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EVALUATING THE EFFICACY OF A STRUCTURED EXERCISE REGIMEN FOR PATIENTS UNDERGOING HAND SURGERY

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ABSTRACT

Background: Hand injuries caused by crushing incidents are common in workplaces. Caring for individuals with these injuries requires thorough assessment, carefully planned surgeries, and a prolonged rehabilitation period. Due to the complexity of such injuries, a problem-solving approach has been adopted in designing the physical therapy program. This method aims to achieve the best results in a shorter time, enabling patients to resume work quickly with minimal impairment. Presently, there is limited data on the immediate benefits of specific exercise plans post-hand surgery. This study aims to investigate the efficacy of structured exercise protocols in hand surgery

Method: A study was conducted with a sample size of 30 participants chosen according to specific inclusion and exclusion criteria. The participants were then divided into two groups: Group A, the Experimental group, and Group B, the Control group. Both groups were evaluated before the intervention and for 28 days post-intervention. The assessment of outcomes utilized the Visual Analog Scale (VAS) and the Patient-Rated Wrist Hand Evaluation (PRWHE).

Result: The experimental group demonstrated substantial improvements in hand functioning compared to the control group, as evidenced by a statistically significant $p< 0.005$. The study's results showed significant enhancements in hand functioning, which were statistically significant.

Conclusion: The research revealed that the structured exercise sessions yielded superior results compared to the control group. Furthermore, statistically significant enhancements in hand functioning were observed in the study.

Keywords: Crush Injury, Hand Surgery, VAS, SANE, PRWHE scale

INTRODUCTION

Among the most common injuries of hand lies injuries sustained by Crush **[1]**. Crush injuries of the hand involve damage to multiple structures within the hand, loss of tissue, devascularisation and possibly amputation of digits. Each injury has a unique pattern and requires a unique plan of management **[2]**. Before the 1970'S, most flexor tendon repair rehabilitation protocols focused on immobilization during the first 3 weeks following repair, as research had shown tendon tensile strength to be low with most ruptures occurring during this time period **[8]**.

Early rehabilitation in the first six to eight weeks following surgery is focused on protecting the tendon repair (Evans 2012; Strickland 2005) **[7]**. Healing the flexor tendon takes about 3 months, a period which is sometimes longer than that for which the hand can be kept free of activities or accidents liable to snap the repair **[9]**. The soft tissue envelope of the hand is uniquely designed to provide tactile input from our environment and must also withstand substantial wear over a lifetime **[10]**.

The extensor tendon system has less movement or excursion than the flexor tendon system does. The extensor apparatus also has decreased ability to compensate for shortening because of the connection between the intrinsic and the extrinsic mechanisms of this tendon system. The profundus flexor tendon provides a terminal pinch. Loss of the flexor profundus tendon may prevent full digital palmar grip. The flexor superficialis tendon helps provide balance to the finger flexion arc.

The A1, A3, and A5 pulleys have a variable relationship to the joint axis and are only helpful in restraining some bowstringing. The cruciate pulleys vary in their location and contribute little biomechanical resistance to bowstringing **[21]**. In some patients, presentation of digit length is more important than rapid recovery **[2]**. Early mobilization does not, of course, prevent adhesions entirely, but it does create a form of scarring which allows us to regain much of the range of movement and, sometimes, even return function to normal[9]. Because rupture defeats this aim, there has been a need to create

sutures and suture techniques strong enough to allow this movement **[8]**.

Midgeley and Entin in 1979 provided a list of characteristics that constitute functionality in the hand, These are: Strength, Position, Length, Stability, Mobility and Sensibility **[6]**. These parameters also form the guide to what aspect need to be restored in order to provide a functional digit or a functional hand **[18]**. In this situation, composite tissue (skin and fat) reconstruction is usually required. The cross-finger flap and thenar flap are excellent options, but digital stiffness and proximal interphalangeal (PIP) joint contractures can result from the immobilization **[4]**.

