

Comparison of Bilateral Approach versus Mirror Therapy on Hand Function in Post-Operative Wrist Complex Injuries

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ABSTRACT

Background: The hand is an important functional unit of the upper limb without which the whole of the upper limb become almost useless. Injuries to hand affect hand function which limits the activities of daily living. Hence, early rehabilitation should be provided to the person suffering from hand injuries.

Objective: To determine the effect of bilateral approach on wrist and fingers range of motion and pain status. To determine the effect of mirror therapy on wrist and fingers range of motion and pain status. To compare the effect of bilateral approach versus mirror therapy on wrist and fingers range of motion and pain status.

Materials and Methods: Total 40 subjects were selected aged between 30 to 40 years according inclusion and exclusion criteria. Prior consent was taken. They were divided into two groups: group A and group B. Group A received bilateral approach and group B received mirror therapy. Pre assessment was taken for pain status, disabilities of wrist and hand function, mobility of wrist and hand prior to the treatment. These subjects were treated for 5 days per week for 3 weeks. After 3 weeks the post treatment assessment was taken. The outcome measures were visual analogue scale, range of motion, Michigan hand outcome questionnaire.

Conclusion: The study concluded that there was no significant difference between bilateral approach and mirror therapy. Both the treatment methods showed significant improvement equally on pain status, disabilities of wrist and hand function, mobility of wrist and hand in post operative wrist complex injuries.

Key words: wrist, hand function, bilateral approach, mirror therapy, fractures, motor control, pain status.

INTRODUCTION

Upper limb is useless without hand as it is an important functional unit. [1] Wrist joint is formed between lower end of radius and articular disc of inferior radioulnar joint proximally and three lateral bones of upper row of carpal-scaphoid, lunate and triquetral distally. It is a synovial type of joint of ellipsoid variety. Bones at wrist are Hamet, Pisiform, Triquetral, Capitate, Lunate, Trapezoid, Trapezium, Scaphoid.

Movements take place at wrist are flexion, extension, abduction (radial deviation), adduction (ulnar deviation). Wrist joint is also called as radiocarpal joint. [2] Joints of hand are carpometacarpal, intercarpal and intermetacarpal joints. First carpometacarpal joint is synovial type of joint of saddle variety. Movements occur at it are flexion, extension, abduction, adduction and opposition. Metacarpophalangeal joints movements are flexion, extension,

abduction, adduction and opposition for first joint and flexion, extension, abduction, adduction for second to fifth joints. It is synovial joints of ellipsoid variety. Interphalangeal joint is a hinge type of joint. Movements at second to fifth digits are flexion and extension. [2]

Function of the hand occurs with the balance and control of forces between the extrinsic and intrinsic muscles of wrist and hand. There are two types of grips used for performing activities of daily living- power grip and precision grip. Power grip are isometric functions and involve clamping an object with partially flexed fingers against the palm of the hand and with counter pressure from the adducted thumb like cylindrical grip, spherical grip, hook grip and lateral prehension. Precision grip are isotonic functions and involve manipulations an object not in contact with the palm between opposing abducted thumb and fingers like pad-to-pad, tip-to-tip, pad-to-side prehension. There is also a combined type of grip which involves digits 1 and 2, sometimes 3 for performing activities like pinch. [3]

During accidents and emergency cases hand injuries are commonly seen. This is because during emergency and accidents people try to protect them self with help of hand to resist injury. Injury to hand is a potential for serious handicap so as early as possible medical evaluation is required even for smallest hand injury. These injuries vary from childhood to adulthood and even for elderly population due to various factors like, pattern of injury, age group and growth mechanism. [4] Injuries to wrist and hand leads to reduce range of motion due to formation of edema, scar, adhesion with changes in connective tissue. Injuries to hand affect the day to day activities and it is difficult to treat. [5] Injuries can be fractures, tendon injury, nerve injury, dislocation, crush injury, soft tissue injury. [1]

