



## EFFECTIVENESS OF TASK ORIENTED HAND FUNCTION TRAINING ON HANDGRIP STRENGTH AMONG STROKE PATIENTS

### Occupational Therapy

**Harsha K H**

Occupational Therapy Intern, College of Occupational Therapy, NIEPMD, Chennai, India.

**Janardan Patra\***

Lecturer & HOD, Department of Occupational Therapy, Composite Regional Centre-Davanagere, Karnataka, India. \*Corresponding Author

### ABSTRACT

Stroke is one of the major cause of long-term disability and weakness of the hand is a frequent problem that limits independence in daily living. This study aimed to find out the effect of task-oriented hand function training on handgrip strength among individuals with stroke. Ten participants between 30 and 60 years of age were selected to participate in this study and they underwent a structured program of hand function training for a period of eight weeks. Grip strength was evaluated before and after the intervention with the Jammer Hydraulic Hand Dynamometer. The intervention resulted in significant improvement in grip strength. The findings suggest that task-oriented hand function training is a viable technique for increasing motor recovery and hand abilities during stroke rehabilitation.

### KEYWORDS

Stroke, Hand Grip Strength, Hand Function Training

### INTRODUCTION

#### Stroke

Stroke is the sudden onset of neurological deficits caused by vascular abnormalities. There are two primary categories: ischemia (infarction) refers to reduced blood flow due to vascular stenosis/occlusion, resulting in insufficient oxygen and glucose supply to the central nervous system (CNS), and hemorrhage refers to brain bleeding (1).

According to the 2016 Global Burden of Disease estimates, published in 2019, one in every four people will experience a stroke throughout their lifetime (2). Stroke has a one-month case fatality rate of 18% to 42%, a prevalence of 26 to 757 per 100,000 people annually, and an incidence of 108 to 172/100,000 people annually (3). The World Health Organization's (WHO) stroke diagnostic criteria revealed that 51.7% of patients had an ischemic stroke and 48.3% had a hemorrhagic stroke. Among the most common risk factors were hypertension (74.9%), family history (33.6%), alcohol use (22.4%), smoking (17.2%), and heart failure (17.2%) (4). The most common clinical feature among stroke patients was motor impairment (90.5%), followed by dysphagia (15.67%), headache (39.8%), vomiting (22.3%), dysarthria (35.2%), and sensory dysfunction (27.3%). The carotid bruit was the least common symptom (0.3%) (5).

#### Hand Grip Strength

Handgrip strength (HGS) is a simple and accurate way to measure maximal voluntary muscle strength(6). The handgrip test assesses hand muscular strength. This is the combined strength of the flexor muscles in the palmar, thenar, and hypothenar portions of the hand. The extensor system, which includes the intrinsic musculature, plays a minor role in the development of hand grip strength. Each finger plays a significant role in handgrip strength (7).

#### Hand Grip Strength and Stroke

Weakness, or a subject's inability to generate normal levels of muscle tension is now being recognized by an increasing number of rehabilitation professionals as a vital impairment leading to disability in stroke patients(8). Grip strength also reduced after stroke. This affects the ability to retain grip strength and quickly increase force. The grip strength of both the entire palm and fingers is essential for upper limb function, and different studies have demonstrated that grip strength is positively related to motor function and ADL performance(9). Because grip strength is easier to measure and takes less time than arm muscular strength measurements, it can be used to assess muscle weakness throughout the upper extremity during the chronic phase of stroke (10).

#### Hand Function Training

Hand Function Training consists of constraint-induced movement therapy (CIMT), robot-assisted therapy, bilateral training, task-oriented training, exercise therapy, functional electrical stimulation (FES), orthotics, mental practice, and mirror therapy (11).

Because of its enormous biomechanical complexity, the hand is substantially represented in a significant portion of the brain's motor

cortex, implying that the fine control of hand movement depends heavily on an intact corticospinal tract. Loss of hand function can significantly reduce the functional independence and quality of life of patients with stroke. According to previous studies, hand function rehabilitation after moderate to severe stroke has received less attention(11). This study aimed to examine how hand function development therapy affects hand grip strength in individuals with moderate to severe stroke.

