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A Comparative Study on the Efficacy of Fascial Manipulation and Maitland Mobilization in the Management of Pain and Dysfunction among Subjects with Carpal Tunnel Syndrome

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Abstract: ***Introduction: Carpal tunnel syndrome (CTS) is the most common compression neuropathy and is due to compression of the median nerve. The exact cause of carpal tunnel syndrome is unknown. Carpal tunnel syndrome can be associated with any condition that causes pressure on the median nerve at the wrist. Some common conditions that can lead to carpal tunnel syndrome include obesity, oral contraceptives, hypothyroidism, arthritis, diabetes, and trauma. Compression of the median nerve at the carpal tunnel is the result of a discrepancy between the volume of the contents of the canal and its relative size. The condition may be caused by inflammation of the digital tendon sheaths, fluid retention, excessive exercises, infection and repetitive activities. Aim of the study: The study was aimed to introduce Fascial manipulation and Maitland mobilization for reducing pain and dysfunction among carpal tunnel syndrome subjects. The other motive was to popularize this technique among Physiotherapy population. Background of the study: Carpal tunnel syndrome results in considerable discomfort and pain, limitations of daily living activities. So, this study emphasizes the importance of the Fascial mobilization and Maitland mobilization in reducing the pain and dysfunction. Materials & Methodology: The study design was a pre and post - test experimental study.30 patients were randomly selected who fulfilled the inclusion and exclusion criteria and were divided in two groups. Group A treated with Fascial manipulation and Group B with Maitland mobilization. Both the groups received their programs for 5 weeks; 5 sessions per week. The pre and post - test values for pain and dysfunction were collected using respective measurement scales. The collected data were analysed; paired 't' test to find out significant difference between pre and post value of experimental groups and further unpaired 't' test was applied to find out the difference between the groups. Conclusion: Facial manipulation is more effective in reducing pain and improving wrist extension range of motion than Carpal bone mobilization among carpal tunnel syndrome patients.***

Keywords: Carpal Tunnel Syndrome, Fascial Mobilization, Maitland Mobilization, Carpal Bone Mobilization, Fascia, Wrist Dysfunction

1. Introduction

Carpal tunnel syndrome (CTS) is the most common compression neuropathy and is due to compression of the median nerve (**Ibrahim et al, 2012).** The median nerve sits deep under the flexor retinaculum. It becomes superficial to the flexor digitorum superficialis (FDS) muscle bellies just above 5cm proximal to the transverse carpal ligament. The median nerve is composed of 94% of sensory fibres and 6% of motor fibres at the level of carpal tunnel. However, the motor branch presents many anatomical variations, which create great variability of pathology in cause of CTS (**Lanz, 1977).**

Incidence of carpal tunnel syndrome is 1 - 3 cases per 1000 subjects per year. The prevalence is approximately 50 cases per 1000 subjects in the general population. Incidence may rise as high as 150 cases per 1000 subjects per year, with prevalence rates greater than 500 cases per 1000 subjects in certain high risk groups (**Nigel Ashworth 2013).**

The carpal tunnel is an Osteo - fibrous canal located in the volar wrist. The boundaries are the carpal bones forming the floor and the flexor retinaculum forming the roof. The carpal tunnel contains 9 tendons and a nerve, flexor pollicis longus, 4 flexor digitorum superficialis, 4 flexor digitorum profundus. The median nerve is located between the flexor digitorum superficialis and flexor digitorum profundus muscles. When travelling towards the periphery, the median nerve becomes superficial, reaches the carpal tunnel and travels through it in a superficial position just below the flexor retinaculum (**Presazzi et al 2011).**

The exact cause of carpal tunnel syndrome is unknown. Carpal tunnel syndrome can be associated with any condition that causes pressure on the median nerve at the wrist. Some common conditions that can lead to carpal tunnel syndrome include obesity, oral contraceptives, hypothyroidism, arthritis, diabetes, and trauma. Compression of the median nerve at the carpal tunnel is the result of a discrepancy between the volume of the contents of the canal and its relative size. The condition may be caused by inflammation of the digital tendon sheaths, fluid retention, excessive exercises, infection and repetitive activities.

