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EFFECT OF NEURAL TISSUE MOBILIZATION ON NERVE CONDUCTION, HAND DEXTERITY AND HAND GRIP STRENGTH IN YOUNG OLD POPULATION-AN EXPERIMENTAL STUDY

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ABSTRACT

Background: Aging leads to a progressive decline in physiological functions, affecting coordination, sensory processing, and musculoskeletal health. In India, the elderly population (60+) is expected to rise significantly, with those aged 70+ projected to increase from 27 million in 2001 to 132 million by 2050. A key age-related change is the decline in hand function due to muscle loss and reduced strength, particularly after 60 years. This study aimed to assess the effects of a 4-week neural tissue mobilization program on hand grip strength, nerve conduction, and dexterity in the "young-old" population using the Jamar dynamometer, NCV test, and 9-hole peg board test.

Methodology: The study included 25 subjects aged 60-75 years, with ethical clearance obtained. Participants were selected based on specific criteria and provided informed consent. Assessments included hand grip strength (Jamar dynamometer), dexterity (9-hole peg board test), and nerve conduction velocity (NCV apparatus). Neural tensioners were applied for 4 weeks, 3 times per week, with 6-8 oscillations, a 10-second hold, and 3 sets per nerve, allowing a 1-minute rest or until symptoms subsided. Pre- and post-intervention readings were recorded.

Results: The study results showed significant post-intervention improvements in hand dexterity and grip strength, with slight enhancements in nerve conduction across all three nerves. The dominant hand exhibited greater improvement than the non-dominant hand. The findings suggest that neural tissue mobilization can effectively enhance grip strength, thereby improving dexterity and helping prevent hand function deterioration in the elderly.

Conclusion: This study concludes that neural tissue mobilization effectively enhances hand grip strength and dexterity in the young-old population. However, no significant improvement was observed in nerve conduction.

Keywords: Elderly, Grip strength, Dexterity, NCV, Neural tissue mobilization.

INTRODUCTION

Aging is a natural process marked by a gradual decline in body functions, which not only reduces quality of life but also increases the risk of age-related diseases [1]. Healthy aging means maintaining good mental, social, and physical well-being in older adults [2]. In India, the elderly population (60+ years) is projected to rise sharply—from 71 million in 2001 to 179 million in 2031, and those aged 70+ from 27 million in 2001 to 132 million in 2051 [3].

One major change with aging is reduced hand function. This decline is linked to changes in coordination, vision, touch, hearing, muscles, bones, and nerves. Muscle mass and strength start to fall after 60, though muscles used regularly are less affected. Bone loss begins in the late 30s, while aging also brings slower movements, weaker reflexes, and reduced neuromuscular function. Nervous system changes—like slower nerve conduction, reduced sensory activity, and delayed reflexes—further affect coordination. Sensory decline, in particular, has been identified as a key factor in reduced motor function [4].

The functional use of the upper extremity is essential for carrying out everyday activities. Upper limb function is generally classified into fine motor skills (like feeding, dressing, and grooming) and gross motor skills (like reaching, grasping, walking, and postural control). In older adults, both fine and gross motor skills tend to become slower and less precise compared to younger adults [5].

Hand function and manual dexterity play a vital role in maintaining independence in daily living, work, and recreational activities. Since the hand is the most active and important part of the upper extremity, age-related changes in its function have a significant impact. While the exact effects of normal aging on hand function are not fully understood, it is believed that both intrinsic factors (genetic, hormonal, metabolic, and pathological changes in soft tissues) and extrinsic factors (environment, nutrition, physical activity, and past injuries) contribute to the decline in manual ability [6].

Disuse atrophy is frequently seen in older adults and is marked by a decline in skeletal muscle mass and function. With age, the peripheral nervous system also shows changes, such as impaired excitation–contraction coupling and reduced performance of high-threshold motor units, which may contribute to hand muscle fatigue. A key age-related change is the reduction of skeletal muscle mass by about 25–45%, often termed “sarcopenia of old age.” The decline in hand strength is largely due to this muscle loss [6].

