Acta Scientific Orthopaedics (ISSN: 2581-8635)

Volume 5 Issue 10 October 2022

Research Article

The Effect of Phonophoresis Versus Iontophoresis in Lateral Epicondylitis-RCT

Aher Ravindra Karbhari*

Department of Krishna college of Physiotherapy, Karad, Maharashtra, India

***Corresponding Author:** Aher Ravindra Karbhari, Department of Krishna college of Physiotherapy, Karad, Maharashtra, India.

DOI: 10.31080/ASOR.2022.05.0579

Received: August 19, 2022

Published: September 27, 2022

Abstract

Background: Lateral Epicondylitis is prevalent in 95% of non-tennis players and predominantly in women. Current literature supports the effectiveness of the Phonophoresis and Iontophoresis with Dexamethasone in treating lateral epicondylitis but studies regarding its safety and effectiveness are not done. The study is intended to find the superiority of Phonophoresis and Iontophoresis on lateral epicondylitis by using Dexamethasone.

Aims and objectives: To find out the effect of Phonophoresis and Iontophoresis in patients with lateral epicondylitis.

Materials and Methods: One year of Study was done at Krishna hospital in patients diagnosed with lateral epicondyltis. Patients assigned randomly into three Groups A, B and C (n = 3). Subjects were treated by Phonophoresis, Iontophoresis and ultrasound respectively for 2 weeks, and the outcome were measured and documented.

Results: Significant improvement in pain relief was measured by VAS in Group A than B and C (p = 0.0332) and improved grip strength was better in Group B than Group A and C (p = 0.5745).

Conclusion: Phonophoresis and Iontophoresis are effective in pain reduction and increased grip strength as proved statistically and clinically.

Keywords: Lateral epicondylitis; Phonophoresis; Iontophoresis; Ultrasound

Introduction

Lateral Epicondylitis is the inflammation of the common wrist extensors origin at the tendinious junction. It was first differentiated from *Writer's cramp* by Range in 1873 and Wink worth 1883. Shortly thereafter it was called "Tennis elbow" by Madris.[1] The primary pathological process involved in this condition is tendinosis of the extensor carpi radialis brevis (ECRB) tendon, usually within 1-2cms of its attachment at the lateral epicondyle [3]. Lateral epicondylitis is an extremely common presentation among sportsmen and manual laberers [3].

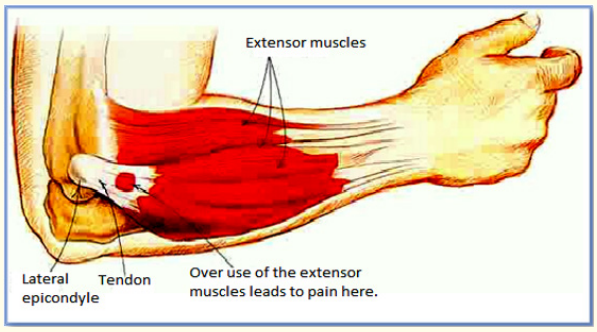


Figure 1

LE is predominantly prevalent in 95% of non-Tennis players and in women with dominant arm involvement [4]. Causes of tennis elbow such as poor technique of execution like tennis back hand stroke, Occupational tasks involving repetitive movements of the wrist and hands, Injury either as a primary cause, or secondary to degeneration.

It seen in all levels of tennis players, may be occupational, repeated activities which lead to Tennis elbow (Tightening a screw, Using a wrench, Wringing washed clothes, Mopping floor etc) [1].

Sign and symptoms related to tennis elbow includes tenderness over the lateral aspect of the forearm, over extensor tendons and muscles belly which may radiate into the forearm, decreased grip strength and pain on gripping, decreased strength in wrist extension, pain on resisted radial deviation and extension of the middle finger, symptoms may disturbed sleep when severe state [5-11].

Anatomy and Biomechanics

Elbow joint is a synovial of hinge variety, the articular surface of the lower end of the humerus mainly capitulum and the trochlear articulates with the upper end of the radius (humeroradial) and upper end of ulna (humero ulnar) respectively, is intermediate joint of the upper limb linking mechanically between the first segment, the upper arm and the second segment, the forearm [11]. Joint capsule: The humeroulnar joint, humeroradial joint and superior radioulnar joints are enclosed in a single joint capsule. Anteriorly, the proximal attachment of the capsule is just above the coronoid and radial fossae; distally it is inserted into the ulna on the margin of the coronoid process and into annular ligament. Laterally, the capsule attaches to the radius and blends with the fibers of the lateral collateral ligament. Medially, the capsule blends with the fibers of the medial collateral ligament. Posteriorly, the capsule is attached to the humerus along the upper edge of the olecranon fossa. The capsule is fairly large, loose and weak anteriorly and posteriorly, but reinforce its sides [11]. Most hinge joints in the body have collateral ligaments and the elbow is no exception. Collateral ligaments are located on the medial and lateral sides of the hinge joints to provide medial/lateral stability to the joint and to keep joint surfaces in apposition. The two main ligaments associated with the elbow joint are the medial (ulnar) and lateral (radial) collateral ligaments [11].

