

## **Effectiveness of Ultrasound Therapy with Active Hand Exercises in Patients with Rheumatoid Hand**

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### **ABSTRACT**

This study was aimed to find out the effectiveness of ultrasound therapy with active hand exercises for the patients with rheumatoid arthritis. The patients were selected based on the articular index tenderness score. Patients were divided into two groups. Group A received ultrasound therapy alone and group B received ultrasound therapy with active exercises. Pain and range of motion of MCP joints of both right and left hand were assessed before and after treatment using Visual analog scale and goniometer. The results were analyzed statistically. Both the group showed significant difference in reducing pain and improving range of motion. The improvement was found more in group B than group A. It was concluded that ultrasound therapy with active hand exercises are more effective than ultrasound therapy alone in reducing pain and improving range of motion in patients with rheumatoid hand.

**Key words:** ultrasound therapy immersion; articular index score; joint tenderness; visual analog scale; goniometer; range of motion; metacarpo phalangeal joint

### **INTRODUCTION**

Rheumatoid arthritis (RA) is a chronic inflammatory disorder. About 1% of the population worldwide, most commonly middle-aged women are affected. (Wheless CR et al, 2012). It is characterized by a symmetrical inflammatory synovitis which initially affects the metacarpophalangeal/metatarsophalangeal (MCP/MPT) joints. Subsequently, this evolves to systemic disease with an increase acute phase response and extra articular manifestations (Paul Emery, Michael Salmon, 1995; 54: 944-947)

RA is thought to be initiated by immunity against an unknown antigen and then it leads to a sustained inflammatory process. Early stage RA (stage 1) is characterized by synovitis, or an inflammation of the synovial membrane which causes swelling of involved joints and pain during movements. In moderate RA, (stage 2), the inflammation spreads into synovial tissue and affects the joint cartilage. This inflammation will gradually result in a destruction of cartilage

which causes narrowing of the joint space. Severe RA, (stage 3), is marked by pannus formation in the synovium. Loss of joint cartilage leads to exposure of bone beneath the cartilage. Joint deformities may also become visible. Stage 4 is called terminal or end stage RA. The inflammatory process is reduced in this stage and fibrous tissues are formed which leads to fusing of bone. Subcutaneous nodules may also be formed in this stage (Wheless CR et al, 2012).

Ultrasound therapy is a sensitive method for treating joint or tendon inflammation in patients with rheumatoid arthritis. Both pulsed and continuous ultrasound therapy has been shown to increase cell membrane permeability by stable cavitation. This cavitation effects causes movements of cells across articular membranes and lining resulting in reduced inflammation. Stable cavitation effects also reduce the nerve conduction velocity of c fibre resulting in decreased pain. One of the benefits of these thermal effects is the reduction of muscle spindle activity and consequently the reduction of muscle spasms and pain (Lynn Casimiro, 2002).

Active hand exercises with non-resisted motion are effective in reducing pain, stiffness and increased ROM. Therapeutic putty exercise are found to be effective in improving ROM and grip strength in patients with rheumatoid hand (Alison Hammond\* and Yeliz Prior, 2016)

Currently no study has been done to find out the effect of ultrasound therapy in combination of active hand exercises on reducing pain and increasing the range of motion of MCP joints.

## **MATERIAL AND METHODS**

Twenty samples were taken based on convenient sampling method. Samples considered were 30 to 40 years old females with stage-1 rheumatoid arthritis (RA). They were selected based on the articular index score. It was used to measure the tenderness over MCP joints. Grade +1 and Grade +2 tenderness scored patients were included in this study. Patients with peripheral nerve lesion, tendon dysfunction in the hand, open sepsis hand and those with fixed deformities, including swan neck and boutonniere, or wrist subluxation to the extent that passive or active extension was not possible were excluded in this study.

After the written informed consent were obtained from the patients, they were randomly allocated into two groups viz. Group A and Group B. Group A received Ultrasound therapy only and group B received ultrasound therapy with active hand exercises. The duration of the treatment was once in a day for one week. Pain and range of motion of MCP joints of both hands were assessed before the treatment begins and on the last day after the treatment session. Visual analog scale for pain and goniometer for range of motion were used.