### MATERIALS & METHODS

This was a quasi experimental study with a convenience sampling method conducted in Occupational Therapy, Department of Therapeutics, NIEPMD, Chennai over a period of three months. Ten stroke patients of both sexes of aged between 30 and 60 years who were in the chronic phase and with Brunnstrom stage 4 and above were selected for the study. Patients with shoulder subluxation and those affected by stroke for the past 6 months were excluded from this study. The eligible participants were divided into a group and given hand function interventions such as carrying a plastic water bottle from one hand to another, releasing objects into a container that was placed on the floor or below the patient chair's seat, attempting to lift each finger individually from the table, crumbling a sheet of paper into a ball, and attempting to spread it back out into a flat piece of paper, holding a container while placing objects in it, wrapping rubber bands around fingers, performing typing movements, cutting with scissors and pasting it, and rolling a pencil between the thumb and each finger. The intervention lasted for 12 weeks, 30 minutes per day, three days a week.



Task Oriented Hand Function Training

**Tool Used****Hydraulic Hand Dynamometer**

To assess grip strength, a Jamar Hydraulic Hand Dynamometer was employed. Every grip strength assessment stuck to the norms established by the American Society of Hand Therapists( ASHT). Every grip strength assessment stuck to the norms established by the American Society of Hand Therapists( ASHT). Grip strength of the party's innocent hand was assessed by bringing the shoulder in adduction, bending the elbow to a 90- degree angle, and situating the lower arm and wrist joint in the middle. The average values of three measures were recorded. Force product in kilograms( 0- 90) or pounds( 0- 200) was used to score the instrument.

**Statistical Analysis**

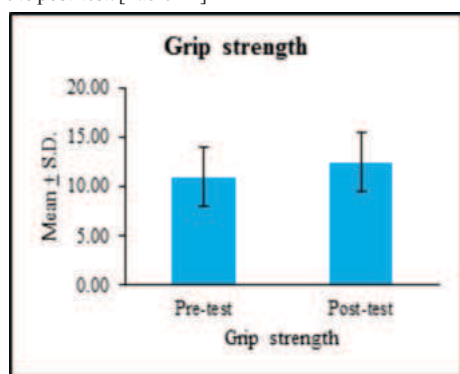
The collected data were summarized using the following Descriptive Statistics: frequency, percentage, mean, and S.D. A paired t-test was used to compare grip strength before and after the test. Statistical significance was set at p value < 0.05. Data were analyzed using the SPSS software (SPSS Inc., Chicago, IL, USA) version 29.0.10.

**RESULT****Table 1: Pre to Post-test Comparison of Grip Strength (kg)**

| Grip strength (Kg) | Side affected: Right |      |       |         | Side affected: Left |      |       |         |
|--------------------|----------------------|------|-------|---------|---------------------|------|-------|---------|
|                    | Mean                 | S.D. | "t"   | p value | Mean                | S.D. | "t"   | p value |
| Pre-test           | 9.37                 | 1.15 | -7.01 | 0.02*   | 11.61               | 3.30 | -4.93 | 0.003*  |
| Post-test          | 12.00                | 1.30 |       |         | 12.66               | 3.47 |       |         |

("t"= Paired "t" test; \* Significant)

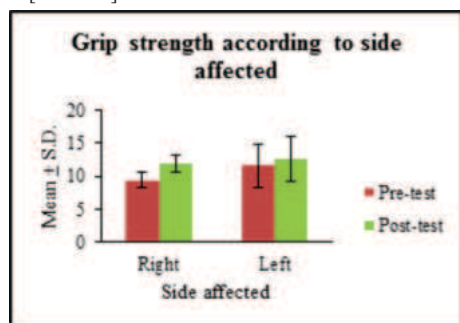
The Paired "t" test was used for pre to post-test comparison of grip strength (Kg). There was a difference ( $p < 0.05$ ) in grip strength (Kg) from pre to post-test. [Table – 1]