The hand relies on 11 intrinsic and 15 extrinsic muscles for its function. These muscles generate the grip force needed for holding objects. After the age of 60, hand-grip strength decreases rapidly—by about 20–25%—along with the loss of muscle fibers and reduced muscle-fiber length, particularly in the Thenar muscle group. Since the Thenar group is crucial for thumb movements, its decline plays a major role in reduced action potential and functional capacity. The thumb’s intrinsic muscles, making up about 40% of the hand’s intrinsic musculature, are vital for stability during pinch grips. However, muscles like the oblique adductor pollicis, Opponens pollicis, and flexor pollicis brevis commonly show dysfunction with age.

Although elderly individuals often display higher fatigue resistance, this is linked to alterations in both the peripheral and central nervous systems. Still, aging is associated with a marked decline in action potentials and a reduction in viable motor units in the hand muscles, leading to diminished contractile performance [6].

The peripheral nervous system (PNS) of the hand includes cutaneous nerves (dermatomes C6–C8, T1) and motor nerves (ulnar, median, and radial). Aging leads to a loss of motor neurons and ventral root axons, with about 25% of motor axons in hand muscles lost in old age. There is also a reduction in the number and diameter of myelinated fibers from the cervical nerve roots, causing smaller and slower muscle twitches. Motor unit loss is particularly evident in the Thenar and dorsal interossei muscles, though less pronounced in the hypothenar group, while the biceps brachii remains relatively unaffected. Overall, elderly hand muscles contain fewer but larger and slower motor units, reducing efficiency in motor control and function. Additionally, tactile sensibility declines, slowing afferent processing and further affecting hand movement [6].

Hand-grip strength is crucial for independence in daily life—such as holding objects, using handrails, carrying items, and performing self-care. A decline in grip strength threatens autonomy and daily functioning [7].

Manual dexterity, defined as the ability to control finger movements precisely and quickly, also diminishes with age. This decline interferes with fine tasks like handling small objects, writing, dressing, and eating, leading to reduced independence and quality of life [8,9]. Importantly, manual dexterity assessments can help in the early detection of age-related functional decline and may even predict cognitive decline [8].

According to David Butler, neural mobilization plays a key role in restoring movement and elasticity of the nervous system, helping it returns to normal function. The technique involves applying movement and/or tension to the nervous system, which reduces pressure within neural tissue and restores biomechanics such as elasticity and axoplasmic flow. This allows the nerves to better tolerate compressive, tensile, and frictional forces during daily and sports activities. Neural mobilization may also enhance motor unit recruitment, thereby improving muscle strength. Additionally, it has long been recognized for reducing pain intensity and improving range of motion and grip strength in neural disorders [10].

Anatomically, when nerves pass near joints, they are enclosed in tunnels or attached to surrounding tissues by collagen or fascia. Since upper-limb nerves run longitudinally, mobilization helps break cross-linkages and promotes sliding of nerves toward the moving joint. Larger amplitude movements increase this sliding, helping maintain joint and nerve mobility. Neural mobilization also helps restore the dynamic equilibrium of neural tissue, supporting normal physiological functions. On a cellular level, stretch can increase vesicle clustering, promote F-actin polymerization, and enhance ion flux (notably Ca^{2+} influx) through stretch-sensitive ion channels. These changes contribute to force generation, regulation, and downstream signalling that support nerve function [11].

With aging, movements of the hand become slower, less coordinated, and less controlled. Research consistently shows a strong relationship between age, reduced grip strength, and reduced dexterity. This decline is largely attributed to loss of muscle mass, changes in motor units, reduced nerve conduction, and altered proprioception—all consequences of neuromuscular degeneration. Fine, precise, and rapid movements like aiming or tapping rely heavily on grip strength, whereas tasks involving steadiness and tracking are more strongly influenced by age itself [12].

Although studies have demonstrated that neural mobilization can improve grip strength in different populations, there is no current evidence on its effectiveness for improving nerve conduction, dexterity, or overall hand function in healthy elderly adults. Since neural mobilization is simple to apply and effective in improving grip strength, further research could clarify whether it also enhances nerve conduction and manual dexterity in the geriatric population.