Muscles, the superficial muscles that originates at lateral epicondyle of the humerus. They includes the Extensor carpi radialis longus (ECRL), Extensor carpi radialis brevis (ECRB), Extensor digitorum (ED), Extensor digiti minimi (EDM), Extensor carpi ulnaris (ECU) and brachioradialis. The deep muscles of the back of the forearm include Supinator, extensor policis brevis and extensor indicis. The tendon of their muscles passes under the extensor retinaculum which is divided into 60distinct tunnels separated by septa. The septa helps to stabilize the tendons on the dorsum of the hand and allow the muscles to be effective stabilizers of the wrist. The ECRB is somewhat smaller than the ECRL but has a more central location and generally shows more activity during wrist extension activities. Studies have shown that ECRB is active during all grasp and release activities of the hand, except those performed in Supination. ECRL shows increased activity when there is a radial deviation or when forceful finger flexion motions are performed. The ongoing activity of ECRB makes it vulnerable of overuse and is more likely than the quieter ECRL to be inflamed in lateral epicondylitis [11].

Biomechanics

When the upper extremity is in the anatomical position, the long axis of the humerus and the long axis of the forearm form an acute angle medially when they meet at the elbow this angle is called “carrying angle”. This is slightly greater in women than men. In women it is about 0˚-15˚, in men it is about 0˚- 5˚. An increase in angle is considered to be abnormal and it is called “cubitus valgus”. The carrying angle disappears when the forearm is pronated with the elbow in extension and in full flexion [11].

Range of motion

The range of active flexion at the elbow is usually less than range of passive motion, because the bulk of the contraction flexors on the anterior surface of the humerus interferes with the approximation of the forearm and the humerus. The active flexion of the elbow with supinated forearm ranges from 0˚-140˚ to 0-150˚. Passive range of flexion is from 0˚-150˚ to 0˚-160˚ [12].

Pathophysiology and pathomechanics

- **Stage I:** There is acute inflammation but no angioblastic invasion. complains pain during activity.
- **Stage II:** Chronic inflammation stage, there is some angioblastic invasion with complains of pain both during activity and at rest.

- **Stage III**: Chronic inflammation with extensive angioblastic invasion. complains pain at rest, night pains, and pain during daily activities [1].

A tear occurs at the teno-muscular junction, in the tendon, or at the teno-periosteal junction. The resulting inflammation produces exudate in which fibrin forms to heal the torn tissue. If excessive fibrin is formed fibrous tissue will result in adhesions between the tendon and neighboring tissues. This causes pain on being stretched and impairs function. Repeated use and minor injury to the tendon prevents healing and excessive scar tissue can form [14].

The classical lateral epicondylitis is caused by repeated forceful contractions of the wrist extensors, primarily ECRB. The tensile stress created at the origin of the ECRB may cause microscopic tears that lead to inflammation at the lateral epicondyle. Repeated tensile stress on the elastic tendon may result in microscopic tears at the musculo-tendinous junction and result in tendinitis [1].

Nirschl [13] (1973) referred red to dull grayish edematous tissue replacing the normal glistening tendon. These tissues often encompassed the entire origin of the ECRB tendon to the level of the radial head. He found pathological changes on the inner side of the extensor aponeurosis in approximately 35% of cases. In 20% calcific exostosis of the lateral epicondyle was present [13].

Steiner [13] (1976) commenced on the poor blood supply to the lateral epicondyle and how the fibers of the tendon attached to the periosteum of the epicondyle are relatively vascular compared with the muscle. Damage to muscle heals rapidly when compared with tendon. Since nutrition becomes even further impaired with age related degenerative changes. Hooper (1975) stated that due to the intimate association of ECRB muscle to the capsule of the elbow, irritation of free nerve endings in the capsule has been postulated as a cause of joint involvement [13].

Clinical diagnosis

- **Cozens test:** The patients elbow is stabilized by the examiners thumb, which rests on the patient's lateral epicondyle. The patient is then asked to actively make a fist, pronate the forearm, and radially deviate and extend the wrist while the examiner resists the motion. A sudden severe pain in the area of the lateral epicondyle of the humerus is a positive sign. The epicondyle may be palpated to indicate the origin of the pain [12].
- **Mill's test:** While palpating the lateral epicondyle, the examiner passively pronates the patient's forearm, flexes the wrist fully, and extends the elbow. Pain over the lateral epicondyle of the humerus indicates a positive test. This maneuver also puts stress on the radial nerve and in the presence of the compression of the radial nerve, causes symptoms similar to those of tennis elbow [12].
- **Tennis elbow test:** The therapist resists extension movement of the third digit of the hand distal to the proximal interphalangeal joint, stressing the extensor digitorum muscle and tendon. A positive test is indicated by pain over the lateral epicondyle of the humerus [12].

Ultrasound

Ultrasound is a type of sound, and all forms of sound consist of waves that transmit energy by alternately compressing and rarefying material. Ultrasound is defined as sound with a frequency greater than 20,000 cycles per second [hertz (Hz)]. This definition is based on the limits of normal human hearing. Human can hear sound with a frequency of 16 to 20,000 Hz; sound with a frequency greater than this is known as ultrasound. Generally, therapeutic ultrasound has a frequency between 0.7 and 3.3 megahertz (MHz) to maximize energy absorption at a depth of 2 to 5 cm of soft tissue [15].

Effect of ultrasound

Ultrasound has a variety of biophysical effects. It can increase the temperature of deep and superficial tissues and has a range of non-thermal effects. Thermal effects of ultrasound including, acceleration of metabolic rate, reduction or control pain and muscle spasm, alteration of nerve conduction velocity, increased circulation, and increased soft tissue extensibility.

Non-thermal effects cavitation's, microstreaming, and acoustic streaming. When ultrasound is delivered in a pulsed mode, with a 20% or lower duty cycle heat generated during the on time of the cycle is dispersed during the off time, resulting in no measurable net increase in temperature. Thus pulsed ultrasound with a 20% duty cycle has generally been used to apply and study the non-thermal effects of ultrasound [15].