### **Ultrasound therapy immersion method**

After proper assessment and arrangement of the patient, the treatment head of ultrasound is inserted in water which is degassed. The treatment head was parallel to dorsum of the hand and maintained at distance of 2 cm away from the body part

Dosage of ultrasound therapy: Mode: Continuous, Frequency: 3 MHZ, Duration: 8 Minutes, Intensity:  $0.250 \text{ W/Cm}^2$ , Sets: One session in a day for one week.

### **Active hand exercises**

Immediately after the therapy, the patients were asked to perform active exercises which includes;

- Flexion, extension, radial deviation and ulnar deviation of wrist
- Flexion and extension of MCP, proximal and distal interphalangeal joint

They were asked to repeat it for 5 times during each session.

### **Visual Analogue Scale (VAS)**

It was used to measure the pain. The VAS is a 10 cm long horizontal line with polar description of “no pain” and “worst pain” possible. VAS was used to grade their level of hand pain. Patients indicated their pain by placing a vertical line at the point that represented their current level of symptom.

### **Goniometric assessment of wrist and MCP joints**

The range of motion (ROM) of four MCP joints was measured and the mean value was noted. Finger goniometer was used to measure the ROM.

Goniometry position:

- **METACARPOPHALANGEAL JOINT FLEXION**
  - Axis -Dorsal metacarpophalangeal joint
  - Stationary arm- aligned with metacarpal
  - Moving arm- aligned with proximal phalanges
- **METACARPOPHALANGEAL JOINT EXTENSION**
  - Axis- Dorsal metacarpophalangeal joint
  - Stationary arm- aligned with metacarpal
  - Moving arm – aligned with proximal phalanges.

## **RESULT AND DISCUSSION**

The results were analyzed statistically

Table:1 Shows the significant difference between PRE-TEST and POST-TEST within Group A RIGHT HAND. The paired “t” test VAS mean difference is 0.7 and is statistically significant (p=0.0013).

Table: 2 Shows the significant difference between PRE-TEST and POST-TEST within Group A Left hand . The paired “t” test VAS mean difference is 0.8 and is statistically significant (p=0.002).

Table 3: Shows the significant difference between PRE-TEST and POST-TEST within Group A Right hand .The paired “t” test ROM Mean difference for MCP Flexion all fingers is 1.1 and statistically significant (p=0.0001). Mean difference for MCP Extension all fingers is 1.2 and statistically significant (p=0.0001).

Table:4 Shows the significant difference between PRE-TEST and POST-TEST within Group A LEFT HAND .The paired “t” test ROM. Mean difference for MCP Flexion all fingers is 1.1 and statistically significant (p=0.0001). Mean difference for MCP Extension all fingers is 1.1 and statistically significant (p=0.0001).

Table: 5 Shows the significant difference between PRE-TEST and POST-TEST within the group B. The paired “t” test shows Right hand (VAS) mean difference 0.8 and is statistically significant ( $P=0.0002$ )

Table:6 Shows the significant difference between PRE-TEST and POST-TEST within the group B. The paired “t” test shows Left hand (VAS) mean difference 0.9 and is statistically significant ( $P=0.0001$ )

Table:7 Shows the significant difference between PRE-TEST and POST-TEST within group B RIGHT HAND .The paired “t” test ROM. Mean difference for MCP Flexion all fingers is 1.3 and statistically significant ( $p=0.0001$ ). Mean difference for MCP Extension all fingers is 1.5 and statistically significant ( $p=0.0001$ ).

Table:8 Shown the significant difference between PRE-TEST and POST-TEST within group B left hand .The paired “t” test ROM. Mean difference for MCP Flexion of all fingers is 1.7 and is statistically significant ( $p=0.0013$ ). Mean difference for MCP Extension of all fingers is 1.4 and is statistically significant ( $p=0.0001$ ).

The findings in this study showed that both group A and group B showed statistical significance within the group. Konrad (1994) stated that treatment with ultrasound reduces pain, swelling and stiffness in the joints. Hence, this study supports that ultrasound therapy reduces the pain in patients with rheumatoid hand.

