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Original Research Article

Effectiveness of Shoulder Girdle Neuro Dynamic Stabilization Exercises on Hand Muscle Strength for Normal Young Individuals

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ABSTRACT

Background: Shoulder girdle stabilization influences hand strength, but the effects of functional training remain unknown.

Objective: To determine the influence of shoulder girdle stabilization on hand muscle strength.

Methods: Handgrip strength was measured in 20 healthy individuals during the first week of the pretest and after completing four weeks of the intervention. The training consisted of six specific Dynamic Neuromuscular Stabilization exercises, performed twice a week. The exercises were designed to obtain maximum joint stability within the shoulder.

Results: t–test was used for data analysis. The mean difference and standard deviation of handgrip strength for the group were 4.30 ± 1.34 for the Pretest and 8.90 ± 1.80 for the posttest, with a mean difference of -4.60 ± 0.15. The Intragroup analysis of the group showed that handgrip strength was statistically significantly different, with $p < 0.05$ ($P = 0.0001$).

Conclusion: Shoulder girdle exercises based on DNS may generate clinically significant gains in hand muscle strength.

Key words: Upper extremity, hand-held dynamometry, functional stabilization,Dynamic Neuromuscular Stabilization, rehabilitation

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INTRODUCTION

Hand grip strength is used as a general measure of overall muscle strength (and weakness), which is reflective of overall fitness, coordination, and health. Grip strength may also be used to assess lower extremity strength (leg, knee, and ankle strength) and can indicate one's level of mobility, balance, and overall postural aptitude [1]. Naturally, with age, muscle mass declines along with physical activity, predisposing one to lowered hand grip strength. Those with healthier

lifestyles tend to have better grip strength for longer, and all the anti-aging benefits that accompany it. Maintaining a strong, healthy hand grip bears associations with longevity and preserved physical functionality throughout life[1].

Handgrip strength depends on the synergistic coordination between finger and wrist flexors and extensors. It is a vital component in the proper execution of daily living activities as well as in various sports movements[2]. Hand strength training is one of the most essential activities used to treat pathological conditions such as neurological conditions after stroke spinal cord injury, multiple sclerosis, myopathy, peripheral nerve injury etc., as well as in many orthopaedic conditions (upper extremities fractures and/or soft tissue damage, joint dysfunction, burn injury etc.), but also while trying to improve daily or athletic performance[3].

Dynamic Neuromuscular Stabilization (DNS) is a concept that continues to evolvein the field of rehabilitation. The idea of reflex locomotion explains that specific Involuntary motor reactionsor movement Patterns are observed when firm pressure stimulation is applied over certain zones in the Muscles. These movement patterns are Generic and were termed “global patterns”. The global pattern evoked from the prone position is called “reflex creeping,” while the one from supine or side lying is called “reflex rolling”[2]. According to Wickstrom, in healthy newborns (free of developmental Disorders), specific motor movements, such as grabbing, turning, crawling, and eventually walking, are developed automatically without any particular training. Evidently, the neuronal circuitry that guides these complex developmental Behaviours may be activated by stimulating Peripheral areas or zones. These zones are generally derived from balance and Stabilizing points during an infant’s Development. Professor Pavel Kolar employed Vojta’s concept for the Treatment and rehabilitation of athletes and termed it Dynamic Neuromuscular Stabilization (DNS). DNS works on the Principles of Developmental Kinesiology (DK).Dynamic Neuromuscular Stabilization (DNS) exercises, which focus on the functional integration of muscles and joints through developmental kinesiology, present a potential therapeutic approach to enhance hand muscle strength. Despite its theoretical benefits, there is limited empirical evidence on the effectiveness of DNS exercises in specifically strengthening hand muscles. This study aims to investigate the impact of DNS exercises on hand muscle strength, providing insights into its viability as a rehabilitation technique[4-6].

MATERIALS AND METHODS

Research Design: This study employed a quasi-experimental research design to investigate the impact of DNS exercises on hand muscle strength.

Research Setting: The study was conducted at PES Institute of Medical Sciences and Research (PESIMSR), Kuppam, Andhra Pradesh, India. This institutional setting provided access to the target population and the necessary research facilities. Ethical approval for the study was obtained from the school review board.

Duration of Study: The data collection period spanned one month from January 2024 to February 2024.

Research Population: The study population consisted of students enrolled at the PES Institute of Medical Sciences and Research (PESIMSR), Kuppam, Andhra Pradesh, India.

Sampling Method: APurposive sampling method was employed to select participants who met the predetermined inclusion and exclusion criteria. This non-probability sampling technique was chosen to ensure participants possessed the specific characteristics required for the study objectives.

Sample Size: A total of 20 subjects were recruited for the study.