- **Phonophoresis:** Phonophoresis is the application of ultrasound in conjunction with a topical drug preparation as the

ultrasound transmission medium. The ultrasound is intended to enhance delivery of the drug through the skin, thereby delivering the drug for local or systemic effect. Trans-cutaneous drug delivery has a number of advantages over oral drug administration [15].

- **Treatment sessions:** Six treatments with dexamethasone have been shown not to cause an increase in urinary free cortisol, which is a measure of adrenal suppression, a course of six treatments is considered safe for patients who do not have other contraindication for corticosteroid treatment [15].
- **Treatment parameters:** The use of ultrasound for facilitation of transdermal drug penetration. The treatment parameters most likely to be effective are pulsed 20% duty cycle, to avoid heating of any inflammatory condition, at 0.5 to 0.75 w/cm^2 intensity, for 5 to 10 minutes [15].
- **Contraindications:** Malignant tumor, Pregnancy, Joint cement, Plastic components, Pacemaker, Thrombophlebitis [15].
- **Iontophoresis:** It first described by the Pivati [18] in 1747. Iontophoresis is a therapeutic technique of delivering medication ion through the intact skin. It is an alternative to injection or oral delivery. It is also called as ion transfer [18].

Theoretical basis of iontophoresis

The Greek "*ion*" or "*iontos"* refers to an atom having a negative or a positive charge as a result of the loss or gain of one or more electrons. "*Phoresis*" refers to being carried. A direct electric current provides the electromotive force to move the ionized particle of the drug past the barrier of the skin and into the deeper tissues.

The route of entry is through the skin by ducts of the sweat glands, and the hair follicles. Additionally, the overall resistance of the skin will decrease somewhat under the influence of electricity, allowing further passive passage of the drug into the dermal layers. The skin acts as a reservoir of the drug, extending its release into the deeper layers after the Iontophoresis device is removed [18].

Theory of drug transport by iontophoresis

Iontophoretic drug delivery occurs by a combination of concentration gradient (diffusive/passive transport component) and electrochemical potential gradient developed across the skin**,** increased skin permeability under applied electric current (electromigration/electro-repulsion), a current-induced water transport effect (electrosmosis/convective transport/ionto-hydro-kinesis) [33].

Principle of iontophoresis

Iontophoresis is a drug delivery method that uses low level direct current in the mA. Range to transport drugs and other water soluble salts through and into the tissues of the body. Iontophoretic doses are usually defined as current multiplied by time of application [18].

Iontophoresis devices consist of (1) the power source, a low voltage direct current generator; (2) Lead wires consisting of a positive lead and a negative lead**;** (3) electrode, with an attached drug reservoir and a ground electrode [18].

Applications in Physical therapy: Corticosteroids are the primary drugs used with Iontophoresis in human physical therapy. Formulated as a water-soluble salt, the corticosteroid molecule has a negative charge. Dexamethasone is often administered by, in the treatment of joint or musculoskeletal disorders [18].

Mechanism of ion transport

The cathode (Black) will only repel negative ions. The anode (Red) will only repel positive ions. Iontophoresis is limited to medications/ionic solutions with the following profile: The ions must be charged. Relatively small ions**-** They must have a molecular weight less than 8000 Daltons. Must be in a solution- no creams or suspensions. Transcutaneous delivery also avoids the pain, trauma, and infection risk associated with injection and allows delivery to a larger area than is readily achieved by injection [15].

Major side effects of iontophoresis are very rare when using Iontophoresis as a diagnostic tool. However, Minor reactions are pain, burning sensations, skin irritation, erythema, blister formation and skin necrosis [29].

Contraindications for iontophoresis are important in patients with higher susceptibility to applied currents include such patient those carrying electrically sensitive implanted devices such as cardiac pacemakers, who are hypersensitive to the drug to be applied, or those with broken or damaged skin surfaces [29].

Trans-cutaneous drug delivery has number of advantages over oral and injection administration. It is relatively painless and non - invasive. There is no trauma to the skin from a needle puncture which decreases the likelihood of infection. It provides a higher ini-

tial drug concentration at the delivery sites [16]. it avoids gastric irritation and avoids first pass metabolism by the liver [15,29].

Corticosteroids are the primary drugs used with Iontophoresis in physical therapy. Corticosteroids are widely used because they possess a profound anti-inflammatory effect and are available in relatively inexpensive forms designed both for oral and topical administration. Several corticosteroids are available as water soluble salts, rendering the corticosteroid molecule negatively charged and therefore available to move under the Influence of a negative current field.

Corticosteroids inhibit the inflammatory process, in part by reducing the migration of neutrophils and monocytes into the inflamed area and reducing the activity of white blood cells [19,20].

Outcome measures

pain intensity and grip strength were captured before the first treatment session then at 2 weeks.

- **Visual analog scale (VAS):** The visual analogue scale has shown greater sensitivity than discrete points of the categories scale. Pain severity was measured with the visual analogue scale (VAS). The VAS consists of a 10 cm line with 0 cm for the "least pain imaginable" and 10 cm the "worst pain imaginable". Patients were instructed to intersect the scale with a vertical line based on their current level of pain. The visual analogue scale has been found to be a valid and reliable method of measuring perceived pain. VAS is a general measure that may be used for multiple conditions and is not specific to the elbow [41,43].
- **Grip strength:** Hand grip strength is a fundamental procedure used by therapist to assess patient status following injuries and treatment procedures to hand and upper extremity.