Fracture healing includes debridement, stabilization and remodeling of the fracture site. Healing occurs in two ways, either primarily, presence of rigid

fixation and secondarily, absence of rigid fixation. It takes weeks to years for fracture healing. Fixation of fracture can be done by various devices like stress sharing or stress shielding device. Stress sharing devices are cast, rods, pins, screws or wires and external fixator. Stress shielding device is plates. [6] Management of fractures can be done according three phases: emergency care, definitive care and rehabilitation. In emergency phase RICE method is used at the site of accident. RICE stands for rest of the part by splinting, ice therapy to reduce swelling, compression to reduce swelling and elevation to reduce swelling. In definitive phase fracture is been treated by various methods like- immobilization, closed reduction and percutaneous fixation, open reduction and internal fixation, minimally invasive surgery. During rehabilitation phase joint mobilization, muscle re-education exercises and functional use of the limb. [1]

Physiotherapy interventions for hand injuries:

1. Mobilization: They are passive skilled manual therapy techniques applied to a joint and related soft tissue at varying speed and amplitudes using physiological and accessory motions for therapeutic purpose. It helps to reduce pain, reduce post traumatic stiffness and increase range of motion. [3]

2. Exercises: These strengthening exercises are used to increase the potential tension which produces contractile and static elements of the muscle. They are of various types- isometric exercises, isotonic exercises and isokinetic exercises. Even there are high performance strengthening exercises like closed chain, open chain and plyometric exercises. Exercises can be conditioning based or functional or task specific which increases neuromuscular coordination, agility, strength and endurance. [6]

3. Modalities: Various modalities can be used for the treatment that is heat, cold, hydrotherapy, electrical stimulation. [6]

4. Stretching: it can be used to lengthen the muscle involved. It helps to relax the muscle and lead to reduce pain and improve movement. Along with stretch sprays can be used like vapocoolant to reduce muscle spasm. [6]

5. Assistive devices: Various devices can be used by the patient to carry out daily activities and for ambulation. Devices like reacher, grapper, adjustable height beds and toilet seats, canes, crutches, walker, etc. [6]

Unilateral movements are done using one side only. It is also called as constraint induced movement therapy. The affected part is involved for the treatment and to carry out the movements. The mechanism of unilateral approach is to grow the new neural pathways which changes in brain referred to as neuroplasticity. [7] Alternative method can be bilateral approach. Previous studies have shown more effect regarding bilateral approach compared to unilateral approach. [7]

Symmetrical bilateral movements repetitively performed in various ways along with bilateral isokinematic training are bilateral approach. [8] The mechanism of bilateral approach is simultaneous movement activate [8] neural networks and cortical excitability. [8] This allows to learn a motor task and non rhythmic movement. [7] Thus promotes neural plasticity and facilitate movement control. [8] Benefits of bilateral approach was found that subjects were able to perform daily activities like bathing, carrying objects easily. [7] In everyday activities we require both the arms to carry out the activities like bathing, feeding, dressing, driving, toileting, carrying objects, cooking, shopping, getting up from the bed, using keyboard, etc. So this is the reason behind performing bilateral training. [9] This is applicable for functional improvement, motor control, neurophysiologic mechanism is improved, reduce disability, improve coordination. [9] Thus, studies have shown effect of bilateral arm training on motor control and functional performance in stroke individuals, even comparative study between unilateral and

bilateral arm training for upper extremity for stroke patients. [7,8]

Mirror therapy is non invasive method of treatment. Mirror visual feedback conveyed through mirror helps in restoring the brain function. [10] Mirror therapy helps in reducing pain, correct sensory and motor system problems. [11] The concept behind the mirror therapy is neurophysiologic. [11] In mirror therapy a virtual reality box is used. The roof of the box is removed by placing a vertical mirror inside it. Two holes are made in front of it through which the patient inserts his both the arms. Thus the illusion is created by seeing the reflection of the normal hand. This allows motor commands to both arms to make mirror symmetric movements. This will help to correct the affected arm by creating the positive visual feedback informing the brain that his affected arm is moving correctly. [12]

Previous studies were carried out on the effect of bilateral arm movement in stroke patients and on mirror therapy in stroke, phantom limb, complex regional pain syndrome type 1 and 2, hand surgery and orthopedic hand injuries. Till date a comparative study is not carried out. So the study needs to be done comparing both the treatment methods in post operative wrist complex injuries.

