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Effects of Hand Function Rehabilitation Strategies in Fracture Recovery

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Abstract

Background: Hand function is vital since it is required for carrying out essential everyday tasks that call for accurate hand-to-object interactions. Alarmingly, the hands account for about 29% of all orthopedic injuries treated in emergency rooms, highlighting the fragility of this body component.

Methodology: Participants take part in routine five-day rehabilitation sessions throughout the three-month trial under the supervision of both physical and occupational therapists. The multidisciplinary team closely monitors development and modifies treatments in response to the changing requirements of participants.

Results: A total number of n=60 participants, including n=33 males and n=27 females of mean age 42.4±2.5 years, were recruited in the study. The demographic characteristics of participants in each group revealed that the mean age of participants in Group-A was 41.24±3.4 years, in Group-B was 42.6±2.2 years and in Group-C was 43.15±2.7years.

Conclusion: The findings have highlighted that adequate results may be achieved by including functional activities in post-hand fracture rehabilitation programs. Such an all-encompassing strategy speeds up recovery and emphasizes the significance of personalized therapies for the best functional recovery.

Keywords

Occupational therapy, Pain, Physical Therapy Techniques, Splints.

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Introduction

Hand function is vital since it is required for carrying out essential everyday tasks that call for accurate hand-to-object interactions[1]. Alarmingly, the hands account for about 29% of all orthopaedic injuries treated in emergency rooms, highlighting the fragility of this body component[2]. Given that the hand is the most often damaged location in cases of severe occupational injuries, a large majority of these injuries occur in industrial contexts. Such accidents have severe repercussions, including rising healthcare costs, extended absences from work, and weakened physical and mental health[3-4]. The significant occurrence of these workplace hand injuries has far-reaching effects and places a significant financial burden on society as a whole. The severity of this problem was brought to light by a thorough research in the Netherlands, which estimated that hand and wrist injuries alone cost over US$740 million annually[5]. Surprisingly, these injuries became the most expensive kind, far outpacing even fractures in the lower limbs, hip fractures, and head traumas. Due to the size of this economic burden and the rapid waves of industrialization and mechanization, research targeted at improving the treatment of hand injuries is very necessary[6]. This becomes a major issue in both developed and developing countries. The combination of Occupational Therapy (OT) and Physical Therapy (PT) is highly recommended for the rehabilitation of hand fractures by patients as well as medical experts. Occupational Therapists (OTs) are experts in enhancing motor skills and coordination[7-8]. They carefully craft interventions to support grip strength, range of motion, and hand-eye coordination, empowering patients to do daily tasks like dressing and grooming confidently.

On the other hand, Physical Therapists (PTs) concentrate on lowering pain, reducing inflammation, and regaining joint mobility using specific exercises and modalities[9-10]. The restoration of hand function and an enhanced quality of life are the results of this combined approach, which includes functional adaptation monitored by OTs and physical therapy under the control of PTs[11-12]. Because there is no agreement on the efficacy and benefits of PT and OT for everyday hand operations, the field of hand fracture rehabilitation is plagued with discrepancies in therapy prescription patterns. About using PT/OT to achieve optimal functional recovery following the treatment of conditions like Distal Radius Fractures (DRFs), de Quervain (DEQ) Tenosynovitis, Trigger Finger (TRF), Carpometacarpal (CMC) Arthritis, Ganglion Cysts (GANGs), and Carpal Tunnel Syndrome (CTS), there is limited evidence both in favour of and against its use[13]. This lack of study also covers the variance in PT and OT practice patterns after common hand surgeries. Although several research studies have examined how patient- and surgeon-related variables affect therapy use, these analyses have been limited to specific hand

procedures and have yet to examine geographical or temporal variations. In this context, a recent study is set to clarify the complex roles that OTs and PTs play in the recovery from hand fractures. This randomized controlled experiment not only intends to provide light on the relative efficacy of conventional workouts, splinting, and functional activities but also has the promise of filling in the gaps in current therapeutic prescription practices that help to reduce unjustified variations in care delivery and move the field towards evidence-based, standardized practices.

Methodology

Study Design

A randomized controlled trial was performed to determine the efficacy of various hand function rehabilitation treatments in fracture healing.

Study Setting

The study was performed at Shah Physical and Occupational Therapy Center, Karachi, Pakistan, which provided a controlled and supervised setting for the rehabilitation therapies and evaluations during the research.