In terms of biomechanical motion the hand performs approximately seven basic maneuvers, which make up most hand function **[15]**: **Precision pinch (terminal pinch) -** otherwise known as the terminal pinch, involves flexion of the interphalangeal (IP) joint of the thumb and the distal IP (DIP) joint of the index finger. The fingernail tips are brought together so that a small item, such as a pen, can be picked up. **Oppositional pinch (subterminal pinch) -** otherwise known as the subterminal pinch. This pinch is where the pulp of the thumb and index finger are brought together with the IP and DIP joints in extension, which allows for increased forces to be generated through thumb opposition. It also relies on the first dorsal interosseous contracting while, simultaneously, the index profundus flexion is occurring. **Key pinch-** in this situation, is when the thumb is adducted to the radial aspect of the index finger's middle phalanx. The key pinch maneuver does require a stable post, which in this situation is really the index finger. It also requires adequate length of the digit and a metacarpal phalangeal joint (MCP), which is capable of resisting thumb adduction. **Directional grip (chuck grip)-** allows the index finger, long finger, and thumb to come together to envelop a cylindrical object. A rotational and axial force is usually applied to the object when using this type of grip. **Hook grip-** requires finger flexion at the IP joints and extension at the MCP joints. This grip is used, for example, when one picks up a suitcase or a briefcase. It does not require thumb function. **Power grasp**-the fingers are flexed and the thumb is flexed and opposed relative to the other digits such as gripping a club or bat **Span grasp-** when the DIP joints and the proximal IP (PIP) joints flex to approximately 30 degree and the thumb is palmary abducted such that forces are generated between the thumb and fingers. This maneuver differs from the power grasps

maneuver whereby forces are generated between the fingers and the palm. Stability is needed at the thumb, MCP, and IP joints.

Method and Material:

Study setting: Himalayan Hospital, Dehradun

Sample size: 30

Type of study: Experimental study

Subjects: Plastic surgery OPD/ ward/ Physiotherapy clinics

Sampling technique: convenience sampling

Inclusion criteria:

1. Male and female with age 12-60yrs suffering from crush injuries.
2. Injury to one or more than one digits.
3. Injury to the palmar/dorsal aspect of the hand.
4. Tendon repair

Exclusion criteria:

1. Amputation
2. Congenital deformity

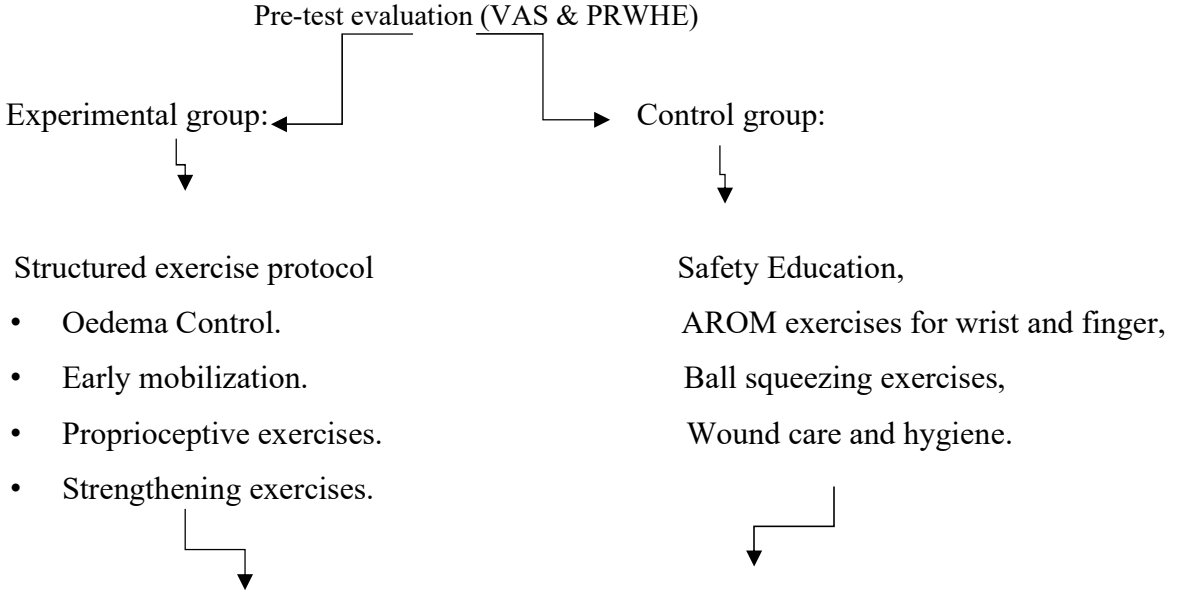
Instrumentation:

1. Couch
2. Table
3. Chair
4. Theraband, physioball, plate and marble ,thera putty clay

Outcome measures:

1. VAS SCORE
2. PRWHE (Patient Rated Wrist/Hand Evaluation)

PROTOCOL



Exercises protocol for group A and group B

Structured exercises	Control group
1. Oedema Control by elevation and pillow positioning	1. Safety Education
2. Early mobilization: • Full finger extension • Table top position • Fist position • Claw position • Half fist position • Thumb to tip Repetition- 3 sets of 10 repetition	2. AROM exercises for wrist and finger
3. Proprioceptive exercises Balancing a marble on a plate Juggling of a ball Repetition- 3 sets of 10 repetition	3. Ball squeezing exercises
4. Strengthening exercises Theraband Theraputty exercises : Thumb press, finger pinch, finger spread, finger scissor and full grip Repetition – 3 sets of 10 repetition	4. Wound care and hygiene

Data analysis:

The data was entered in MS excel and was analyzed using IBM SPSS V20. Qualitative variables were expressed in terms of frequency and percentages whereas quantitative variables were expressed in terms of Descriptive statistics.

Normality of the data was determined by using Shapiro Wilk test. Normally distributed data was analyzed by using parametric test whereas non-normally distributed data was analyzed by using non-parametric test. Paired t-test was used to find out significance differences of VAS variable within the groups. Wilcoxson signed rank test was used to find out significance of exercises protocol in patients, P-value<0.05 was considered to be statistically significant.

RESULTS:

The number of frequency that in the experimental and control groups, there were 2 females and 8 females, respectively, making up 13.3% and 53.3% of the total, while there were 13 males and 7 males, respectively, representing 86.7% and 46.7% of the total. This information is illustrated in **Figure 1**, showcasing the distribution of males and females in the experimental and control groups based on frequency and percentage.

Table 1: Shows the distribution of gender on the basis of Experimental and control

Gender	Experimental		Control	
	Frequency	percent	Frequency	percent
Female	2	13.3	8	53.3
Male	13	86.7	7	46.7

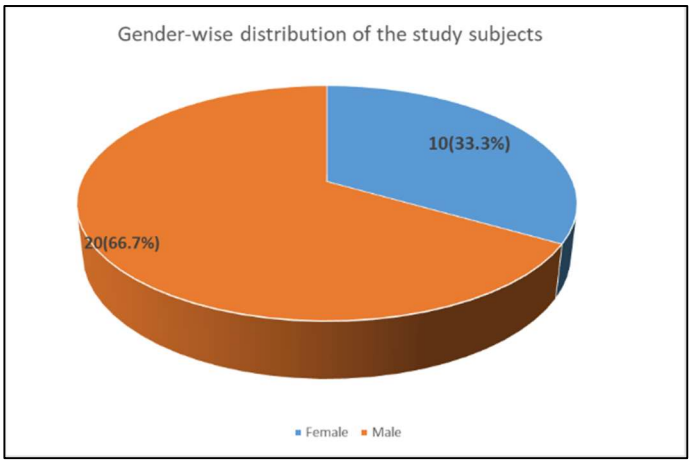


Figure 1: Show the graphical representation of male and female

Comparison of Mean and standard deviation of age in between Experimental and Control group: (Table 2, Figure 2)

The mean and standard deviation of the age variable in two different groups, A and B, are key statistical measures used to describe the central tendency and the spread of ages within each group.