**Figure 1:- Comparison of the Pre-test and Post-test Values After the Intervention****Table 2: Comparison of Grip Strength (Kg) within the Side Affected**

| Grip strength (Kg) | Mean     | S.D.      | "t"  | p value |
|--------------------|----------|-----------|------|---------|
|                    | Pre-test | Post-test |      |         |
|                    | 10.94    | 12.46     | 2.95 | 0.001*  |
|                    | 2.95     | 2.92      |      |         |

("t"= Paired "t" test; \* Significant)

The Paired "t" test was used to compare the grip strength (kg) on the affected side. There was a difference ( $p < 0.05$ ) in grip strength (kg) within the right side as well as the left side affected, from pre-test to post-test. [Table – 2]

**Figure 2:- This Figure Shows the Comparison of Grip Strength within and Between the Side Affected (Table 2 and 3)****DISCUSSION**

This study aimed to determine the effectiveness of Hand Function Training on Hand Grip strength in stroke patients. This study includes a set of activities that are not widely used in stroke patients.

The collected data included 10 subjects with reduced hand grip strength, which was assessed using a Jammer Hydraulic Hand Dynamometer. Hand function training was provided for 12 weeks, and reassessment of grip strength was analyzed after 12 weeks. Based on the results, the alternate hypothesis of the study is accepted, and the null hypothesis is rejected.

Table 1 presents the results of a paired t-test used to compare grip strength (kg) before and after the intervention. The mean grip strength for the pre-test was 10.94 kg with a standard deviation (SD) of 2.95, while the post-test mean was 12.46 kg with a standard deviation (SD) of 2.92. The calculated t-value of -5.09, along with the p-value of 0.001, indicated that the difference in grip strength from pre-test to post-test was statistically significant ( $p < 0.05$ ). This means that there was a meaningful increase in grip strength following the intervention, suggesting that the intervention had a positive effect on participants' grip strength (10).

Table 2 shows the results of the paired t-test comparing grip strength (in kilograms) on the right and left sides of the body before and after the intervention. For the right side, the pre-test mean grip strength was 9.37 kg (SD = 1.15), and after the intervention, the post-test mean was 12.00 kg (SD = 1.30). A t-value of -7.01 and a p-value of 0.020 indicate a statistically significant improvement ( $p < 0.05$ ). For the left side affected, the pre-test mean was 11.61 kg (SD = 3.30), and the post-test mean was 12.66 kg (SD = 3.47). A t-value of -4.93 and a p-value of 0.003 also showed a significant increase in grip strength ( $p < 0.05$ ). These results suggest that the intervention led to significant improvement in grip strength on both the right and left sides of the affected body.

From Table 1, it can be concluded that there is a significant improvement in grip strength following hand function training among stroke patients. The adherence to training sessions was good, and the materials used for training were cost-effective.

**CONCLUSION**

The major aim of this experimental study was to determine the role of hand function training in improving hand grip strength. Based on the study results and statistical analysis, the pre to post-test comparison showed a significant improvement in hand grip strength. These findings emphasize the importance of including targeted therapies aimed at enhancing grip strength and upper limb function in stroke rehabilitation regimens. More extensive training is necessary to enhance hand function and activities in daily life.

**Limitations**

- Uneven gender distribution was present.
- Limited number of Right hemiplegic patients were participated.
- Institutionalised stroke patients are analysed.

**Recommendations**

- The training duration could be increased to explore the additional benefits of treatment programme.
- The study with large population could be increased to investigate further.