Target Population

Male and female patients who suffered hand fractures and seek rehabilitation treatments at the clinic make up the target group.

Inclusion and Exclusion Criteria

Individuals between 18 and 65 with various types of hand fractures meet the inclusion criteria. People with pre-existing hand impairments, neurological diseases that influence hand function, and people who are unable to attend the recommended therapy sessions regularly were all excluded.

Randomization Technique

A computer-generated randomization sequence was used to randomly assign participants to one of the three intervention groups (n=20). This guarantees a fair allocation of participants among the functional activities, splinting, and conventional exercise groups.
Intervention Strategies

Conventional Exercise (Group-A)

Participants in this group undergo a rigorous program of therapeutic exercises to improve grip strength, joint mobility, and muscular flexibility. Physical therapists lead participants through resistance training, isometric contractions, and range-of-motion exercises customized to their unique fracture and functional restrictions.

Splinting Group (Group-B)

Individuals in this group were given personalized splints designed by occupational therapists to provide the injured hand with the best alignment and support. OTs modify the splints to help prevent healing and deformity. As mentioned in Group-A, qualified physical therapists also performed conventional exercises to improve hand function.

Functional Activities (Group-C)

Participants participate in various functional exercises that resemble daily activities that occupational therapists had carefully selected. These exercises test the participants' adaptability, dexterity, and hand-eye coordination, gradually improving their capacity to restore functional independence. Functional exercises include routine activities like gripping glass, drinking, buttoning, and transferring water from one glass to another.

Participants take part in routine five-day rehabilitation sessions throughout the three-month trial under the supervision of both physical and occupational therapists. The multidisciplinary team closely monitors development and modifies treatments in response to the changing requirements of participants.

Outcome Measures

- ***Grip Strength***

  Participants were advised to hold the Hand Dynamometer with a firm and comfortable grasp to test their grip strength. Different hand sizes were considered while adjusting the dynamometer to ensure optimum alignment. Afterwards, participants were instructed to press the dynamometer as hard as possible for a limited time, usually between 3 and 5 seconds[14]. The participant's maximal grip strength for that trial was determined by the reading on the dynamometer's scale at the top of the grasp. Average grip strength numbers for humans might differ depending on age, gender, and dominant hand. However, as a general rule of thumb, an adult's typical grip strength in pounds (lbs) can range from roughly:

  - 110 to 140 lbs. for men
  - 70 to 90 lbs. for women

  Values below these limits may be considered abnormal and indicate a decline in hand strength. It is crucial to remember that geographic and population standards for grip strength might vary. Various factors, including ageing-related changes, levels of physical activity, and underlying medical disorders, may also impact values.

- ***Box and Block Test***

  The Box and Blocks Test evaluate manual dexterity, especially in the upper extremities, by timing how quickly a person can move blocks from one compartment to another. A box with two compartments was set up in front of the participant. Blocks were placed in

one compartment, leaving the other unfilled. Ascertain that the participant's hand and arms were situated adequately for the task. A timeframe of 60 seconds was fixed for the completion of the task. Several boxes transferred from one compartment to another were counted to determine the functional improvement of the hand[15].

- ***Pain***
  The pain was determined using a Visual Analogue Scale (VAS). Participants were shown a horizontal line labelled with numerical values ranging from 0 to 10, where 0 indicated "No Pain", and 10 indicated "Worst Pain Imaginable," in order to quantify pain severity using the Visual Analogue Scale (VAS). The number on the line that matched each participant's current degree of pain was to be selected by the participants. Higher scores indicated more pain, and this number represented their sense of pain severity. The participant's pain severity at that particular moment was measured using the number they had selected on a ten-point scale[16].

Results

A total number of n=60 participants, including n=33 males and n=27 females of mean age 42.4±2.5 years, were recruited in the study. The demographic characteristics of participants in each group revealed that the mean age of participants in Group-A was 41.24±3.4 years, in Group-B was 42.6±2.2 years and in Group-C was 43.15±2.7years. The male-to-female population of participants in each group and detailed demographic description as illustrated in Table-1 as follows:

Table-1 Demographic description of participants in each group

Variables	Age in years Mean±S.D	Male (%)	Female (%)
Group A	41.24±3.4	12	10
Group B	42.6±2.2	11	8
Group C	43.15±2.7	10	9

Further pre-post analyses was performed that revealed that the impact of conventional treatment, splinting and functional activities therapeutic strategies were found to be significantly effective $p<0.05$ in relieving pain as measured using VAS, improving dexterity as estimated using box and block test and hand grip as evaluated using Jamar Hand Dynamometer (Table-2).