Group A: The mean age in Group A is 31.27 years, with a standard deviation of 10.99 years. This indicates that, on average, individuals in Group A are around 31 years old, and the ages within this group vary by approximately 10.99 years around this average.

Group B: In contrast, the mean age in Group B is 36.93 years, with a standard deviation of 10.18 years. This suggests that the average age in Group B is higher at 36.93 years compared to Group A, and the ages within Group B have a slightly lower variability of around 10.18 years.

T able 2: Shows the comparison of group according to Age

Group	Age	
	Mean	Standard deviation
Experimental	31.27	10.990
Control	36.93	10.180

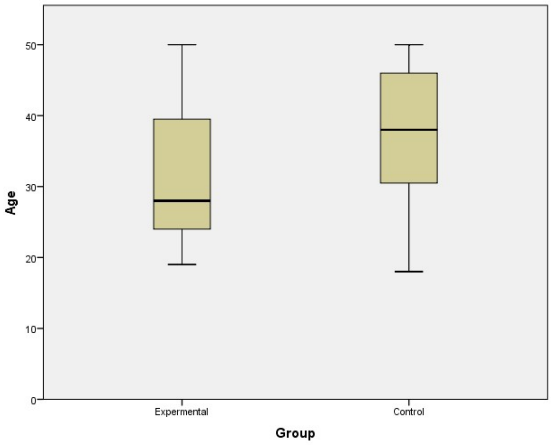


Figure 2: Show the graphical comparison of group according to Age

Comparison of VAS between group A and group B

In comparison of pre and post treatment variables between group A and group B. The median (IQR) of pre VAS score was 8(9-8) and 9(9-8) and post median (IQR) was 5(6-4) and 5(6-5) which was statistically significant (p<0.001). **(Table 3, Figure 3)**

Table 3: Shows the comparison of group according to VAS score

Group	VAS Score		p-value
	Pre	Post	
	Median (IQR)	Median (IQR)	
Experimental	8(9-8)	5(6-4)	<0.001
Control	9(9-8)	5(6-5)	<0.001

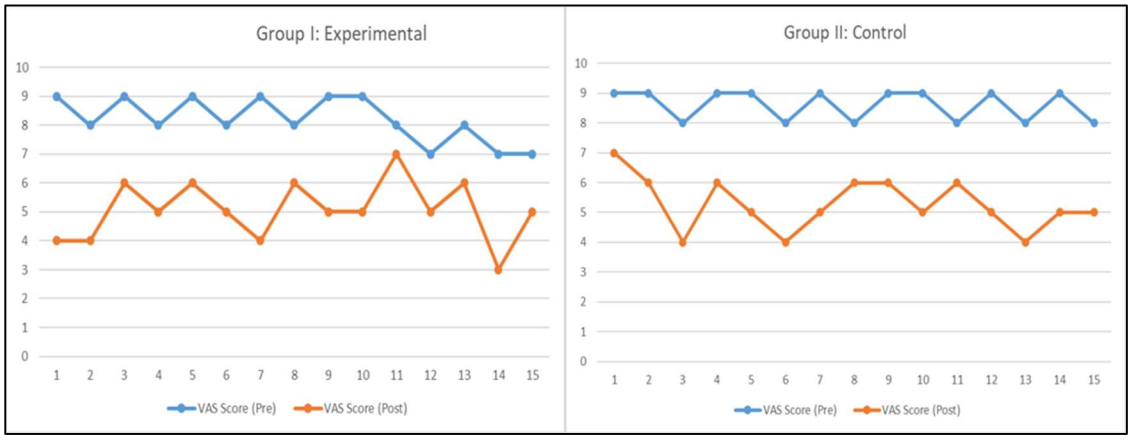


Figure 3: Comparison of VAS score between experimental and control

Comparison of PRWHE SCALE in pre and post intervention of Experimental and Control group (Table 4, Figure 4)

In comparison of pre and post treatment variables between experimental and control. The median (IQR) of pre PRWHE SCORE was 90(91-84) and 92(94-90)) and post median (IQR) was 60(68-56) and 81(83-76) which was statistically significant (p<0.001).