MATERIALS & METHODOLOGY

Methodology:

Type of study- Experimental study

Study design- Pre test and Post test

Sampling method- Simple random sampling

Place of study- Krishna College of physiotherapy, KIMSDU, Karad

Sample size- 40

Duration of study- 6 months

Inclusion criteria:

Age Group: 30 – 40 yrs

Both males and females

Post operative fractures with limited range of motion of wrist and hand

Exclusion Criteria:

Loss of sensation in wrist and hand

Nerve injuries

Materials Used:

Paraffin wax bath

Mirror box

Towels

Rubber bands

Ball

Goniometer

Outcome measures:

Active range of motion.

Visual analogue scale.

Michigan hand outcome questionnaire.

Active range of motion: To measure baseline limitations of motion, to decide appropriate therapeutic interventions and to document the effectiveness of these interventions physical therapists generally makes use of goniometric measurements.

Visual analogue scale: A Visual Analogue Scale is a measurement instrument that tries to measure a characteristic or attitude that is believed to range across a continuum of values and cannot easily be directly measured. For example, the amount of pain that a patient feels ranges across a continuum from none to an extreme amount of pain.

Michigan hand outcomes questionnaire: This outcome questionnaire capable of measuring health state dominance important to patient with hand disorder .it includes over all hand function, activities of daily living, pain work performance, aesthetics and patients satisfaction with hand functions.

Procedure:

The subjects were selected according to the inclusion and exclusion criteria using simple random sampling. They were divided into two groups: group A and group B. Informed consent was taken from the subjects. Subjects were assessed for pain status, disabilities of wrist and hand function, mobility of wrist and hand prior to the treatment for which visual analog scale, Michigan hand outcome questionnaire and range of motion respectively was used. Subjects were explained about the procedure of the study. Group A received bilateral approach and Group B received

mirror therapy. Group A: paraffin wax bath, mobilization and free exercises, towel exercises, exercises with ball, rubber band exercises, in bilateral pattern. Group B: mobilization and free exercises, towel exercises, exercises with ball, rubber band exercises, in front of mirror box. These subjects were treated for 5 days per week for 3 weeks. After 3 weeks the post treatment assessment for pain status, disabilities of wrist and hand function, mobility of wrist and hand was taken with the help of assessment tools (visual analogue scale, range of motion, Michigan hand outcome questionnaire). The interpretation of the study was done on the basis of comparing pre test and post test assessment of Range of motion, Visual analogue scale, Michigan hand outcome questionnaire. Thus statistical analysis was done.

Statistical Analysis

Data of all outcome measures was measured as pre treatment & post treatment values. Mean & standard deviation was calculated for each outcome measure.

Within the Group Comparison:

Within group comparison was done by applying ‘Paired t-test’ to pre and post treatment values of same group for all outcome measures.

Between the Group Comparison:

Between groups comparison was done by applying ‘unpaired t test’.

Group I: bilateral approach

Group II: mirror therapy

RESULT

AGE DISTRIBUTION:

Table No. 1: Age distribution

Sr No	AGE	TOTAL
1	30-33	15
2	34-36	13
3	37-40	12

GENDER DISTRIBUTION:

Table No. 2: Gender distribution

Sr No	GENDER	TOTAL
1	Male	19
2	Female	21

**DATA ANALYSIS
WITHIN THE GROUP COMPARISON:
Group A:**

Table No. 3: baseline parameters in group A

Sr No	PARAMETERS	PRE	POST	t value	p value	INFERENCE
1	Visual Analog Scale	6.05±1.76	2.35±1.309	12.711	<0.0001	Significant
2	Wrist Flexion	51.85±11.69	70.5±6.065	9.269	<0.0001	Significant
3	Wrist Extension	52.3±8.909	68.5±6.048	13.167	<0.0001	Significant
4	Wrist Ulnar Deviation	23.95±5.42	34.85±3.46	7.421	<0.0001	Significant
5	Wrist Radial Deviation	12±2.34	18.5±2.43	10.98	<0.0001	Significant
6	Fingers Flexion	29.75±28.82	35.25±32.88	2.299	0.0421	Significant
7	Fingers Extension	15.75±14.44	20.15±18.18	5.14	0.0003	Significant
8	Michigan Hand Outcome Questionnaire	115.3±11.49	130.9±12.22	11.203	<0.0001	Significant

