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Effect Of Structured Exercise Protocol VS Constraint Induced Movement Therapy on Shoulder Control in Post Stroke Individuals

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ABSTRACT

Background: Strokes are a leading cause of disability, often resulting in persistent motor deficits, particularly in the upper limb and shoulder. Regaining shoulder control is crucial for functional independence and quality of life. While Constraint-Induced Movement Therapy (CIMT) and Structured Exercise Protocol (SEP) have shown promise in enhancing motor function post-stroke, their effectiveness on shoulder control specifically remains unclear.

Methods: The sample size taken was 30 which was divided into 2 groups. Group A was given experimental treatment which included CIMT and conventional management. Group B was given only conventional management. The outcome measures used were STREAM and Fugl-Mayer scale. The pre and post assessment were taken on the first and last day respectively. The data was assessed using paired and unpaired t test for within and between the group analyses.

Result: - The baseline values of both the groups didn't show any statistical significant changes. But the post results of the experimental group showed a significantly large improvement in STREAM (p=0.03) and Fugl- Mayer Scale (p=0.01) results

Conclusion: This study shows that post-stroke patients can benefit from both structured exercise protocols and constraint-induced movement therapy in terms of shoulder control. Nonetheless, the findings imply that CIMT might be more successful in improving shoulder control, especially with regard to range of motion and motor function.

Keywords: *Constraint-Induced Movement Therapy (CIMT), Structured Exercise Protocol, Stroke, Shoulder control, Motor function..*

1. INTRODUCTION

Stroke ranks as the primary cause of disability in adults and the third largest cause of death. One of the most prevalent underlying disabilities following a CVA is upper limb hemiparesis. Lowering functional independence, upper extremity hemiparesis dysfunction affects the ability to accomplish numerous daily tasks, including dressing, bathing, writing, and self-care. Following a stroke, only 5% of adults regain full arm use, and 20% do not regain any functional use. One of the biggest issues in rehabilitation is getting the upper extremity that was damaged by the stroke back to full function. Therefore, other approaches are required to lessen the functional impairment and long-term difficulties brought on by upper extremity hemiparesis.[1] A stroke is characterized as an abrupt neurological outburst brought on by compromised blood vessel perfusion to the brain. Studying the clinical manifestation of a stroke requires an understanding of neurovascular anatomy.

Two internal carotids in the front and two vertebral arteries in the back (the circle of Willis) control blood flow to the brain. Hemorrhagic stroke results from bleeding or blood vessel leaks, whereas ischemic stroke is caused by insufficient blood and oxygen reaching the brain. Brain thrombosis and embolism are caused by ischemic occlusion. Vascular narrowing brought on vascular atherosclerosis affects blood flow in thrombosis. Plaque accumulation eventually causes the vascular chamber to narrow and clot, which results in thrombotic stroke. When blood flow to the brain is reduced, it causes extreme stress and premature cell death (necrosis), which results in an embolism in an embolic stroke. Loss of neuronal function, organelle enlargement and cellular contents seeping into extracellular space and plasma membrane rupture follow necrosis.[2]

The most common disability that leads to dysfunction following a stroke is weakness or paralysis. The absence of signal transmission from the motor cortex, which produces the movement impulse, to the spinal cord, which transmits the signals to muscles to carry out the movement, is the direct cause of it. There are detrimental functional effects as a result, including delayed muscular contraction initiation and termination, slow force development, and an inability to move or move fast.[3]

After a stroke, the American Heart Association recommends constraint-induced movement therapy (CIMT), an evidence-based method for restoring function and movement of injured upper extremities (UEs).In Three pillars form its foundation: behavioural techniques (transfer package) acquired during training and applied from the clinical setting to the patient's actual environment through functional activities (task practice); repetitive, intense, task-oriented training for several hours each day through small activities called shaping.[4]

According to physiological principles, the imbalance of transcallosal inhibitory circuits between the cerebral hemispheres' main motor cortex regions results in an increase in the excitability of the hemisphere that is less impacted, impairing arm function. A condition known as imbalance of the inter-hemispheric competition results from this, which causes an excessive inhibition of the most impacted hemisphere.[5] In physical rehabilitation, people with impaired upper extremity function can be treated with constraint-induced movement therapy (CIMT).The purpose of CIMT is to maximize or restore motor function by encouraging the use of the afflicted upper extremity.[6]

2. MATERIALS & METHODOLOGY:

The Ethical Committee and Protocol Committee authorized the research investigation (protocol number- 263/2024-2025). The research was an Interventional study involving 30 participants including both genders from the Neurosciences OPD of Krishna College Of Physiotherapy Karad. The research recorded the pre- and post-treatment values between the same group that lasted for a duration of 6 weeks. The goal of the study was to find the effect of structured exercise protocol VS constraint induced movement therapy on shoulder control in post stroke individuals, to evaluate the effect of physiotherapy on patients on shoulder control in post stroke individuals. And to explore the experiences and perceptions of patients and health care providers regarding physiotherapy interventions.

This study was executed according to the established inclusion and exclusion criteria. Participants were informed about the nature of the study, its duration, and the intervention used in their preferred language. This study included subjects diagnosed with Middle Cerebral Artery Stroke with Right or Left hemiplegia in age Adult [above 30] years, with a Upper limb impairment [Moderate to severe hemiparesis] recorded during the first visit, and with an Brunnstrom recovery stage :- Stage 3,4,5,6. Additionally, those who can provide informed consent or have a legally authorized representative were included. Patients who are not terminally sick, have serious cognitive impairment, or are under the age of 30 years. Subjects Any Medical condition.[Severe arthritis, Traumatic brain injury, Disability, Fracture etc] were excluded from this study. This study was conducted on 30 subjects with Middle Cerebral Artery Stroke with Right or Left hemiplegia of Neurosciences OPD of Krishna College Of Physiotherapy Karad . Informed consent was taken from the study participants & baseline data was collected. Pre-assessment was done regarding shoulder assessment, Neurological assessment and Functional assessment of patients. They were assessed with Stroke Rehabilitation assessment of Movement [STREAM] and Fugl-Meyer Assessment: Upper Extremity [FMA-UE].The study evaluated an overall 30 individuals, they met eligibility criteria and provided their consent to participate. The individuals taking part in the research were assigned to a group, who received a preset structured physiotherapy protocol for 6 times a week for 60 mins; for 6 weeks duration.