Table-2 Paired t-test to determine within the group analysis at baseline and after 3-months						
Variables	Strength Baseline (µ±SD) lbs.	Strength Post (µ±SD) lbs.	Box and Block Test Baseline (µ±SD)	Box and Block Test Post (µ±SD)	VAS Baseline (µ±SD)	VAS Post (µ±SD)
Group A	85.4±2.5	95.6±1.35	60.2±2.5	70.5±1.4	8.2±1.5	5.1±1.5
Group B	82.5±3.5	98.75±2.25	61.5±1.4	75.5±2.1	8.5±1.7	4.9±2.0
Group C	83.7±2.24	105.6±3.54	59.8±2.2	79.45±1.5	8.9±1.47	3.2±1.4
Level of significance	p<0.05		p<0.05		p<0.05	

Further one-way analysis of variance was performed that provided evidence in favour of functional activity management group where the values were found to be significantly effective ($p<0.05$) in relieving pain, improving hand grip and functional activity of hand as measured using a Box and Block Test (Table-3, Figure-1).

Table-3 One-way analysis of variance in between-group comparison						
Variables	Strength Post (µ±SD) lbs.	p-value	Box and Block Test Post (µ±SD)	p-value	VAS Baseline (µ±SD	p-value
Group A	95.6±1.35	<0.05	70.5±1.4	<0.05	5.1±1.5	<0.05
Group B	98.75±2.25		75.5±2.1		4.9±2.0	
Group C	105.6±3.54		79.45±1.5		3.2±1.4	