An accurate, quantifiable assessment of hand grip strength helps the clinician establish realistic treatment goals, provides treatment outcome data. Grip strength was measured in mmHg with a sphygmomanometer.

When measuring grip strength in the hand-disabled subject, there are multiple advantages of the Sphygmomanometer over the Jamar unit: Ready availability of a sphygmomanometer in most clinics, a soft compliant surface that may produce less discomfort to the injured hand during testing, a scale with smaller increments than the Jamar and therefore, greater sensitivity to small changes in strength [39,40].

The present study was undertaken with the help of above mention techniques by using visual analogue scale (VAS) and sphygmomanometer as outcome measures to find the effects of Phonophoresis and Iontophoresis in Lateral epicondylitis.

Materials and Methodology

- **Study Type:** Experimental study.
- **Study Design:** Pre test - Post test.
- **Sample Size:** 45 subjects.
- **Place of Study:** Krishna College of Physiotherapy, OPD, Karad.
- **Duration of Study:** One year.
- **Sampling Method:** Simple Random Sampling.

Inclusion criteria

- Age between 30- 60 years [45].
- Both male and female subjects.
- Unilateral clinically diagnosed subjects with Sub-acute and chronic lateral epicondylitis.

Exclusion criteria

- Allergic to drug.
- Metal implant.
- Subject with psychosomatic pain.
- Any pathology around the elbow.

Materials

- Data collection sheet.
- Consent form.
- Chair.
- Pillow.
- Talcum powder.
- Cotton.
- Aqua sonic gel.
- Anti inflammatory drug

Main Outcome Measures

Outcome measures of pain intensity and grip strength were captured before the first treatment session then at 2 week.

- Visual Analog Scale (VAS)
- Grip Strength measurement.

Figure 2

Figure 5: Sphygmomanometer.

Figure 3: Dexamethasone Cream and Solution.

Figure 6: Low voltage Contineous D.C. Generator with accessories.

Figure 4: Ultrasound machine.

Procedure for Study

All subjects signed a consent form in which basic information of the study was explained and instructions are given to the participants about techniques to be performed.

Outcome measures of Pain intensity and grip strength is assessed by visual analogue scale and Sphygmomanometer were captured before the first treatment session then at last day of 2 weeks.

- **Pain intensity:** The visual analogue scale has shown greater sensitivity than discrete points of the categories scale. Pain severity was measured with the visual analogue scale (VAS). The VAS consists of a 10 cm line with 0 cm for the "least pain imaginable" and 10 cm the "worst pain." Patients were instructed to intersect the scale with a vertical line based on their current level of pain and document the intensity of pain.

- **Grip strength:** Apparatus used in this study is adult sphygmomanometer which measures forces in units of mmHg.

Procedure

All subjects signed a consent form in which basic information of the study was explained. Each subject was positioned in a straight back chair with both feet flat on the floor. Arm positioning was demonstrated by the operator and then each subject was instructed to place her left hand on her right thigh and assume a position of adducted and neutrally rotated shoulders.

Figure 7

For the arm to be tested, the elbow was flexed to 90º, the forearm and wrist were in neutral positions, and the fingers were flexed as needed for a maximal contraction. The American society of Hand Therapist standardized arm position for hand strength testing was utilized [43].

Each subject was instructed to breathe IN through nose and blow OUT through pursed lips as a maximum grip effort was made. Then sphygmomanometer cuff was evenly rolled, forming a circumference of approximately 7 inch to confirm to a normal functional hand position for grip. A rubber band was placed around each end of the cuff to hold it in position. The cuff was inflated to 20mmHg, which was the starting position for measurement of each subject. Ask participant to squeeze rolled cuff at this time, a verbal command of "Squeeze! Harder! Harder! Relax!" was given by the examiner.

Demonstration of maximum hand grip performance was given prior to the recording grip strength. At the time maximum squeezing cuff; record reading at same for three times. A total of three measures were recorded with 30sec rest intervals between each. The mean value of the repetitions was calculated and represented the patient's pain free grip strength [40].

Group A were treated with Phonophoresis

Figure 8

Patient positioned comfortably, clean the area to be treated with alcohol topical skin antiseptic 2.5% solution, ultrasound head placed over the treatment area with aqua sonic gel and Dexamethasone water base gel then ultrasound unit set to the pulse mode with 20% duty cycle and frequency to 3MHZ, for 10min. then start moving ultrasonic head and simultaneously slowly increase intensity towards a maximum 0.75w/cm^2. Frequency of treatments are given 3 times/week for 2weeks [15].

Group B were treated with Iontophoresis

Figure 9

Patient positioned comfortably, clean the area to be treated with alcohol topical skin antiseptic 2.5% solution, unit set to continuous direct current; Dexamethasone solution is placed into the designated space within the electrode. Cathode (-): Delivery electrode (with medication) over lateral epicondyle and Anode (+): Dispersive electrode over forearm. Then slowly increase the intensity towards maximum of ≤ 4mA for 10min. Therapist must monitor the subject during treatment to ensure that the skin is not burned under the electrode [36]. After treatment apply talcum powder or Lactocalmine lotion to avoid dryness of skin and erythema. Frequencies of treatments are given 3 times/week for 2weeks.

Group C were treated with Plain Ultrasound

Figure 10

Patient positioned comfortably, clean the area to be treated with alcohol topical skin antiseptic 2.5% solution, ultrasound head placed over the treatment area with aqua sonic gel, ultrasound unit set to the pulse mode with 20% duty cycle and frequency to 3MHZ, for 10min. then start moving ultrasonic head and simultaneously slowly increase intensity towards a maximum 0.75w/cm^2. Frequencies of treatments are given 3 times/week for 2weeks [15].