Compression of the median nerve leads to sensory changes over the lateral side of the hand and muscle weakness in the thenar eminence. This results in the pain, numbness and tingling sensation in the index, middle and radial half of the ring finger and restricted wrist extension range of motion.

The investigation techniques of carpal tunnel syndrome are nerve conduction studies and electromyography. Phalen's test and Tinel's test is the provocative test used in the diagnosis of carpal tunnel syndrome. The Tinel's test is performed by lightly tapping over the nerve to elicit a sensation of tingling or pins and needles in the distribution of nerve.

Goniometry is an instrument that either measures an angle or allows an object to be rotated to a precise angular position. The term goniometry is derived from two Greek words, *gonio* means angle and *metron* means measure.

Treatment approaches commonly used in carpal tunnel syndrome are include carpal bone mobilization, ultrasound, immobilization of hand by splinting in the neutral position, injection of steroids just proximal to or in to the carpal tunnel, activity modification, neural tissue mobilization, and decompression of the median nerve by transverse carpal ligament.

Carpal bone mobilization is the specific technique to mobilize individual's carpal bones. Mainly localized the mid carpal joint i. e., between the proximal and distal rows of carpal bones (**Kisner 2012).**

Fascial manipulation is a manual therapy that focuses on deep muscular fascia. This technique considers the fascia as a three dimensional continuum. The main stay of this manual technique lies in the identification and treatment of specific, localized areas of fascia. Fascia is formed by undulated collagen fibres and elastic fibres arranged in distinct layer the fibres are aligned in different directions.

In fascial manipulation the body is divided into 14 segments as head, neck, thorax lumbar, pelvis, scapula, shoulder, elbow forearm, hand, hip, knee, ankle and feet. Each body segment is served by six myofascial units consisting of mono - articular and bi - articular muscle fibres, their deep fascia and the articulation that they move in one direction on one plane. A new functional classification is applied to body movements to facilitate analysis of motor variations. All movements are considered in term of directions on spatial planes and are defined as follows: retro lateral humerus (re - la - hu), latero - humerus (la - hu), extra cubitus (ex - cu). Within each myofascial unit, in a precise location of the deep muscular fascia a specific point, termed center of coordination (cc) is identified. Each cc is located in the point of convergence of the vectorial, muscular forces that act on the body segment during a precise movement. Biarticular muscles link unidirectional myofascial units to form myofascial sequence. One sequence is considered to monitor movement of several segments in one direction on the three planes. Other points, termed centers of fusion located on the intramuscular septa, retinacula, and ligaments, monitor movements in intermediate directions between two planes and three dimensional movements (**Luigi stecco2004).**

Statement of study

A study to find out and compare the efficacy of fascial manipulation and carpal bone mobilization in the management of pain and dysfunction among subjects with carpal tunnel syndrome.

Need of the study

The study was aimed to introduce fascial manipulation and maitland mobilization for reducing pain and dysfunction among carpal tunnel syndrome subjects. This other motive was to popularize this technique among physiotherapy population.

Objectives of the study

To compare the effectiveness of fascial manipulation and carpal bone mobilization in the management of pain and dysfunction among carpal tunnel syndrome subjects.

Hypothesis

1) It is hypothesized that there may be significant difference in pain and dysfunction followed by fascial manipulation in the management of carpal tunnel syndrome subjects.
2) It is hypothesized that there may be significant difference in pain and dysfunction followed by carpal bone mobilization in the management of carpal tunnel syndrome subjects.
3) It is hypothesized that there may not be significant difference in pain and dysfunction followed by fascial manipulation and carpal bone mobilization in the management of carpal tunnel syndrome subjects.