The study also showed that there was significant difference found between group A and group B to increase the ROM. There was not much difference found between both groups. While performing active exercises, there is release of natural pain killers like endorphin and enkephalin, leading to reduce in pain (Coutts 1994). The marginal increase in group B showed some correlation with study done by Coutts 1994. Although there were no similar results found between right and left hand, both hands showed statically significant result to reduce the pain and improve the ROM of MCP. Shorter duration of this study limits the quality of obtaining better results. We propose that future study could focus on including large number of samples and increasing the treatment duration for getting better results.

It was found that both group showed significant results to reduce pain and increasing the range of motion, however group B showed more improvement than group A in reducing pain and increasing range of motion in patients with RA hand.

## CONCLUSION

In this study, treatment with ultrasound therapy and ultrasound therapy with active exercise both showed significant improvement in pain relief and increase in ROM in patients with rheumatoid arthritis hand. This study concludes that ultrasound therapy with active exercise is more effective than ultrasound therapy alone in treating Rheumatoid Hand.

**Table: 1 Results from VAS of right hand RA\* in ultrasound therapy group.**

VAS** GROUP-A (Right hand)						
Mean values		Mean difference	Standard Deviation		T value	P value
Pre test	Post test		Pre test	Post test		
5.70	5.00	0.7	1.06	1.05	4.5826	0.0013

\*Rheumatoid arthritis

\*\*Visual Analog Scale

**Table: 2 Results from VAS of left hand in ultrasound therapy group.**

VAS GROUP-A (Left hand)						
Mean values		Mean difference	Standard Deviation		T value	P value
Pre test	Post test		Pre test	Post test		
6.20	5.40	0.8	0.92	0.70	6.0000	0.0002

**Table: 3 Results from ROM measurement of right hand in ultrasound therapy group**

Outcome Measures	GROUP-A (Right hand) ROM						
	Mean Values		Mean Difference	Standard Deviation		t- Values	p- Values
	Pre test	Post test		Pre test	Post test		
Mean MCP* Flexion of all fingers	83.80	84.90	1.1	0.79	0.88	11.0000	0.0001
Mean MCP* Extension of all fingers	40.00	41.20	1.2	0.82	0.79	9.0000	0.0001

\*Metacarpophalangeal joint

**Table:4 Results from ROM\* measurement of left hand in ultrasound therapy group**

Outcome Measures	GROUP-A (Left hand) ROM						
	Mean Values		Mean Difference	Standard Deviation		t- Values	p- Values
	Pre test	Post test		Pre test	Post test		
Mean MCP Flexion all Fingers	83.90	85.00	1.1	0.74	0.67	11.0000	0.0001

Mean MCP Extension all Fingers	40.20	41.30	1.1	0.63	0.48	11.0000	0.0001
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\*Range of motion

**Table: 5 Results from visual analog scale of right hand RA\* in group B**

Outcome Measure	GROUP B (Right hand)						
	Mean Values		Mean Difference	Standard Deviation		t- Value	p- Value
	Pre test	Post test		Pre test	Post test		
VAS	6.40	5.60	0.8	1.17	0.97	6.0000	0.0002

\*Rheumatoid arthritis

**Table: 6 Results from visual analog scale of left hand RA in group B**

Outcome Measure	GROUP B (Left hand)						
	Mean Values		Mean Difference	Standard Deviation		t- Value	p- Value
	Pre test	Post test		Pre test	Post test		
VAS	6.50	5.60	0.9	1.08	0.97	9.0000	0.0001

**Table: 7 Results from range of motion assessment of group right hand**

Outcome Measures	GROUP-B ROM (Right hand)						
	Mean Values		Mean Difference	Standard Deviation		t- Values	p- Values
	Pre test	Post test		Pre test	Post test		
Mean MCP Flexion all fingers	84.00	85.30	1.3	0.82	0.67	8.5105	0.0001
Mean MCP Extension all fingers	40.10	41.60	1.5	0.74	0.52	9.0000	0.0001

**Table: 8 Results from range of motion assessment of group B left hand**

Outcome Measures	GROUP-B ROM (Left hand)						
	Mean Values		Mean Difference	Standard Deviation		t- Values	p- Values
	Pre test	Post test		Pre test	Post test		

MCP* Flexion of all Fingers	84.00	84.70	0.7	0.94	0.82	4.5826	0.0013
MCP Extension of all Fingers	40.2	41.60	1.4	0.79	0.97	8.5732	0.0001

\*metacarpophalangeal joint

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