MATERIAL AND METHODS

- Plinth
- Stopwatch
- Pen
- Paper
- Hydraulic hand Jamar dynamometer, SH5001
- 9 Hole Pegboard
- NCV apparatus [RMS ALERON]
- Surface electrodes

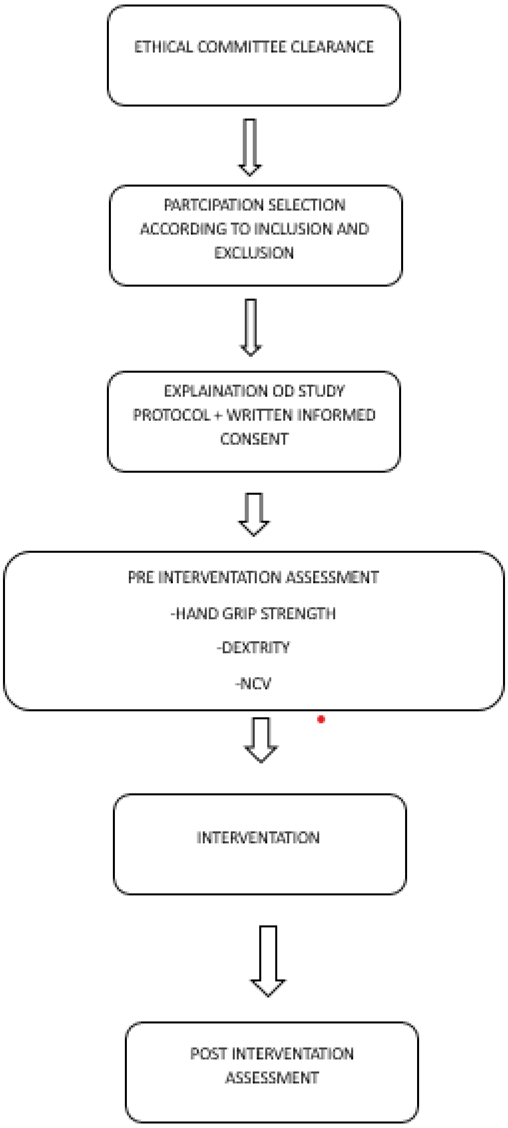
METHODOLOGY

It was an experimental study which included 25 young old population of age group 60-75 years and the study was carried out over the duration of 1 year.

SELECTION CRITERIA

Criteria	Description
Inclusion	• Age group: 60–75 years (both genders) • Intact cognitive function • Hand grip strength below 83 kilopascals (men) and below 52 kilopascals (women)
Exclusion	• Recent hand injuries • Congenital hand deformities • Neurological conditions (e.g., Stroke, Parkinson's disease)

PROCEDURE



INTERVENTION

- Neural tensioners were applied for a period of 4 weeks, with a frequency of 3 sessions per week.
- Each session included 6–8 oscillations with a 10-second hold, performed in 3 sets for each nerve.
- A rest period of 1 minute (or until symptoms subsided) was given before proceeding to the next nerve.

Starting Position:

The participant was positioned lying supine on the treatment bed with the arm placed near the edge, allowing the scapula to move freely. The therapist stood beside the participant, providing support at the elbow and wrist joints.

Neural Mobilization Techniques:

1. Median Nerve Mobilization
   - Shoulder girdle depression
   - Shoulder abduction up to 110°
   - Forearm supination
   - Wrist and finger extension
   - Elbow extension
   - Contralateral side flexion of the neck for further sensitization
2. Radial Nerve Mobilization
   - Shoulder girdle depression
   - Shoulder abduction to 10°
   - Shoulder medial rotation
   - Forearm pronation
   - Wrist flexion with ulnar deviation
   - Finger and thumb flexion
   - Elbow extension
   - Contralateral side flexion of the neck for further sensitization
3. Ulnar Nerve Mobilization
   - Shoulder girdle depression
   - Shoulder lateral rotation and abduction (10°–90°)
   - Forearm supination
   - Wrist extension with radial deviation
   - Fingers and thumb extension
   - Elbow flexion
   - Contralateral side flexion of the neck for further sensitization

RESULTS

Table1: Age distribution among subjects

FACTORS	TOTAL	MEAN	SD	MIN	MAX
AGE (YEARS)	25	66.16	±4.24	60	73

The mean ± SD, of age of subjects in the study was 66.16±4.24 years. The minimum- maximum age range in subjects was 60-73.