Operational definition

Pain:

Pain is unpleasant feeling often caused by intense or damaging stimuli. Pain is steady and constant in which it can be an ache pain is an individual experience (**Sembulingam, 2009).**

Carpal tunnel syndrome: -

Carpal tunnel syndrome is the most common of all the nerve entrapment syndrome. This syndrome is defined by the signs and symptoms resulting from compression of the median nerve at wrist. Carpal tunnel syndrome results in considerable discomfort and pain, limitations of daily living activities (**Bickel 2010).**

Fascial Manipulation:

It is a manual technique, the aim of which is to restore normal fluidity to the ground substance and to eliminate adherences between collagen fibres by exploiting the malleability of the fascia (**Luigi stecco 2004).**

Mobilization

Mobilization is passive, skilled manual therapy technique applied to joints and related soft tissues at varying speeds and amplitudes using physiological or accessory motions for therapeutic purposes. (**Kisner 2012)**

Numerical pain rate scale

Numerical pain rate scale is a unidimensional measure of pain intensity. It is a segmented numeric version of the visual analog scale in which a respondent selects a whole number (0 - 10 integers) that best reflects the intensity of his /her pain. The 10 - point numeric scale ranges from '0'representing no pain extreme to '10' representing the extreme pain or worst pain. (**Boonstra Anne et. al., 2009)**

Goniometer
An appliance used in the static test. A protractor like device, commonly with a 180 - degree range, used to measure the joint's position when stationary.

2. Methodology

Study setting
The study was conducted in Physiotherapy Out - Patient Department of Nehru college of Physiotherapy, Coimbatore.

Selection of subjects
30 patients were randomly selected who fulfilled the inclusion and exclusion criteria and were divided in two groups.
Group A: Fascial manipulation.
Group B: Maitland mobilization.

Variables

Dependent variables
Pain
Wrist extension range of motion

Independent variables
Fascial manipulation
Maitland mobilization

Study Design
The study design was a pre and post - test experimental study.

Inclusion criteria
- Clinically diagnosed carpal tunnel syndrome patients.
- Age 30 to 40 years.
- Both sexes.
- Patients with complains of numbness, tingling sensation in the thumb, index and middle finger.
- Patient who are willing to participate.
- Patients who can co - operate

Exclusion criteria
- Patients having known psycho social problems.
- Diabetes mellitus, herpes zoster, rheumatoid arthritis.
- Pregnancy, hyperthyroidism, congenital abnormality of the nervous system.
- Congenital coagulopathies.
- Use of oral anti - coagulant therapy

Orientation to the subject
Before collection of data, all the subjects were explained about the purpose of study. The investigator had given a detailed orientation about the various test procedures such as numerical pain rate scale to measure pain and goniometry to measure the ROM. The concern and full co - operation of each participant was sought after complete explanation of the condition and demonstration of the procedure involved in the study.

Materials used
- Couch
- Pillow
- Goniometer
- Data collection sheet
- Evaluation chart
- Patient concern chart
- Bed sheet
- Fascial manipulation assessment chart
- Numerical pain rate scale

Test administration

a) Numerical pain rate scale
The numerical pain rate scale used to assess the pain intensity. It consists of10cm horizontal scale with points labelled pain.0 (no pain) and 10 (most severe imaginable). The measurement is based on self - report.

b) Goniometer
Goniometry is an instrument that either measures an angle or allows an object to be rotated to a precise angular position. The term goniometry is derived from two Greek words, *gonio* means angle and *metron* means measure.

Treatment procedure
Twenty patients were selected randomly between the age group 20 to 40 years. All the subjects underwent a pre - test assessment of pain and wrist extension range of motion using numerical pain rate scale and goniometry. The pre - test assessment was taken following procedure.

The numerical pain rate consists of a 10cm line with two end points representing '0' no pain and '10' worst pain and wrist extension range motion measured by goniometry.

The patient was asked to mark the pain and wrist extension range of motion that she (or) he felt pre and post assessment pain and functional ability level were documented.

Group A: Facial Manipulation
The patient is positioned properly in a comfortable position as for the requirement. The therapist verifies the movement assessment and proceeds for palpation assessment and finds the centre of co - ordination that is painful, densified from which the referred pain expands towards the centre of perception. Once the verification as defined the centre of cc is treated. The therapist used his knuckles to economise energy and manipulates over the cc and to be treated for the length of time required for the initial pain reaction to diminish. The pressure used to manipulate should always be bearable for the patient. Therefore, a consent feedback between patient and therapist is advised.