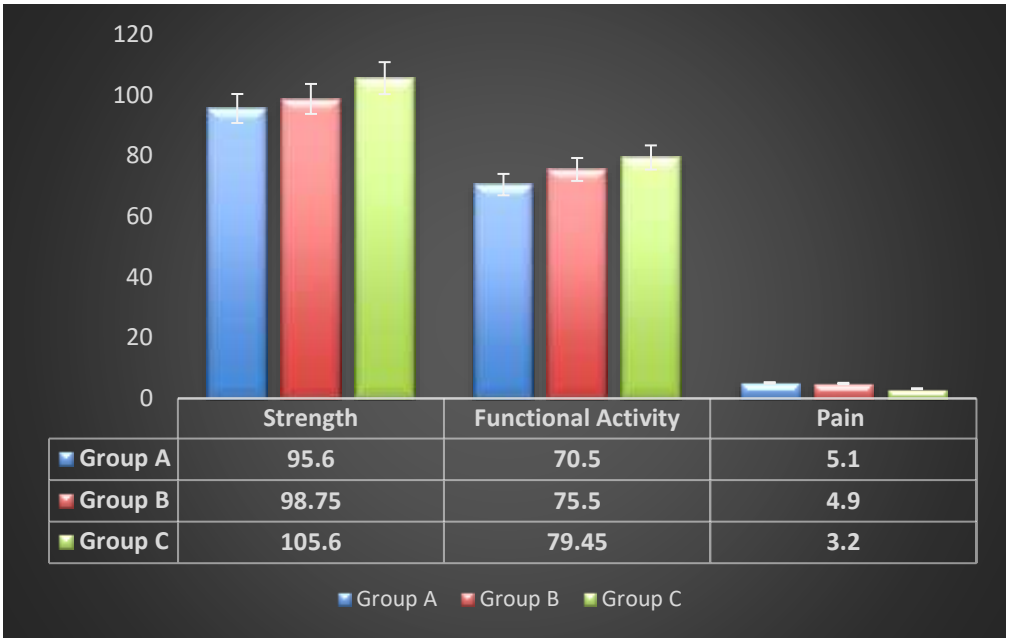

Figure-1 Between-the Group Comparisons of Outcomes

Discussion

The study involved n=60 individuals, with a mean age of 42.4±2.5 years, and assessed the effectiveness of various rehabilitation modalities in increasing hand function following hand fractures. The participants were split into three groups and performed functional exercises, splinting, and conventional therapy. After three months, all groups had significantly improved hand grip strength, dexterity, and pain relief. Notably, the functional activities group showed the most apparent improvements compared to the other groups, with statistically significant gains ($p<0.05$) in pain alleviation, hand grip strength, and functional hand activity. The study's results highlight the value of functional activities as a successful post-hand fracture rehabilitation strategy. In a previously conducted randomized control parallel-group study, feedback-guided exercises conducted on a tablet touchscreen were compared to a traditional home exercise program for n=74 employees with compromised functional capacity due to wrist, hand, and finger injuries. With the ReHand tablet application, the experimental group showed notable improvements, returning to work 18 days early and needing fewer sessions of physical therapy, occupational therapy, and cosmetic surgery[17]. Additionally, compared to the control group, the experimental group showed greater short-term functional recovery and pinch strength. According to the study's findings, using a tablet-based feedback-guided home exercise program speeds up return to work, accelerates functional recovery, increases pinch strength, and lessens the need for doctor visits among people who have suffered bone and soft-tissue injuries to the wrist, hand, and fingers[17]. Hence, the study emphasized that functional exercise-based programs with a supervised/structural home plan produce better results. In a prospective cohort single-

centre research, Self-Efficacy (SE), or confidence in one's ability to achieve goals, was the main topic of inquiry[18]. The study sought to evaluate the influence of high SE on physical functioning, discomfort, and patient-rated wrist function three months following plating surgery for distal radius fractures in light of the importance of high SE in injury/illness recovery. At the first physiotherapy visit, SE was measured in the sixty-seven patients getting plating[18]. The Patient-Rated Wrist Evaluation (PRWE), pain ratings, hand grip strength, and range of motion were assessed during the three-month checkup. The findings showed that people with high SE had significantly better hand grip strength, wrist flexion and supination range of motion, and PRWE ratings. Even though there was no statistically significant pain decrease during exercise, a modest association existed between SE and pain, wrist flexion, and PRWE score. According to the study, SE may be related to wrist function after plating surgery for distal radius fractures, thus assisting in identifying individuals needing specialized rehabilitation assistance. Another study was conducted to examine the controversial use of routine PT and OT after particular hand procedures, such as carpal tunnel release, by assessing baseline use, changes over time, regional prescribing patterns, and associated costs for PT/OT after common hand procedures. Several hand treatments, including carpal tunnel syndrome, trigger finger, carpometacarpal arthritis, de Quervain tenosynovitis, wrist ganglion cysts, and distal radius fracture, were evaluated using administrative claims data from the Truven Health MarketScan database covering 2007 to 2015. With a notable average yearly increase rate of 8.3%, the study found a rising trend in PT and OT use throughout a 90-day postoperative period[19]. The study supported the increasing usage of PT and OT after common hand surgeries, highlighting the need for greater consistency in care delivery and increased value in healthcare[19].

Nevertheless, the current study has some strengths and limitations. The large sample size improves generalizability, while the randomized controlled approach provides reliable results. However, the study's comparatively brief length and probable variances in participant compliance are drawbacks. This experiment clarifies the efficacy of various rehabilitation strategies for healing hand fractures, arguing in favour of a complete plan incorporating conventional exercises, splinting, and functional activities to improve patient results.

Conclusion

In conclusion, by examining the effects of various rehabilitation strategies on the development of hand function, this study offers insightful information into post-hand fracture rehabilitation. The study, which included a cohort of 60 people, showed notable improvements in hand grip strength, dexterity, and pain reduction across all groups, highlighting the effectiveness of functional exercises, splinting, and traditional treatment. Notably, compared to the other groups, the functional activities group showed significant and statistically significant gains in pain relief, hand grip strength, and functional hand activity, making it the most promising group. The findings have highlighted that improved results may be achieved by including functional activities in a post-hand fracture rehabilitation program. Such an all-encompassing strategy speeds up recovery and emphasizes the significance of personalized therapies for the best functional recovery. Both clinical practice and the development of hand fracture therapy regimens can benefit from these revelations.

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Conflict of Interest
None.

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AUTHORS' CONTRIBUTION

The following authors have made substantial contributions to the manuscript as under:

Conception or Design: Saba N

Acquisition, Analysis or Interpretation of Data: Tipu FI, Jalil MA

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All the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.