Selection Criteria

Inclusion Criteria: Participants were included in the study if they met all the following criteria:

1. Age range: 19-24 years

2. Healthy female individuals with no underlying medical conditions

3. Right-handed dominance (confirmed through self-report)

4. Voluntary consent and willingness to participate in the study

5. Full range of motion and unrestricted gripping movements in both hands

Exclusion Criteria: Participants were excluded from the study if they presented with any of the following:

1. Current participation in any other treatment or intervention that could interfere with study results

2. Unwillingness to cooperate or complete the study protocol

3. Previous history of hand, wrist, or upper limb injuries

4. Diagnosed neuromuscular disorders affecting the upper limbs

5. Current pain or discomfort in wrist joints

6. Recent fractures (within the past 6 months) affecting the upper limbs

7. Known disabilities affecting hand grip strength or function

Data Collection Procedures: Data were collected through direct physical assessment using standardized measurement protocols. All measurements were conducted by trained researchers to ensure consistency and reliability.

Study ProtocolProcedure: Approval from the ethics committee was obtained, and recruitment of subjects was then carried out among PESIMSR students. Subjects who met the inclusion criteria were selected and then divided into a single group. Hand grip strength was recorded using a dynamometer as pre-test and post-test readings. Then the participant was asked to remove their shoes and any watches and or bracelets. They were shown how to hold the dynamometer for the participant by testing it on themselves and explaining how the dial registers the best result by squeezing as tightly as possible.

Pre-Test:Isometric grip strength was measured using a handheld dynamometer in the supinated position during testing. Participants were seated in an adjustable chair without armrests. The participant's posture was adjusted to maintain an upright supine position with the head in a Neutral position and eyesight oriented in a horizontal plane. The participant's shoulders were relaxed to maintain a neutral pelvis position, and the participant was instructed to bear weight on the ischial tuberosities. The hips were positioned at 90 degrees of flexion and slight abduction, with both feet supported on the ground. The tested arm was abducted along the trunk with 90-degree elbow flexion. To test hand grip strength, the supination forearm position was utilized. The participants were continually verbally encouraged by the researcher to develop maximum force (in Newtons), which was automatically displayed by the dynamometer after five seconds of isometric grip. Only the researcher was able to read the values, The participant could not read the values achieved. The measurements were taken before introducing the training program, and the last measurement occurred four weeks later [7].

Dynamic neuromuscular stabilization exercise intervention: DNS represents a novel rehabilitation strategy grounded in the principles of developmental kinesiology and the neurophysiological aspects of a maturing postural locomotor system. The DNS approach compares the individual's stabilizing pattern with the stabilization developmental pattern of a healthy infant. The treatment approach emphasizes training in natural postural and locomotion patterns, as defined by developmental kinesiology. The brain must be properly stimulated and trained to automatically activate optimal movement patterns necessary for the co-activation of stabilizers. This can be achieved by activating the stabilizers when placing the patient in developmental positions, as done in this study. The training group participated in a home-based training program twice a week for four weeks. Each training session consisted of six exercises performed in the following order: 1) prone static; 2) quadruped static; 3) quadruped dynamic rock forward; 4) bear position; 5) side-sitting with dominant arm support; and 6) side-sitting with non-dominant arm support. Overall, one exercise session took up to 25–30 minutes to complete, including 12 minutes of rest between each position. The following four

positions were used in the exercise program: 1) prone position, 2) for the prone static exercise; 2) quadruped position for the quadruped static and quadruped dynamic rock forward. Exercise: 3) side-sitting position. For the side sitting with dominant and non-dominant arm support exercise, and 4) "bear position" for the bear position exercise. When instructing the participants, the correct "functionally cantered" shoulder girdle (i.e., the position of maximum shoulder stability) and hand position were emphasized. Each participant had to be able to feel and recognize the functionally centered (correct) versus de-centered (incorrect) position of the shoulder girdle and hand, as well as adjust the position correctly. Then, for the actual exercise, the participant was asked to hold the proper position isometrically as long as possible. Once fatigue occurred and decentration of the hand, shoulder, or scapula emerged, the exercise in that position was terminated. Depending on fatigue, an exercise in one position took from approximately 30 to 120 seconds. The prone, side sitting, and bear positions represented are isometric static exercises. This dynamic modification was also exercised only as long as proper stereotyped shoulder girdle and hand stabilization were maintained[8,9].

Post Test: The post-test has been done in the same way as the Pretest after the intervention

Statistical Analysis: GraphPad software was used for the statistical analysis to analyze and interpret the data. The paired t-test was used for intragroup analysis, and the unpaired t-test was used for intergroup analysis.

RESULTS

Gender Distribution: The study included a total of 20 healthy young female participants, all of whom completed the four-week Dynamic Neuromuscular Stabilization (DNS) exercise program. Only female participants were chosen,ensuring sample homogeneity and eliminating any gender-dependent differences in handgrip strength that are typically observed in mixed-gender research. Every subject was a right-hander who did not have any upper limb musculoskeletal or neurological conditions during the assessment.