Treatment Duration: Lasts for 3 to 5 minutes,
One session per week, Total number of 5 sessions.

Myofascial unit of intra - humerus

Center of co ordination
The center of co - ordination of these forces is beneath the pectoralis major tendon over the coraco - clavicular fascia which is continuous with the subscapularis muscle.

Movement verification

Figure 1: Shows movement verification for intra humerus

The patient is asked to rotate the arm such that palm faces outward against manual resistance at the forearms; sometimes the movement is not painful but a difference in strength between the two limbs is noticeable.

Treatment

The patient is made to lie on his back; the therapist uses elbow or knuckle just below the shoulder, and guided by the patient's sensations, palpates for the point that provokes symptoms.

Figure 2: Shows treatment for intra humerus

Myofascial unit of intra - carpus

Center of co ordination

The center of co - ordination of these vectorial forces is over the proximal part of pronator quadratus (between the tendons of Palmaris longus and flexor carpi radialis)

Movement verification

The patient is asked to rotate the forearm such that palm faces downwards against the manual resistance at the wrist. A noticeable difference between strength is common when one arm is suffering.

Figure 3: Shows movement verification intra carpus

Treatment

The patient is made to sit in high sitting position with arm resting over the table the therapist uses his elbow in the mid of forearm, and guided by the patient's sensations, palpates for the point that provokes symptoms.

Figure 4: Shows treatment for intra carpus

Myofascial unit of latero humerus

Site of pain or Centre of perception (CP)

At a times pain localizes beneath the cc (biceps tendon); at other times it manifests in the distal deltoid tendon. Origin of dysfunction or cc;

Three vectors converge beneath the acromion: the supraspinatus, the long head of biceps and the middle or lateral head of deltoid.

Movement verification

The patient is asked to abduct their arms against a resistance placed at the elbow level; a noticeable difference between strength is common when one arm is suffering. In the acute phase, the patient simply may not be capable of carrying out this movement, even without resistance.

Figure 5: Shows movement verification latero humerus
Treatment

Patient is made to lie on non - painful side; the therapist uses the knuckle over the deltoid, In correspondence to the long head of biceps tendon. In acute cases it is preferable to avoid this point, reducing spasm along the sequence first by working on the cc of la - sc and la - cu,

Figure 6: Shows treatment for latero humerus
Myofascial unit of latero carpus

Center of co ordination
The center of co - ordination of these vectors is over the muscle belly of the two extensor carpi radialis muscles.

Movement verification
The patient is asked to abduct and extend the wrist against the manual resistance over the dorsal aspect of wrist a noticeable difference between strength is common when one arm is suffering.

Figure 7: Shows movement verification for latero carpus
Treatment

The patient is on sitting position with arm resting on the table the therapist uses knuckle just below the elbow joint.

Figure 8: Shows treatment for latero carpus

Group B: Carpal bone mobilization
Patient position: Sitting with pronated hand
Therapist position: Walk standing position

Procedure: The patient lies with his pronated hand resting on the couch. Therapist grasps the patient's wrist just proximal to the styloid process to stabilize the distal radio - ulnar joint. The maximum breadth of thumb tips, adjacent to each other, spread the fingers over the adjacent area of the hand for stability. Mobilizing hand placed over the proximal carpal row, gliding scaphoid volarly on fixed radius. Grade II (A large amplitude movement performed within a resistance free part of the available range) postero - anterior glide is produced by pressure from the therapist's arm, transmitted through the spring - like action of the thumbs against the carpal bone.
Number of glides and repetitions: 10 glides, 2 repetitions
Treatment duration: 10 - 15 minutes, 1 Session per day, 5 sessions per week (alternative days).

Figure 9: Shows carpal bone mobilization

Collection of data
The selected 20 carpal tunnel syndrome subjects were divided into 2 groups, Group A - Fascial Manipulation and Group B - Maitland mobilization (5 sessions, 5 weeks).