**REFERENCES**

1. Chung CP. Chapter 77 - Types of Stroke and Their Differential Diagnosis. In: Caplan LR, Biller J, Leary MC, Lo EH, Thomas AJ, Yenari M, et al., editors. *Primer on Cerebrovascular Diseases (Second Edition)* [Internet]. San Diego: Academic Press; 2017 [cited 2024 Dec 23]. p. 372–6. Available from: <https://www.sciencedirect.com/science/article/pii/B9780128030585000771>
2. Campbell BCV, Khatri P. Stroke. *Lancet*. 2020 Jul 11;396(10244):129–42.
3. Jones SP, Baqai K, Clegg A, Georgiou R, Harris C, Holland EJ, et al. Stroke in India: A systematic review of the incidence, prevalence, and case fatality. *International Journal of Stroke*. 2022 Feb;17(2):132–40.
4. Fekadu G, Chelkeba L, Kebede A. Risk factors, clinical presentations and predictors of stroke among adult patients admitted to stroke unit of Jimma university medical center, south west Ethiopia: prospective observational study. *BMC Neurology*. 2019 Aug 7;19(1):187.
5. Misbach J, Wendra A. Clinical pattern of hospitalized strokes in 28 hospitals in Indonesia. *Med J Indones*. 2000 Jan 1;29.
6. Lee SY. Handgrip Strength: An Irreplaceable Indicator of Muscle Function. *Ann Rehabil Med*. 2021 Jun 30;45(3):167–9.
7. Noonari SB, Samejo B, Nonari MH. The Association Between Hand Grip Strength and Hand Span of Dominant and Non-dominant Hand of Undergraduate Physiotherapy Students | *Journal of Modern Rehabilitation*. [cited 2024 Dec 24]; Available from: <https://jmr.tums.ac.ir/index.php/jmr/article/view/224>