Table 2: Gender distribution among subjects

MALE	FEMALE
13	12

Graph 1: Representing the distribution of gender among subjects

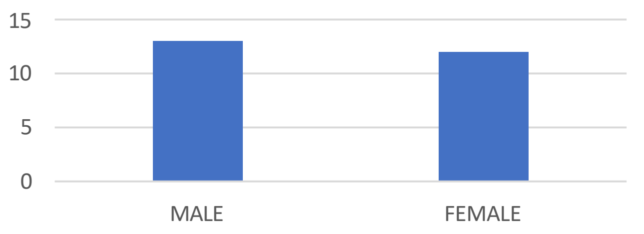


Table 2 and Graph 1 represent the gender distribution among subjects; there were total 12 females and 13 males in the study.

Table 3: Representing pre and post hand grip strength (HGS) values of dominant hand and non-dominant hand in the subjects.

GRIP STRENGTH (Kilopascal)	MEAN		SD		P VALUE	SIGNIFICANCE
	PRE	POST	PRE	POST		
DOMINANT HAND	25.73	29.04	±4.96	±5.42	0.02	Considered significant
NON-DOMINANT HAND	23.52	25.21	±3.34	±3.60	0.09	Considered not quite significant

Table 3 and Graph 2 show pre and post comparison of dominant hand grip strength and non-dominant hand grip strength value in the subjects. Post treatment mean values of dominant hand shows significant difference with p value <0.02.

Graph 2: Representing pre and post grip strength value of dominant hand and non-dominant in subjects

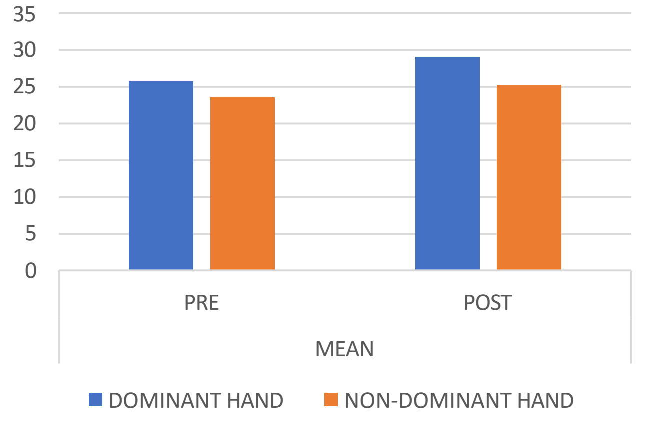


Table 4: Representing pre and post nerve conduction velocity values of median nerve of dominant and non-dominant hand in the subjects.

CONDUCTION VELOCITY (m/s) MEDIAN NERVE	MEAN		SD		P VALUE	SIGNIFICANCE
	PRE	POST	PRE	POST		
DOMINANT HAND	54.40	55.67	±2.77	±3.22	0.14	Considered not significant
NON-DOMINANT HAND	53.47	54.42	±2.63	±2.78	0.22	Considered not significant

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Graph 3: Representing pre and post nerve conduction velocity values of median nerve of dominant and non-dominant hand in the subjects.

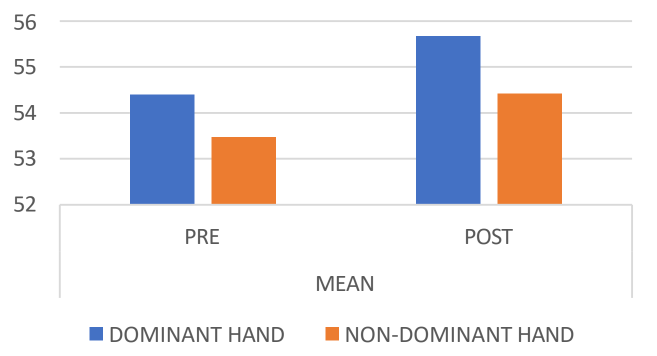

Table 4 and Graph 3 shows pre and post comparison of nerve conduction velocity values of median nerve of dominant hand and non-dominant hand value in the subjects.