Statistical technique:
The collected data were analysed paired 't' test to find out significant difference between pre and post value of experimental groups and further unpaired 't' test was applied to find out the difference between the groups.

3. Data Analysis and Results

Data analysis

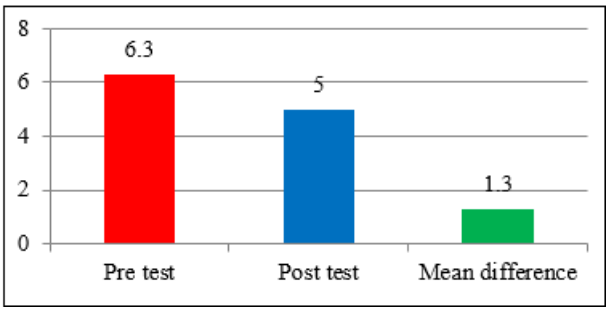
Dependent Variable - Pain	Group A	Group B
Pre Test mean	6.3	6.3
Post Test Mean	3.9	5.0
Mean Difference	2.4	1.3
Standard Deviation	0.69	0.48
Paired 't' Value	0.9*	8.56*
Unpaired 't' value	4.29*	

*0.005 level of significance

Dependent Variable - Dysfunction	Group A	Group B
Pre Test mean	42.5	47.3
Post Test Mean	50.1	50.6
Mean Difference	7.6	3.3
Standard Deviation	2.36	0.82
Paired 't' Value	8.86*	2.75*
Unpaired 't' value	4.18*	

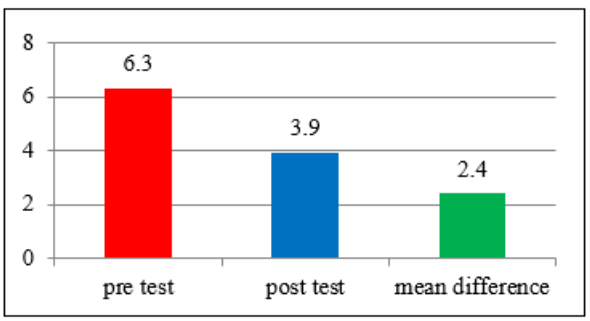
*0.005 level of significance

In group A for pain the calculated paired 't' value is 10.9 and 't' table value is 3.250at 0.005 level of significance. Since the calculated value is more than 't' table value, it shows that there is significant difference in pain following facial manipulation.



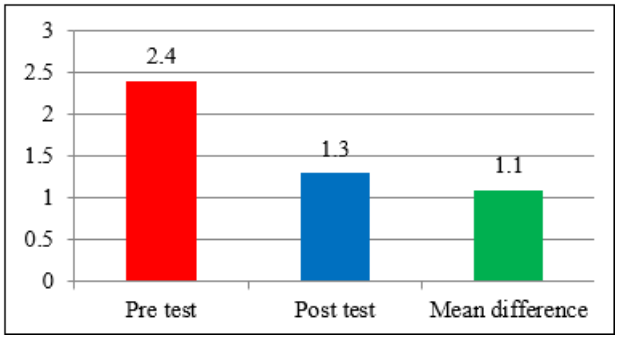
Graphical representation of pre and post - test mean values of pain among Group A

In group B for pain the calculated paired 't' value is 8.56 and 't' table value is 3.250 at 0.005 level of significance. Since the calculated 't' value is more than 't' table value, it shows that there is a significant difference in pain following carpal bone mobilization in carpal tunnel syndrome patients.