Pre-Treatment PRWHE Score

Group A: Median (IQR) of pre-treatment PRWHE score was 90 (91-84)

Group B: Median (IQR) of pre-treatment PRWHE score was 92 (94-90)

Post-Treatment PRWHE Score

Group A: Median (IQR) of post-treatment PRWHE score was 60 (68-56)

Group B: Median (IQR) of post-treatment PRWHE score was 81 (83-76)

The statistical analysis showed that the difference in the pre-treatment and post-treatment PRWHE scores between the two groups was statistically significant (p<0.001).

Table 4: Shows the comparison of group according to PRWHE scale

Group	PRWHE		p-value
	Pre	Post	
	Median(IQR)	Median(IQR)	
Experimental	90(91-84)	60(68-56)	<0.001
Control	92(94-90)	81(83-76)	<0.001

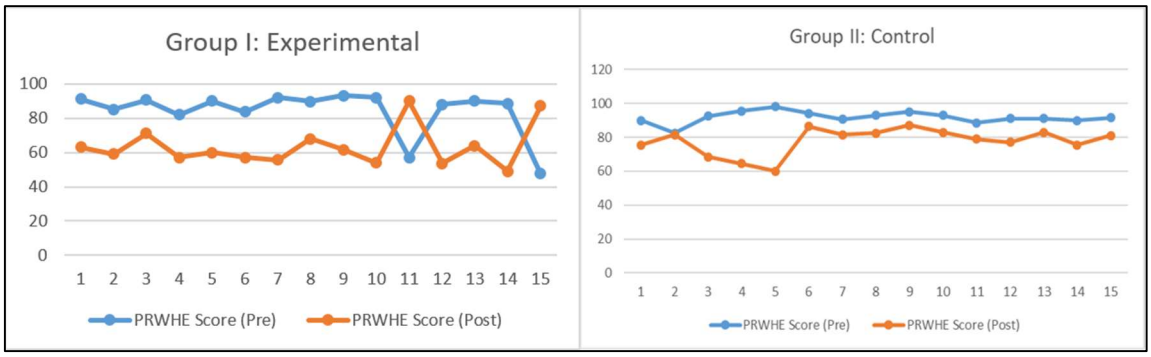


Figure 4: Shows the graphical representation of group according to PRWHE scale

This indicates that the treatment intervention had a more significant impact on the PRWHE scores in Group A compared to Group B. The larger decrease in the median PRWHE score in Group A (from 90 to 60) compared to the smaller decrease in Group B (from 92 to 81) suggests that the treatment was more effective in improving the outcome measure in Group A.

Comparison of SANE SCORE in pre and post intervention of Experimental and Control group (Table 5, Figure 5)

In the comparison of pre and post-treatment variables between group A and group B, the

SANE scores were measured. The SANE score, which stands for Single Assessment Numeric Evaluation, is a self-reported measure of overall health and well-being.

Pre-Treatment SANE Scores:

Group A: Mean SANE score of 83.9 with a standard deviation of 13.3

Group B: Mean SANE score of 63.3 with a standard deviation of 11.7

Post-Treatment SANE Scores:

Group A: Mean SANE score of 91.7 with a standard deviation of 3.56

Group B: Mean SANE score of 77.7 with a standard deviation of 7.83

The statistical analysis revealed a significant difference between the pre and post-treatment SANE scores for both groups, with a p-value of less than 0.001. This indicates that the improvement in SANE scores from pre to post-treatment was statistically significant in both Group A and Group B.