Strengthening program

All three Groups were treated and advice with the gentle strengthening exercises for wrist flexors, extensor by low intensity progressive resisted exercises after a 50% pain relief.

Isotonic eccentric hand exercises with graduated weights not to exceed 5 pounds. Ask the patient to sit on chair with hand over the knee and with palm facing up, bend the wrist 10 times holding a 1-2-pound weight. Increase weight up to 5 pounds. Repeat this with the palm facing down, but progress to only 4 pounds [4].

Wrist curls in Pronation Wrist curls in Supination

Figure 11a: Wrist curls in Pronation.

Figure 11b: Wrist curls in Supination.

Ergonomics advice

- Rest
- Activity modification
  - Avoid repetitive movement at wrist joint.
  - Avoid carrying a heavy weight.
  - Avoid grasping in forearm Pronation and lifting in Supination.
- For Tennis player
  - Use light and smaller grip racket.
  - Avoid back hand stroke [4].

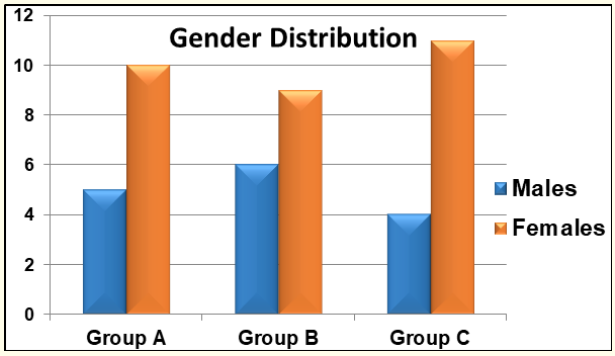
Data presentation

Gender distribution

A total of 45 subjects were taken for study, Out of 45 subjects 15 were males and 30 were females.

Groups	Males	Females	Total
Group A	5	10	15
Group B	6	9	15
Group C	4	11	15
Total	15	30	45

Table 1



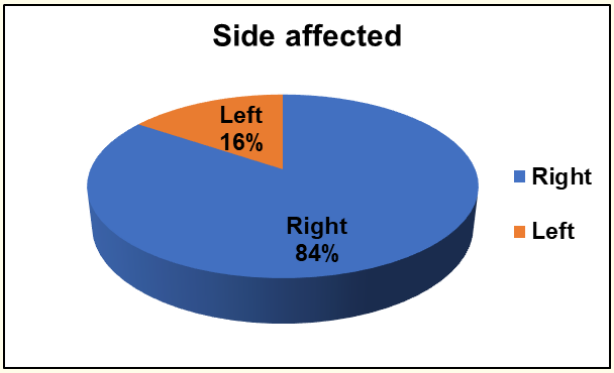
Graph 1

Side affected

Out of 45 subjects 38 were right side affected and 7 were left side affected.

Side	Total
Right	38
Left	7
Total	45

Table 2



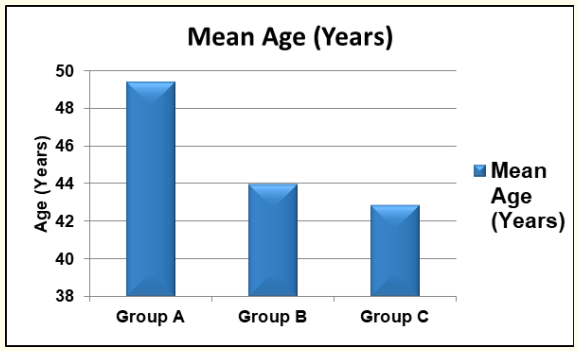
Graph 2

Age distribution

Age Group of all patients ranged between 30-60 years with the mean age of individual Group A was 49.4, Group B was 44 and Group C was 42.9.

Groups	Mean Age (Years)	SD
Group A	49.4	7.59
Group B	44	9.45
Group C	42.9	7.87

Table 3



Graph 3

Data analysis, results and interpretation

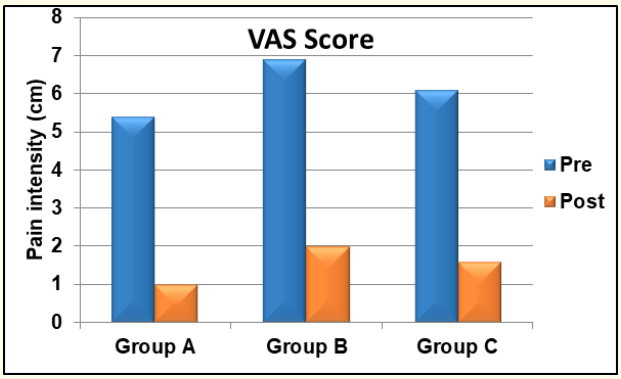
Visual analog scale (Pain intensity)

The table shows comparison of mean values and standard deviation of VAS scores in experimental and control Group. The values were compared by applying Kruskal Wallis test. Pretreatment shows that there is no significant differencing in the VAS scores, whereas post treatment shows significant difference. (P = 0.0051, KW = 10.55).

Groups	Pre	Post	'P' value
	Mean ± SD	Mean ± SD	
Group A	5.4 ± 1.8	1 ± 0.7	< 0.0001
Group B	6.9 ± 1.3	2 ± 0.6	< 0.0001
Group C	6.1 ± 1.4	1.6 ± 0.8	< 0.0001
Kruskal Wallis Test	P = 0.0598 KW = 5.63	P = 0.0051 KW = 10.55	

Table 4

The table also shows that the comparison of mean and standard deviation of pre and post of Group A, B, and C. The values were compared within Group by applying Wilcoxon matched pairs test. It shows that there where extreme significant difference in post treatment compared to pretreatment in all Groups. (Group A P = < 0.0001, Group B P = < 0.0001 and Group C P = < 0.0001).