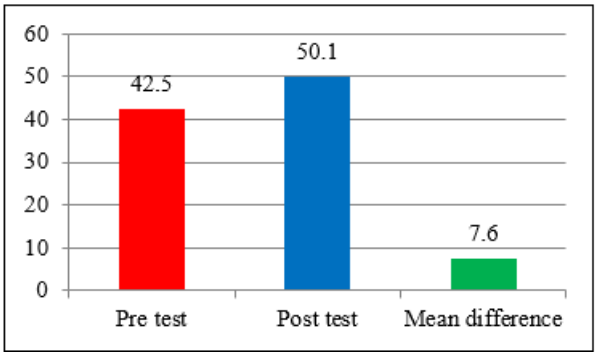
Graphical representation of pre and post - test mean values of pain among Group B

In Group A and B for pain for pain, the calculated unpaired 't' value is 4.29 and 't' table value is 2.878 at 0.005 level of significance. Since the calculated 't' value is more than 't' table value. It shows that there is a significant difference between facial manipulation and carpal bone mobilization in reducing pain among carpal tunnel syndrome patients.



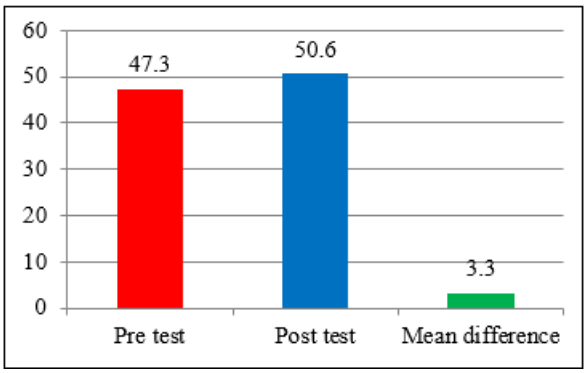
Graphical representation of unpaired 't' test value of pain between Group A and Group B

In group A for wrist extension range of motion the calculated paired 't' value is 8.86 and 't' table value is 3.250 at 0.005 level of significance. Since the calculated 't' value is more than 't' table value. It shows that there is significant difference in wrist extension range of motion in facial manipulation.



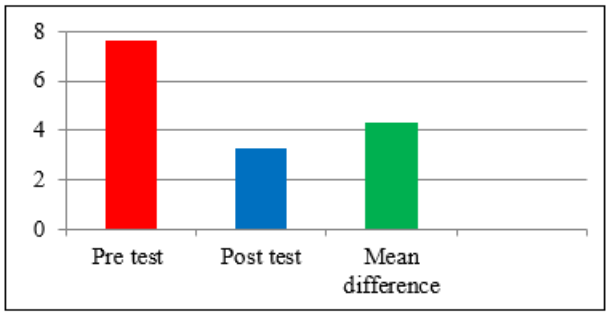
Graphical representation of pre and post - test mean value of wrist extension range of motion among Group A

In Group B for wrist extension range of motion the calculated paired 't' value is 12.75 and 't' table value is 3.250 at 0.005 level of significance. Since the calculated 't' value is more than 't' table value. It shows that there is significant difference in wrist extension range of carpal bone mobilization in carpal tunnel syndrome patients.



Graphical representation of pre and post - test mean value of wrist extension range of motion among Group B

In Group A and Group B for wrist extension range of motion the calculated unpaired 't' value is 4.18 and 't' value is 2.878 at 0.005 level of significance. Since the calculated 't' value is more than 't' table value, it shows that there is significant difference between carpal bone mobilization and facial manipulation in improving wrist extension range of motion among carpal tunnel syndrome.



Graphical representation of unpaired 't' test value of wrist extension range of motion between Group A and Group B

4. Results

Group A was treated with facial manipulation and Group B was treated with carpal bone mobilization.

Analysis of dependent variable pain in group A: The calculated paired 't' value is 10.9 and the 't' table value is 3.250 at 0.005 level of significance. Hence, the calculated 't' value is greater than the table 't' value. There is a significant difference in pain following facial manipulation among carpal tunnel syndrome patients.

Analysis of dependent variable pain in Group B: The calculated paired 't' value is 8.56 and the table 't' value is 3.250 at 0.005 level of significance. Hence, the calculated 't' value is greater than the table 't' value. There is significant difference in pain following carpal bone mobilization among carpal tunnel syndrome patients.

Analysis of dependent variable pain between Group A and Group B: The calculated unpaired 't' test value is 4.29 and the table 't' value is 2.878 at 0.005 level of significance. Hence, the calculated 't' value is greater than the 't' value. There is significance between fascial manipulation and carpal bone mobilization in reducing pain among carpal tunnel syndrome patients.