Group B:

Table No. 4: baseline parameters in group B

Sr No	PARAMETERS	PRE	POST	t value	p value	INFERENCE
1	Visual Analog Scale	6.5±1.433	2.75±1.517	15.674	<0.0001	Significant
2	Wrist Flexion	60.55±9.12	69.05±5.54	5.82	<0.0001	Significant
3	Wrist Extension	53.55±8.29	70.15±6.23	11.44	<0.0001	Significant
4	Wrist Ulnar Deviation	24.6±5.34	34.3±3.48	6.425	<0.0001	Significant
5	Wrist Radial Deviation	11.25±2.48	18.95±2.18	11.71	<0.0001	Significant
6	Fingers Flexion	23.35±26.08	29.8±32.56	2.704	0.014	Significant
7	Fingers Extension	13.2±14.24	17.75±19.17	3.56	0.0021	Significant
8	Michigan Hand Outcome Questionnaire	116.45±10.51	131.15±11.20	9.316	<0.0001	Significant

BETWEEN THE GROUP COMPARISON:

Table No. 5: baseline parameters comparison between both the groups

Sr No	PARAMETERS	GROUP A	GROUP B	t value	p value	REMARKS
1	Visual Analog Scale	2.35±1.309	2.75±1.517	0.8927	0.3777	Not Significant
2	Wrist Flexion	70.5±6.065	69.05±5.549	0.788	0.4351	Not Significant
3	Wrist Extension	68.5±6.048	70.15±6.235	0.8495	0.4009	Not Significant
4	Wrist Ulnar Deviation	34.85±3.46	34.3±3.48	0.5006	0.619	Not Significant
5	Wrist Radial Deviation	18.5±2.439	18.95±2.188	0.614	0.542	Not Significant
6	Fingers Flexion	35.25±32.88	29.8±32.56	0.5266	0.6015	Not Significant
7	Fingers Extension	20.15±18.18	17.75±19.17	0.406	0.686	Not Significant
8	Michigan Hand Outcome Questionnaire	130.9±12.22	131.15±11.207	0.067	0.9466	Not Significant

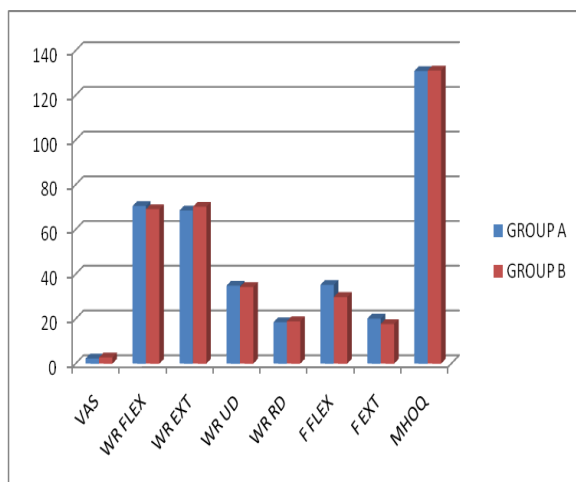


Fig No. 1: baseline parameters comparison between both the groups

Above table and graph shows pre and post comparison between the groups. Post treatment there was not significant improvement noted in both the groups.

DISCUSSION

This study “Comparison of bilateral approach versus mirror therapy on hand function in post operative wrist complex injuries” was conducted to compare the two treatments that is bilateral approach and mirror therapy and find out which one improves functional mobility of wrist and hand and reduces pain. As hand is an important functional unit of the upper limb without which the whole of the upper limb become almost useless. Injuries to hand affect hand function which limits the activities of daily living. Hence, early rehabilitation should be provided to the person suffering from hand injuries.