Age Distribution: The participants were aged 19-24 years with a mean age of 21.4 ± 1.7 years. This age group was chosen as it represents healthy young adults with optimal musculoskeletal and neuromuscular functioning. None of the respondents had any health problems or conditions that would affect the handgrip strength or performance within the intervention period. Throughout the research period, all respondents adhered to the recommended pace and intensity of the DNS exercises.

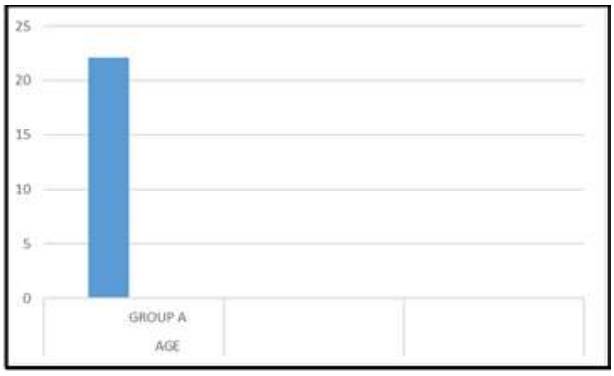

Fig. 2: Age Distribution of Study Participants

Intragroup Analysis: The intragroup comparison between the pre-test and post-test handgrip strength results showed a statistically significant improvement after four weeks of DNS-based exercises focused on stabilizing the shoulder girdle. Handgrip strength means and SD were enhanced, where 11.85 + 2.16kg before the test and 15.10 +2.31kg after the test. The average change was 3.25 ± 0.15 kg, representing a 27.4% strength gain at baseline. The paired t-test statistical analysis showed a very significant difference ($t = 11.72$, $p = 0.0001$, $p < 0.05$). These results demonstrate that Dynamic Neuromuscular Stabilization exercises targeting the shoulder girdle are effective in strengthening hand muscles in healthy young

individuals. The magnitude of the effect (Cohen's d = 2.7) indicates that it is large and has clinical significance, demonstrating that the intervention has led to significant neuromuscular adaptations within a relatively brief training duration.

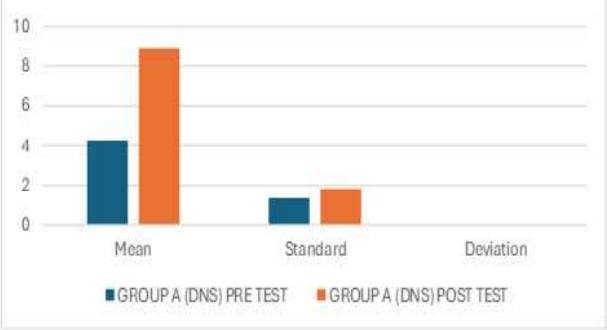

Fig.3: Intragroup Comparison of Handgrip Strength Before and After DNS Intervention

DISCUSSION

The movement of the hands is dependent on the three-dimensional mobility of the shoulder complex, which in turn depends on the coordinated action of the trunk muscles. Pectoralis major and latissimus dorsi move the forces of the arms to the thorax, and the serratus anterior and rhomboids stabilize the scapula, giving a point of attachment to the humerus. The imbalance in these stabilizers, like scapular winging, may lead to pain and loss of upper limb functionality [10].

This research experimentally demonstrated that balancing exercises targeting global trunk and shoulder coordination (Dynamic Neuromuscular Stabilization (DNS)) resulted in a significant enhancement of handgrip strength. Contrary to traditional approaches with resistance exercises, DNS focuses on optimal postural position and joint centration, which involves constant activation of the trunk and shoulder girdle muscles to strengthen distal hand functions.

Whereas Richards et al[11]. realized the best grip in a supinated forearm position; we registered the most significant gains in the neutral position, probably because they had a better trunk and scapular alignment. Other studies have also indicated an increase in grip strength after yoga and upper limb training; however, these have not specifically focused on scapular and trunk stabilization[12].

This research is unique in that the principles of developmental kinesiology are utilized to implement functional postural control, facilitating effective neuromuscular coordination along the kinetic chain. Shoulder girdle exercises involving DNS, therefore, improve neuromuscular control, stability, and the transmission of shoulder force to the hand, leading to an increase in the strength of the hand muscles. To confirm these findings, it is suggested that further studies using bigger and more diverse populations would be needed to investigate long-term adaptations.

CONCLUSION

This study concluded that the Dynamic Neuro-Muscular Stabilization exercise technique has an effect on improving hand grip strength in a group of healthy young individuals. Thus, the Dynamic neuro-muscular stabilization technique can be recommended to improve hand grip strength in healthy young individuals. We found consistent gains in hand grip strength, pointing to the utility of DNS in improving proximal shoulder girdle stability. This study provided evidence for the critical importance of the quality of the global trunk stabilizing pattern on distal extremity movement and strength.

Conflicts of interest: None

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