☐	☐	☐	☐
i)Yorgunluk hissettiniz mi?	☐	☐	☐	☐	☐	☐
j)Sağlığınız sosyal aktivitelerinizi sınırladı mı? (arkadaşları veya yakın akrabaları ziyaret etmek gibi)	☐	☐	☐	☐	☐	☐

Yorum:

APPENDIX-9: CV

Personal Informations

Name	Saltuk Gazi	**Surname**	SESİGÜZEL
Place of Birth	Ürgüp	**Date of Birth**	15.07.1991
Nationality	T.C.	**TR ID Number**	37085019924
E-mail	gazisaltuk@hotmail.com	**Phone number**	+905422205808

Education

Degree	Department	The name of the Institution Graduated From	Graduation year
Doctorate			
Master			
University	FTR	Trakya Üniversitesi Sağlık Bilimleri Fakültesi	2013
High school	Sayısal	H.Avni İncekara Fen Lisesi	2009

#All the grades must be listed if there is more than one (KPDS, ÜDS, TOEFL; EELTS vs),

Languages	Grades (#)
English	75

Work Experience (Sort from present to past)

Position	Institute	Duration (Year - Year)
Fizyoterapist	Özel Fizomer Tıp Merkezi	2015-2018
Fizyoterapist	Özel Romatem Kocaeli Fizik Tedavi Hastanesi	2013-2015

Computer Skills

Program	Level

***Excellent, good, average or basic**

Scientific works

The articles published in the journals indexed by SCI, SSCI, AHCI

Articles published in other journals

Proceedings presented in international scientific meetings and published in proceedings book.

Journals in the proceedings book of the refereed conference / symposium

Others (Projects / Certificates / Rewards)