Previous study “Effect of mirror therapy on hand function in patients with hand orthopedic injuries: a randomized controlled trial” by H. R. Rostami, A. Arefi and S. Tabatabaei was to see the effect of

mirror therapy in restoring hand function in patients with active range of motion impairments followed orthopaedic injuries. The post test baseline TAM, DASH was significant improvement in both the groups ($p=0.001$). The study "Comparison of bilateral approach and unilateral training for upper extremity hemiparesis in stroke" by Mary E. S, Gwyn N. L and Daniel M. C was done to efficacy comparing two groups using various tasks performed in chronic stroke survivors with moderate upper extremity impairments. Thus concluded that both unilateral and bilateral training are efficacious for moderately impaired chronic stroke survivors and bilateral training may be more advantageous for proximal arm functioning.

Previous studies are carried out to see the effect of mirror therapy on hand function in patients with hand orthopaedic injuries but not with bilateral approach. So the study need to be done to compare between bilateral approach and mirror therapy in post operative wrist complex injuries in order to maximize improvement along with reducing treatment period.

The aim of the study is to find out the effect of bilateral approach versus mirror therapy on hand function in post operative wrist complex injuries. The objectives were To determine the effect of bilateral approach on wrist and fingers range of motion and pain status, To determine the effect of mirror therapy on wrist and fingers range of motion and pain status and To compare the effect of bilateral approach versus mirror therapy on wrist and fingers range of motion and pain status.

The study was conducted with 40 subjects. Subjects were selected according to the inclusion and exclusion criteria. Inclusion criteria were age Group between 30-40 yrs, both males and females and post operative fractures with limited range of motion of wrist and hand. Exclusion criteria were Loss of sensation in wrist and hand and Nerve injuries.

The subjects were divided into two groups. Prior consent was taken from them.

One group received bilateral approach and another group received mirror therapy. Pre assessment was taken for pain status, disabilities of wrist and hand function, mobility of wrist and hand prior intervening with the treatment. The interventions were carried out for 5 days per week for 3 weeks.

The outcome measures for this study were Visual analog scale, range of motion, Michigan hand outcome questionnaire. After 3 weeks post assessment was taken. The results of this study indicate that bilateral approach and mirror therapy both are effective in treatment of post operative wrist complex. This was confirmed using statistical analysis by using 'Paired t- test' for within group comparison and 'Unpaired t- test' for between the group comparisons.

Within the group comparison: Group A: pre and post training there was significant improvement noted with bilateral approach in visual analog scale ($p<0.0001$), wrist flexion ($p<0.0001$), wrist extension ($p<0.0001$), wrist ulnar deviation ($p<0.0001$), wrists radial deviation ($p<0.0001$), fingers flexion ($p=0.0421$), fingers extension ($p=0.0003$), Michigan hand outcome questionnaire ($p<0.0001$). Group B: pre and post training there was significant improvement noted with bilateral approach in visual analog scale ($p<0.0001$), wrist flexion ($p<0.0001$), wrist extension ($p<0.0001$), wrist ulnar deviation ($p<0.0001$), wrists radial deviation ($p<0.0001$), fingers flexion ($p=0.014$), fingers extension ($p=0.0021$), Michigan hand outcome questionnaire ($p<0.0001$).

Between the group comparison: Post training there was not significant difference between outcome variables in visual analog scale ($p=0.3777$), wrist flexion ($p=0.4351$), wrist extension ($p=0.4009$), wrist ulnar deviation ($p=0.619$), wrists radial deviation ($p=0.542$), fingers flexion ($p=0.6015$), fingers extension ($p=0.686$), Michigan hand outcome questionnaire ($p=0.9466$).

The reason behind the improvement is due to decreased fear and anxiety of using the affected limb as mirror therapy as well

as bilateral approach helped them to overcome fear and anxiety and movement increased and pain reduced. Among few participants there may not be major changes due to lack of regularity, no information about the necessity of rehabilitation after the surgery. The study was limited to a small geographic area and duration was short and limited. Suggestions for the study given can be that a future study with large sample size and with other joint complex can be done.

CONCLUSION

The study concluded that there was no significant difference between bilateral approach and mirror therapy. Both the treatment methods showed significant improvement equally on pain status, disabilities of wrist and hand function, mobility of wrist and hand in post operative wrist complex injuries.

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