Graph 4

Grip strength

The table shows comparison of mean values and standard deviation of total score of grip strength score. The values were compared by applying one way ANOVA.

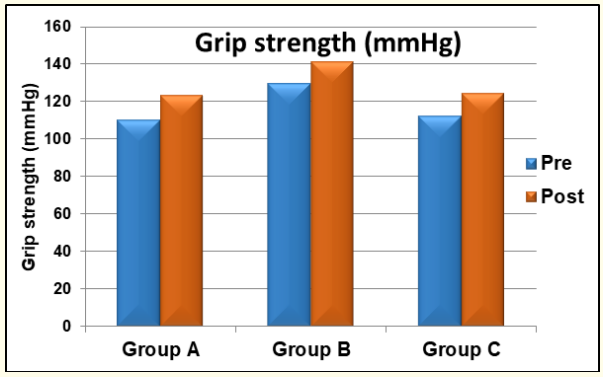
Groups	Pre	Post	'P' value	't' value
	Mean ± SD	Mean ± SD		
Group A	109.99 ± 40.06	123.10 ± 47.46	0.0002	5.14
Group B	129.23 ± 30.70	140.79. ±28.97	0.0004	4.58
Group C	112.21 ± 37.39	124.30 ± 36.49	0.0001	5.97
One Way ANOVA Test	P = 0.2931 F = 1.26	P = 0.38 F = 0.99		

Table 5

Pre treatment shows that there is no significant difference, whereas post treatment showed that there is no significant difference. (P = 0.38, F = 0.99).

The table also shows that the comparison of mean and standard deviation of pre and post of Group A, B, and C. The values were compared within Group by applying Paired 't' test.

It shows that there is no significant difference in post treatment compared to pretreatment in all Groups. (Group A P = < 0.0001, Group B P = < 0.0001 and Group C P = < 0.0001).



Graph 5

Discussion

Lateral epicondylitis is a common condition mostly observed in non- Tennis players, usually people engaged in other occupations, its prevalence is observed 95% in non-Tennis players [4] and predominantly in women. The common site of lesion is wrist extensor origin of dominant arm due to over work. Occupation involving the repetitive use of wrist extensors causes the trauma at its origin leading to lateral epicondylitis [4].

Reviewing various studies it was analyses that use of Phonophoresis, Iontophoresis and plain ultrasound were the lines of treatment accompanied by a strengthening program for lateral epicondylitis [24-40].

Further literatures reviewed the effectiveness of relieving the symptoms that is pain and improving the grip strength without any invasive procedure and followed by a strengthening program to perform the functional activities normally. Ergonomic advice would help in performing task in occupational setup [24-40].

This study was undertaken considering all the mentioned points and the sole aim of this study was to evaluate the comparative effect between Phonophoresis and treatment in lateral epicondylitis. The conclusion was drawn by the outcome measures which were reduction in pain and improvement in grip strength.

45 patients (15 Males and 30 Females) (38 Right and 7 Left side affected) diagnosed as unilateral sub-acute and chronic lateral epicondylitis between the age Group of 30-60 with mean age were drawn from the Krishna College of Physiotherapy, OPD for study purpose. They were divided into three groups by simple random technique. Group A Included 15 subjects treated with Phonophoresis, Group B included 15 subjects treated with Iontophoresis and Group C (control Group) included 15 subjects treated with plain ultrasound.

A pre treatment outcome measure of pain and grip strength was done by VAS and Sphygmomanometer respectively. The specific treatment protocol was been followed as per the group divide for 2 weeks and the post treatment outcome for pain and grip strength were documented accordingly. A strengthening program was designed after 50% reduction of pain and a proper ergonomic advice was given at work place and at rest.

The pre and post data was analyzed statistically using Kruskal Wallis test for pain outcome and one way ANOVA was used to determine the grip strength.

Kruskal Wallis test was performed to evaluate the effect of various treatment protocols in reduction of pain intensity. This shows that there is extremely significant decrease in pain. (P = 0.0051, KW = 10.55).

To evaluate the improvement in grip strength one way ANOVA is used. This shows that there is no much significant improvement in grip strength. (P = 0.38, F = 0.99).

Lateral epicondylitis is due to the over use of wrist extensors causing the inflammation at common extensor origin due to inflammatory mediators. Pain relief with the help of topical application with Anti-inflammatory drug (Dexamethasone) either by Phonophoresis or Iontophoresis to penetrate the drug unto the tissue. The pain was modulated as the drug was delivered directly to tissue and no other parental route of administration causing the reduction in its concentration.

The Anti-inflammatory drug (Dexamethasone) inhibit the inflarnmatory process, in part by reducing the migration of neutrophils and monocytes into the inflamed area and reducing the activity of white blood cells there by enhances tissue healing [19,20].