Table 5: Representing pre and post nerve conduction velocity values of ulnar nerve of dominant and non-dominant hand in the subjects.

CONDUCTION VELOCITY (m/s) ULNAR NERVE	MEAN		SD		P VALUE	SIGNIFICANCE
	PRE	POST	PRE	POST		
DOMINANT HAND	59.78	60.89	±3.80	±4.02	0.23	Considered not significant
NON-DOMINANT HAND	58.54	59.76	±3.81	±4.15	0.28	Considered not significant

Graph 4: Representing pre and post nerve conduction velocity values of ulnar nerve of dominant and non-dominant hand in the subjects.

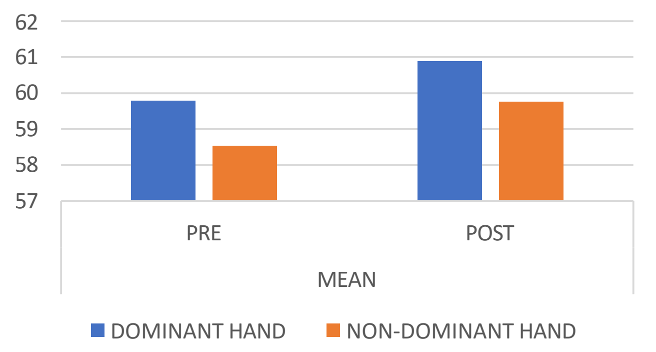

Table 5 and Graph 4 shows pre and post comparison of nerve conduction velocity values of ulnar nerve of dominant hand and non-dominant hand value in the subjects.

Table 6: Representing pre and post nerve conduction velocity values of radial nerve of dominant and non-dominant hand in the subjects.

CONDUCTION VELOCITY (m/s) RADIAL NERVE	MEAN		SD		P VALUE	SIGNIFICANCE
	PRE	POST	PRE	POST		
DOMINANT HAND	64.64	65.81	±4.06	±4.39	0.33	Considered not significant
NON-DOMINANT HAND	62.88	63.91	±3.94	±3.99	0.36	Considered not significant

Graph 5: Representing pre and post nerve conduction velocity values of radial nerve of dominant and non-dominant hand in the subjects.

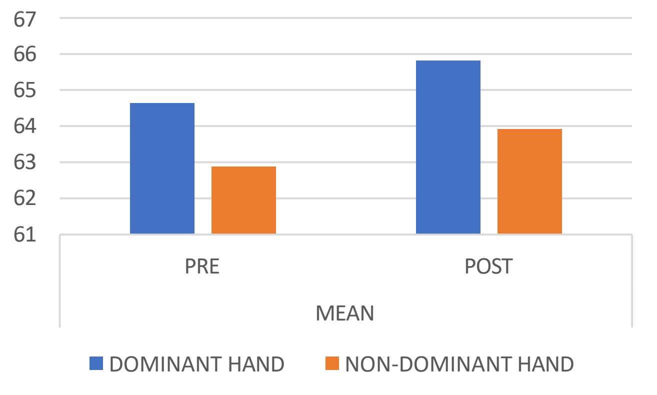

Table 6 and Graph 5 shows pre and post comparison of nerve conduction velocity values of ulnar nerve of dominant hand and non-dominant hand value in the subjects.

Table 7: Representing pre and post hand dexterity values of dominant and non-dominant hand in the subjects.

HAND DEXTERITY (sec)	MEAN		SD		P VALUE	SIGNIFICANCE
	PRE	POST	PRE	POST		
DOMINANT HAND	23.80	21.87	±1.56	±1.58	0.0003	Extremely significant
NON-DOMINANT HAND	25.08	23.50	±1.94	±1.72	0.003	Very significant

Graph 6: Representing pre and post hand dexterity values of dominant and non-dominant hand in the subjects.