8. (PDF) Maximal grip force in chronic stroke subjects and its relationship to global upper extremity function. ResearchGate [Internet]. [cited 2025 Jul 16]; Available from: [https://www.researchgate.net/publication/12840061\\_Maximal\\_grip\\_force\\_in\\_chronic\\_stroke\\_subjects\\_and\\_its\\_relationship\\_to\\_global\\_upper\\_extremity\\_function](https://www.researchgate.net/publication/12840061_Maximal_grip_force_in_chronic_stroke_subjects_and_its_relationship_to_global_upper_extremity_function)
9. Stock R, Thrane G, Askim T, Anke A, Mork PJ. Development of grip strength during the first year after stroke. *J Rehabil Med*. 2019 Apr 1;51(4):248–56.
10. Ekstrand E, Lexell J, Brogårdh C. Grip strength is a representative measure of muscle weakness in the upper extremity after stroke. *Topics in Stroke Rehabilitation*. 2016 Aug 17;23(6):400–5.
11. Wang H, Arceo R, Chen S, Ding L, Jia J, Yao J. Effectiveness of interventions to improve hand motor function in individuals with moderate to severe stroke: a systematic review protocol. *BMJ Open*. 2019 Sep 1;9(9):e032413.
12. Mawase F, Cherry-Allen K, Xu J, Anaya M, Uehara S, Celnik P. Pushing the Rehabilitation Boundaries: Hand Motor Impairment Can Be Reduced in Chronic Stroke. *Neurorehabil Neural Repair*. 2020 Aug 1;34(8):733–45.
13. Mathews S, Paul A. Effect of Task-Oriented Training on Hand Dexterity, Grip Strength, and Function among Institutionalized Geriatric Population. *Journal of the Indian Academy of Geriatrics*. 2022 Sep;18(3):118.
14. Harris JE, Eng JJ. Paretic upper-limb strength best explains arm activity in people with stroke. *Phys Ther*. 2007 Jan;87(1):88–97.
15. Peolsson A, Hedlund R, Öberg B. Intra- and inter-tester reliability and reference values for hand strength. *J Rehabil Med*. 2001 Jan;33(1):36–41.
16. Beaton DE, O'Driscoll SW, Richards RR. Grip strength testing using the BTE work simulator and the Jamar dynamometer: a comparative study. *Baltimore Therapeutic Equipment*. *J Hand Surg Am*. 1995 Mar;20(2):293–8.
17. Bertrand AM, Mercier C, Bourbonnais D, Desrosiers J, Gravel D. Reliability of maximal static strength measurements of the arms in subjects with hemiparesis. *Clin Rehabil*. 2007 Mar;21(3):248–57.
18. Park S, Park JY. Grip strength in post-stroke hemiplegia. *J Phys Ther Sci*. 2016 Feb;28(2):677–9.
19. Ada L, Canning CG, Low SL. Stroke patients have selective muscle weakness in shortened range. *Brain*. 2003 Mar;126(Pt3):724–31.
20. Heller A, Wade DT, Wood VA, Sunderland A, Hewer RL, Ward E. Arm function after stroke: measurement and recovery over the first three months. *J Neurol Neurosurg Psychiatry*. 1987 Jun;50(6):714–9.
21. (PDF) Handgrip Strength as a Predictor of Muscular Strength and Endurance: A Cross-sectional Study. ResearchGate [Internet]. 2024 Oct 22 [cited 2025 Jan 7]; Available from: [https://www.researchgate.net/publication/350549022\\_Handgrip\\_Strength\\_as\\_a\\_Predictor\\_of\\_Muscular\\_Strength\\_and\\_Endurance\\_A\\_Cross-sectional\\_Study](https://www.researchgate.net/publication/350549022_Handgrip_Strength_as_a_Predictor_of_Muscular_Strength_and_Endurance_A_Cross-sectional_Study)
22. Carroll D. Hand function in hemiplegia. *Journal of Chronic Diseases*. 1965 May 1;18(5):493–500.
23. Wade DT, Langton-Hewer R, Wood VA, Skilbeck CE, Ismail HM. The hemiplegic arm after stroke: measurement and recovery. *J Neurol Neurosurg Psychiatry*. 1983 Jun;46(6):521–4.
24. Welmer AK, Holmqvist LW, Sommerfeld DK. Limited fine hand use after stroke and its association with other disabilities. *J Rehabil Med*. 2008 Aug;40(8):603–8.
25. Knutson JS, Harley MY, Hisel TZ, Chae J. Improving hand function in stroke survivors: a pilot study of contralaterally controlled functional electric stimulation in chronic hemiplegia. *Arch Phys Med Rehabil*. 2007 Apr;88(4):513–20.
26. Mathiowetz V, Weber K, Volland G, Kashman N. Reliability and validity of grip and pinch strength evaluations. *J Hand Surg Am*. 1984 Mar;9(2):222–6.
27. Hamilton A, Balnave R, Adams R. Grip Strength Testing Reliability. *Journal of Hand Therapy*. 1994 Jul 1;7(3):163–70.
28. Liu G, Xue Y, Wang S, Zhang Y, Geng Q. Association between hand grip strength and stroke in China: a prospective cohort study. *Aging (Albany NY)*. 2021 Mar 3;13(6):8204–13.
29. Pandian JD, Sudhan P. Stroke Epidemiology and Stroke Care Services in India. *J Stroke*. 2013;15(3):128.
30. Effect of Hand Function Training on Improvement of Hand Grip Strength in Hemiplegic Cerebral Palsy in Children. ResearchGate [Internet]. 2024 Oct 22 [cited 2025 Jan 16]; Available from: [https://www.researchgate.net/publication/270008699\\_Effect\\_of\\_Hand\\_Function\\_Training\\_on\\_Improvement\\_of\\_Hand\\_Grip\\_Strength\\_in\\_Hemiplegic\\_Cerebral\\_Palsy\\_in\\_Children](https://www.researchgate.net/publication/270008699_Effect_of_Hand_Function_Training_on_Improvement_of_Hand_Grip_Strength_in_Hemiplegic_Cerebral_Palsy_in_Children)
31. Improving Hand Function of Severely Impaired Chronic Hemiparetic Stroke Individuals Using Task-Specific Training With the ReIn-Hand System: A Case Series - PMC [Internet]. [cited 2025 Jan 9]. Available from: <https://pmc.ncbi.nlm.nih.gov/articles/PMC6234834/>