When a Wilcoxon matched pairs test was performed to evaluate the effect of treatment given in Group A (Phonophoresis), Group B (Iontophoresis), Group C (Plain Ultrasound) over pain intensity with the help of VAS. It showed that there was extreme significant reduction in pain. (Group A p = < 0.0001, Group B p = < 0.0001 and Group C p = < 0.0001)

When a 'paired t test' was performed to evaluate the effect of treatment given in Group A (Phonophoresis), Group B (Iontophoresis), Group C (Plain Ultrasound) on grip strength with the help of Sphygmomanometer. It showed that there was extreme significant improvement in grip strength. (Group A P = 0.0002, t = 5.14 Group B P = 0.0004, t = 4.58 and Group C P = < 0.0001, t = 5.97)

The given treatments were significantly effective in reducing pain on VAS but Group A showed considerable reduction in pain as compared to Group B and Group C. The region behind that might be delivery of anti-inflammatory drug was more easily penetrated by ultrasonic waves in Phonophoresis.

The grip strength improved in Group B than Group A and C as Iontophoresis. It helps in reduce inflammation and promote tissue healing former helps in early strengthening program and there by the grip strength improves.

In occupational activities involving over use of wrist extensors.[1] the main factor in provoking lateral epicondylitis is cumulative repetitive trauma to the common wrist extensors origin [4]. the poor technique at work site is responsible for causing the symptoms. With the help of Phonophoresis and Iontophoresis the pain can be reduce in sub-acute and chronic condition and a strengthening program can be designed to improve grip strength.

Brotzman [4] designed a strengthening program to improve wrist flexors and extensors to enhance grip strength. This explains the basis for improvement in occupational activities.

Enhancement of the grip strength would help in proper griping and performing task that might lead to improvement work efficiency.

Ergonomic advice of activity modification at work site were taught, that is avoid repetitive movement at wrist joint, avoid car-

rying a heavy weight and avoid grasping in forearm Pronation and lifting in Supination [4].

Trans-cutaneous drug delivery by Phonophoresis and Iontophoresis has number of advantages over the oral drug administration such as relatively painless and non - invasive; there is no trauma to the skin from a needle puncture which decreases the likelihood of infection, it provides a highest initial drug concentration at the delivery sites, it avoids gastric irritation and avoids first pass metabolism by the liver [15,16,29].

In this study VAS and grip strength by sphygmomanometer is used as an outcome measure which determines the reduction in pain and grip strength of hand for the subject recruiting them back to the functional activity and significant improvement in overall performance.

Summary

This study was undertaken with aim to determine the effect of Phonophoresis and Iontophoresis in patients with lateral epicondylitis. The basic objective of study was to reduce pain and improve grip strength with lateral epicondylitis with either use of Phonophoresis or Iontophoresis.

In the present study 45 patients diagnosed with lateral epicondylitis patients with age Group between 30-60 years and divided in to three Groups. There were 15 males and 30 females. Each Group consisted of 15 subjects

First Group A was treated with Phonophoresis, Group B was treated with Iontophoresis and Group C (control Group) was treated with plain ultrasound therapy followed by strengthening and ergonomic advice for 2 weeks to all the Groups. In these 2 weeks, pre and post treatment outcomes were measured and documented by VAS for pain intensity and sphygmomanometer for measuring hand grip strength. Values obtained were recorded into data collection sheet.

Methodology Statistical analysis was done by using INSTAT software, Version 3. in which One Way ANOVA, Kruskal Wallis test, Wilcoxon Match Pairs test and Paired 't' test was been used for various analysis, the mean of VAS for Group A was 1.09, Group B 2 and Group C 1.6 thus there was extreme significant difference in between Groups. (KW = 10.55, P = 0.0051). The mean of grip strength for Group A was 123.11, Group B 140.8 and Group C 124.4. So there was no significant difference in group A, B, C. (F = 0.99, P = 0.38).

Conclusion

Based on the statistical results and interpretation, it is more evident that the Phonophoresis and Iontophoresis are equivalently effective in pain relief and improved grip strength. However, Phonophoresis is effective in pain relief and Iontophoresis is effective in improving grip strength.

Bibliography

1. Ebnezar J. "Essentials of Rehabilitation for Orthopedic Surgeons". New Delhi: Jaypee Brothers (2004): 232-234.

2. Hutson AM. "Work-Related Upper Limb Disorders: Recognition and Management" (1997): 54-62.

3. Brukner P and Khan K. "Elbow joint. Clinical Sports Medicine". 3rd edition. Sydney: McGraw-Hill (2008): 289-299.

4. Brotzman SB and Wilk EK. "Clinical orthopaedic rehabilitation". 2nd edition. Pennsylvania: Mosby (1996).

5. Ranney D., *et al.* "Upper limb musculoskeletal disorders in highly repetitive industries: precise anatomical physical findings". *Ergonomics* 38 (1995): 1408-1423.

6. Kelley J., *et al.* "Electromyographic and cinematographic analysis of elbow function in Tennis players with lateral epicondylitis". *American Journal of Sports Medicine* 22 (1994): 359-363.

7. Gruchow H and Pelletier D. "An epidemiologic study of Tennis elbow. Incidence, recurrence, and effectiveness of prevention strategies". *American Journal of Sports Medicine* 7 (1979): 234-238.

8. Murtagh J. "Tennis Elbow". *Australian Family Physician* 17 (1988): 90-95.

9. Ollivierre C and Nirschl R. "Tennis Elbow: Current Concepts of Treatment and Rehabilitation". *Sports Medicine* 22.2 (1996): 133-139.

10. Vincenzo B and Wright A. "Lateral Epicondylalgia. A Review of Epidemiology, Pathophysiology, Aetiology and Natural history". *Physical Therapy* 1 (1996): 23-34.

11. Norkin C and Levangie P. "Joint Structure and Function". 3rd edition. Thiladelpia: FA Davis And Company the Tabers publisher (2001): 226-250.