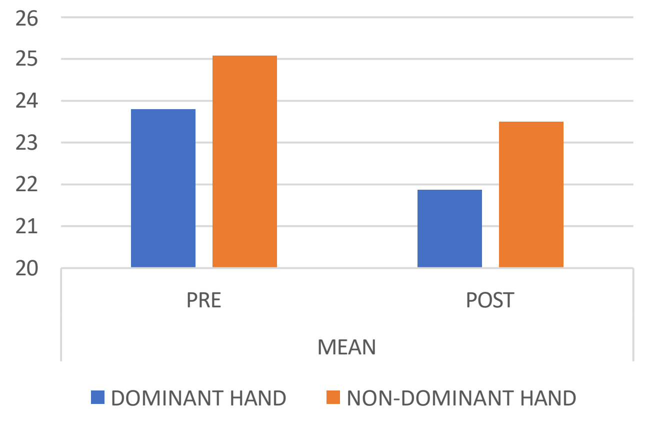

Table 7 and Graph 6 show pre and post comparison of dominant hand dexterity and non-dominant dexterity value in the subjects. Post treatment mean values of dominant hand shows extremely significant difference with p value <0.0003 and non-dominant hand shows very significant difference with p value <0.003.

DISCUSSION

This study investigated the effects of neural tissue mobilization on healthy elderly individuals aged 60–75 years, using nerve conduction, hand grip strength, and dexterity as outcome measures. The results demonstrated a significant improvement in hand grip strength and dexterity, with only a slight improvement in nerve conduction. The improvement was more pronounced in the dominant hand compared to the non-dominant hand, likely due to higher baseline grip strength values [13].

The improvement in grip strength may be explained by the adaptability of elderly muscles, which continue to respond to overload by increasing protein synthesis and contractile elements, similar to younger individuals. Neural mobilization may also have improved peripheral blood flow, axoplasmic flow, and nerve physiology, leading to enhanced hand performance [14]. The dominance effect observed in this study aligns with earlier research, which reported that the dominant hand is typically about 10% stronger than the non-dominant hand [15,16,17].

Dexterity improvement, as assessed by the 9-hole peg board test, can be attributed to better hand grip strength following neural mobilization. Previous studies have also highlighted the strong relationship between muscular strength, grip strength, and hand dexterity in the elderly [18,19]. Furthermore, findings of improved grip strength with neural tissue mobilization are consistent with earlier studies conducted by Nair R et al, Tejashree et al, Elsayed et al, and Savva C et al.

Finally, the observation that the dominant hand showed better dexterity scores compared to the non-dominant hand is supported by previous work by Joy C Macdermid et al., C.A Armstrong et al., Kimatha Oxford Grice et al., and Lucy Hodges et al., who reported that better grip strength in the dominant hand explains superior dexterity [15,16,20,21].

CONCLUSION

The present study concludes that neural tissue mobilization is effective in improving hand grip strength and dexterity in young old population. But there was no significant improvement in nerve conduction.

CLINICAL IMPLICATIONS

The present study demonstrated that neural tissue mobilization is effective in improving hand grip strength and dexterity in the young-old population (60–75 years). The following clinical implications can be derived:

Enhanced hand dexterity supports greater independence in daily activities such as self-care, household tasks, and fine motor functions.

Increased grip strength leads to better overall hand function, reducing the risk of functional decline.

Improved nerve conduction may enhance neural mobility, which could be beneficial in patients with neuropathies.

Being a non-invasive and low-risk intervention, neural tissue mobilization can be safely integrated into rehabilitation programs.

Treatment can be individualized to address specific patient needs and conditions.

Combining neural tissue mobilization with other physiotherapy interventions (e.g., strengthening, balance, proprioceptive training) may yield superior outcomes.

Patient education on correct techniques and home exercises may help sustain improvements over the long term.

LIMITATIONS

Long-term effects were not assessed; therefore, the durability of improvements in grip strength, dexterity, and nerve conduction remains unknown.

Limited generalizability as the study was conducted only on healthy elderly individuals; results may not apply to populations with comorbidities or different demographics.

FUTURE SCOPE OF THE STUDY

Inclusion of a control group in future trials will help establish the specific effects of neural tissue mobilization.

Follow-up assessments are needed to evaluate the long-term sustainability of the intervention's effects.

Further studies should explore the impact of neural tissue mobilization across different age groups and clinical populations (e.g., neuropathic conditions, post-stroke, Parkinson's).

CONFLICT OF INTEREST NONE

SOURCE OF FUNDING SELF

ETHICAL CLEARANCE TAKEN FROM INSTITUE

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