Analysis of dependent variable wrist extension range of motion in Group A: The calculated paired 't' value is 8.86 and the table 't' value is 3.250 at 0.005 level of significance. Hence, the calculated 't' value is greater than the table 't' value. There is significant difference in wrist extension range of motion among carpal tunnel syndrome patients.

Analysis of dependent variable wrist extension range of motion in Group B: The calculated paired 't' value is 12.75 and the table 't' value is 3.250 at 0.005 level of significance. Hence, the calculated 't' value is greater than the table 't' value. There is significant difference in wrist extension range of motion among carpal tunnel syndrome patients.

Analysis of dependent variable wrist extension range of motion between Group A and Group B: The calculated 't' value is 4.18 and the table 't' value is 2.878 at 0.005 level of significance. Hence, the calculated 't' value is greater than the table 't' value. There is significant difference in wrist extension range of motion between carpal bone mobilization and facial manipulation among carpal tunnel syndrome patients.

5. Discussion

The carpal tunnel syndrome is an idiopathic median neuropathy at the carpal tunnel. Numbness and paraesthesia in the median nerve distribution are the features of neuropathic symptoms of carpal tunnel syndrome.

20 patients were randomly selected and divided into two groups.
Group A - Facial manipulation
Group B - Maitland mobilization
The result of this study shows that the Group A has significant improvement in pain and wrist extension range of motion among carpal tunnel syndrome. The present study is supported by,

In the present study the effectiveness of the fascial manipulation technique. The mechanism behind reduction of pain by the fascial manipulation is explained by Elisapratelli et al (2015) they said that on these muscular insertions allow the fascia to perceive stretch produced by a muscle and that this tension can be transmitted at a distance, both in a distal and proximal direction. While the three - dimensional dispersion of forces within anatomical regions of the human body has yet to be thoroughly explored, studies of myofascial force transmission confirm that the actual stiffness of the general fascial compartments appear to be very important for the quality of myofascial force transmission.

Patients underwent fascial manipulation made clinically relevant improvement as pain decreased. The success of fascial manipulation in CTS supports the theory of myofascial continuity between the flexor carpi retinaculum and antebrachial fascia (**Stecco et al., 2010).**

Transformation of extra cellular matrix of deep fascia from sol to gel plays a major role in pathogenesis of CTS (**Stecco et al, 2013).** Increase in viscosity of extra cellular matrix may create an impairment in intrafascicular gliding and can alter signals (**Abe et al, 2005)**

Maitland (1991) suggested mobilizing of carpal bone. A large amplitude movement performed with in a resistance free part of the available range. The randomized study with 50 consecutive patients and concluded that early mobilization following carpal tunnel has effectiveness. Small amplitude oscillatory and distraction movements are used to stimulate the mechanoreceptors that may inhibit the transmission of nociceptive stimuli at the spinal cord or brainstem level. Gentle joint play technique help maintain nutrient exchange and, thus, prevent the painful and degenerating effects of stasis when a joint is swollen or painful and cannot move through the ROM.

Hence the hypothesis 1 and 2 are accepted 3rd is rejected.

6. Conclusion

An experimental study was done to compare the effectiveness of facial manipulation and carpal bone mobilization in carpal tunnel syndrome patients.

20 patients with carpal tunnel syndrome were included in this study and divided in to two groups. Group A and Group B, each group consists of 10 subjects. Group A was treated with facial manipulation and Group B was treated with carpal bone mobilization. Pain and wrist extension range of motion was assessed before and after interventions by numerical pain rate scale and goniometry respectively. From the statistical results it can be concluded that there is reduction in pain in both groups. But when comparing both the groups, facial manipulation is more effective in reducing pain and improving wrist extension range of motion than carpal bone mobilization among carpal tunnel syndrome patients.

7. Limitations

- Sample size was small
- Age group below 18 and above 65 years excluded.

8. Suggestions

- Study can be conducted for larger population.
- Studies can be done to study the long term follow - up.

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