12. Magee DJ. "Orthopedic physical assessment". 5th edition. St. Louis, Missouri: Elsevier (2009): 361-395.

13. Zuluaga M. "Sports Physiotherapy: Applied Science and Practice". Melbourne: Churchill Livingstone (1995).

14. Ann Thomson., *et al.* "Tidy's physiotherapy". 12th edition. Mumbai: Varghese (1996): 60-63.

15. Cameron Michelle. "Physical agents in rehabilitation". 3rd edition. Portland, Oregon: Elsevier; year of publication (2009).

16. McNeill SC., *et al.* "Local enhanced topical drug delivery (LETD) of drugs: does it truly exist?" *Pharmaceutical Research* 9 (1992): 1422-1427.

17. Franklin ME., *et al.* "Effect of Phonophoresis with dexamethasone on adranal function". *Journal of Orthopaedic and Sports Physical Therapy* 22.3 (1995): 103-107.

18. Singh P and Maibach HI. "Iontophoresis in drug delivery: Basic principles and application". *Critical Reviews in Therapeutic Drug Carrier Systems* 11 (1994): 161.

19. Wingard LB., *et al.* "Human pharmacology". St. Louis: Mosby-Year Book (1991): 484-493.

20. Tripathi KD. "Medical pharmacology". 6th edition. New Delhi: Jaypee (2010).

21. Bisset L., *et al.* "A systematic review and meta-analysis of clinical trials on physical interventions for lateral epicondylalgia". *British Journal of Sports Medicine* 39 (2005): 411-422.

22. Donatelli AR and Wooden JM. "Orthopaedic Physical Therapy". 2nd edition. Pennsylvania: Churchill Livingstone (2001).

23. Craig VE. "Clinical Orthopaedics". Pennsylvania: Lippin Cott Williams and Williams (1999).

24. Terri H and Charles D. "Is there evidence that Phonophoresis is more effective than ultrasound in treating pain associated with lateral epicondylitis?" *Physical Therapy* 86 (2006): 136-140.

25. Valma J., *et al.* "A Review of Therapeutic Ultrasound: Effectiveness Studies". *Physical Therapy* 81 (2001): 1339-1350.

26. Klaiman MD., *et al.* "Phonophoresis versus ultrasound in the treatment of common musculoskeletal conditions". *Sports Exercise* 30.9 (1998): 1349-1355.

27. Nancy N Byl. "The Use of Ultrasound as an Enhancer for Transcutaneous Drug Delivery: Phonophoresis". *Physical Therapy* 75 (1995): 539-553.

28. Cameron H., *et al.* "Relative Transmission of Ultrasound by Media Customarily Used for Phonophoresis". *Physical Therapy Journal* 72 (1992): 142-148.

29. Singh PK., *et al.* "Iontophoretic Delivery of Drugs: Maximizing Treatment Effectiveness". *International Journal of Pharmacy and Pharmaceutical Sciences* 1.2 (2011): 28-33.

30. Stefanou A., *et al.* "The use of Iontophoresis for Treatment of Lateral Epicondylitis" (2010).

31. Batheja P., *et al.* "Transdermal Iontophoresis". *Expert Opinion on Drug Delivery* (2007): 46-48.

32. Jean-PS., *et al.* "*In Vitro* Optimization of Dexamethasone Phosphate Delivery by Iontophoresis". *Physical Therapy* 88 (2008): 1177-1185.

33. Nirschl. "Iontophoretic adminitration of dexamethasone sodium phosphate for acute lateral epicondylitis. A double blinded placebo- controlled study". *American Journal of Sports Medicine* 31.2 (2003): 189-195.

34. Bolin DJ. "Tansdermal approaches to pain in sports injury management". *Journal of Sports Medicine* 2.6 (2003): 303-309.

35. Anderson CR., *et al.* "Effect of Iontophoresis current magnitude and duration on Dexamethasone deposition and localized drug retention". *Physical Therapy* 83 (2003): 161-170.

36. Charles T., *et al.* "Iontophoresis: applications in transdermal medication delivery". *Physical Therapy* 75 (1995): 554-563.

37. Jean LC., *et al.* "An isokinetic eccentric programme for the management of chronic lateral epicondylar tendinopathy". *British Journal of Sports Medicine* 41 (2007): 269-275.

38. Stasinopoulos D., *et al.* "An exercise programme for the management of lateral elbow tendinopathy". *British Journal of Sports Medicine* 39 (2005): 944-947.

39. Christine Kaegi., *et al.* "The Interrater Reliability of Force Measurements Using a Modified Sphygmomanometer in Elderly subjects". *Physical Therapy* 78.10 (1998): 1095-1103.

40. George F., *et al.* "Measurement grip strength: validity and reliability of the sphygmomanometer and jamar grip dynamometer". *Sports Physiotherapy* 16 (1992): 215-219.

41. Price DD., *et al.* "A comparison of pain characteristics of mechanical visual analog and simple numerical rating scales". *Pain* 56 (1994): 217-226.

42. Price DD., *et al.* "The validation of visual analog scales as ratio measures for chronic and Experimental". *Pain* 17 (1983): 45-56.

43. Fess EE and Moran CA. "Clinical assessment recommendations booklet". *American Society of Hand Therapists* (1981).

44. Draper NR and Smith H. "Applied Regression Analysis". 2nd edition. New York: Lohn Wiley and Sons (1981): 47-51.

45. Amit V., *et al.* "Cyriax Physiotherapy versus Phonophoresis with Supervised Exercise in Subjects with Lateral Epicondylalgia: A Randomized Clinical Trial". *Journal of Manual and Manipulative Therapy* 17.3 (2009): 171-178.