Table 5: Shows the comparison of group according to SANE

Group	SANE		p-value
	Pre (mean)	Post (S.D)	
Experimental	83.9±13.3	63.3±11.7	<0.001
Control	91.7±3.56	77.7±7.83	<0.001

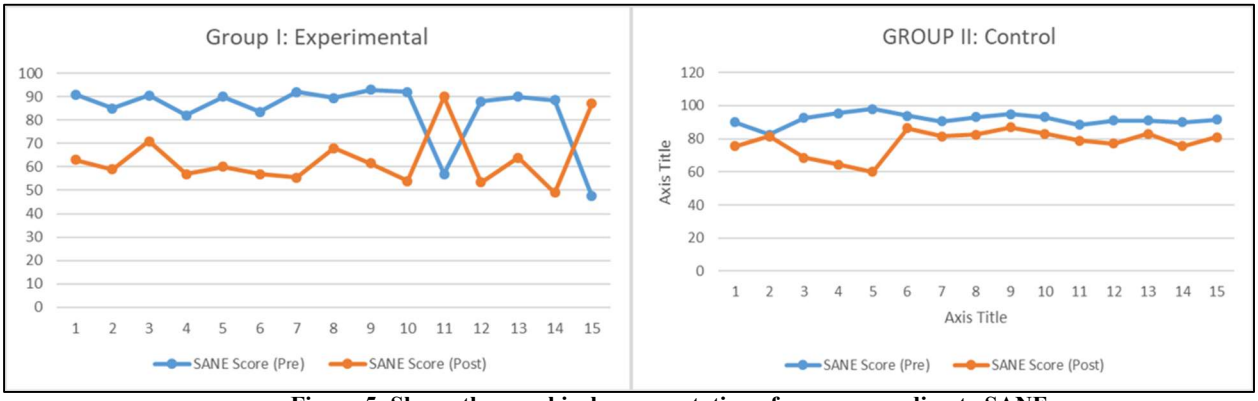


Figure 5: Shows the graphical representation of group according to SANE

This finding suggests that the treatment had a positive impact on the participants' self-reported health and well-being, as reflected in the increase in SANE scores from before to after the intervention. The narrower standard deviations in the post-treatment scores also indicate a more consistent response to the treatment within each group.

DISCUSSION:

The current research was performed to evaluate the effectiveness of structured exercises protocol with the basic functional activities and medical care performed after hand surgery. The analysis was done on 30 subjects including both male and female.

The study indicates that there is not much difference between activities based and exercises based protocol program. Both the groups are statistically significant. It accept the alternate hypothesis which included as structured exercise protocol shows a significant effect on rehabilitation of hand surgery patient.

A. Harth, G. Germann and A. Jester (2008) evaluated the effectiveness of a patient-oriented, hand rehabilitation programme compared to a standard programme regarding functional outcomes, return to work, patient satisfaction and costs and found that the patient-oriented approach was more effective and cost-saving **[4]**.

Attention was focused on the protocol used during the critical, early stage of rehabilitation. For comparison, early stage protocols were divided into oedema control, passive and active motion, proprioception and strengthening exercises. Data were compiled from all qualifying subjects with specific attention to outcomes measures, including functional results by using a PRWHE scale. In several instances, suture size or material varied within this study.

CONCLUSION:

The present study findings indicate that utilizing an exercise-based protocol has proven to be highly effective in the rehabilitation of patients who have undergone hand surgery. The results of the study demonstrate a notable decrease in both the Visual Analog Scale (VAS) scores, which measure pain intensity, and the Patient-Rated Wrist/Hand Evaluation (PRWHE) scores, which assess functional limitations and pain in the wrist and hand. This suggests that the implementation of specific exercises tailored to hand surgery patients can lead to improved outcomes in terms of pain management and functional recovery. Such positive results highlight the importance of incorporating targeted exercise regimens into the rehabilitation process for individuals recovering from hand surgery, ultimately enhancing their overall recovery and quality of life.

Limitation:

1. The primary limitation of the study is the small sample size. A small sample size can limit the statistical power of the study
2. The lack of a standardized protocol are significant limitations that can impact the reliability, validity, and generalizability of the study's findings.

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