A structured rehabilitation protocol was implemented six times a week for 60 minutes over six weeks duration. The treatment plan was progressively designed as follows:

- In **Week 1 and 2 - CIMT for 1 week 2 hours, CIMT for 2 week 4 hours, VCG shoulder grade for shoulder and elbow 3 and 4A training-** Close kinematic chain [Shoulder flexion extension ,Elevation depression , Elbow flexion extension],Active assisted ROM exercises for all joints of upper limb in gravity eliminated plane, Facilitatory techniques for antagonist muscles, Inhibitory techniques for agonist muscle while performing all joint movements of upper limb,Tapping for antagonist muscle group [for ex extensors]Heavy joint compression [weight bearing exercises for upper limb] Sustained stretch [Antispastic upper limb stretch], Isometrics of shoulder, Scapular movements [Elevation depression Protraction and retraction],Shoulder isometrics, Triceps facilitation,RIMP exercise for upper limb,Mat exercises Quadripod weight shifts ant-post and lateral,Gym wrist mover
- In **Week 3 and 4 - CIMT for 3 week 5 hours, CIMT for 4 week 6 hours, VCG group for shoulder and elbow 4B, 4C, 5A**- Close kinematic chain [Shoulder flexion extension Elevation depression , Elbow flexion extension],Active assisted ROM exercises for all joints of upper limb in gravity eliminated plane , Facilitatory techniques for antagonist muscles Inhibitory techniques for agonist muscles while performing all joint movements of upper limb, Tapping for antagonist muscle group [for ex extensors],Heavy joint compression [weight bearing exercises for upper limb],Sustained stretch [Antispastic upper limb stretch] Isometrics of shoulder,Scapular movements [Elevation depression Protraction and retraction] Shoulder isometrics,Triceps facilitation ,RIMP exercise for upper limb ,Mat exercises Quadripod weight shifts ant-post and lateral, Gym wrist mover, Active resisted exercise in the available range followed by active assisted in the remained of the range,Wrist and finger ROM exercise in gravity eliminated plane Task oriented approach for wrist extension and finger extension
- In **Week 5 and 6 - CIMT for 5 week 5 hours, CIMT for 6 week 6 hours, VCG Grade for shoulder and elbow 5B, 5C-** Close kinematic chain [Shoulder flexion extension Elevation depression , Elbow flexion extension],Active assisted ROM exercises for all joints of upper limb in gravity eliminated plane ,Facilitatory techniques for antagonist

muscles,Inhibitory techniques for agonist muscles while performing all joint movements of upper limb,Tapping for antagonist muscle group [for ex - extensors],Heavy joint compression [weight bearing exercises for upper limb],Sustained stretch [Antispastic upper limb stretch],Isometrics of shoulder,Scapular movements [Elevation depression Protraction and retraction],Shoulder isometrics ,Triceps facilitation ,RIMP exercise for upper limb ,Mat exercises Quadripod weight shifts ant-post and lateral,Gym wrist mover Active resisted exercise in the available range followed by active assisted in the remained of the range,Wrist and finger ROM exercise in gravity eliminated plane ,Task oriented approach for wrist extension and finger extension,RIMS exercises ,Mat exercises Kneeling Kneel sitting

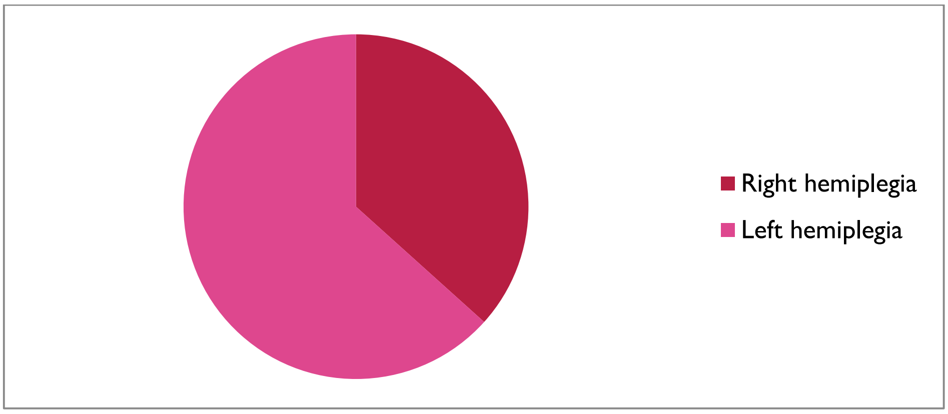
3. RESULTS:

Statistical analysis:

Descriptive statistics was performed to analyse the mean and standard deviation of the outcome measure which was chosen. Inferential statistics to find out the difference between the groups was done using Mann Whitney u test and within group analysis was done using Wilcox on sign rank test.

Informed consent: The informed consents had been obtained from all individuals who were involved in this research.

Graph 1- Affected side-wise distribution of stroke individuals



Interpretation:

The study's participant demographics revealed a notable affected side imbalance, with a significantly higher proportion of left hemiplegic participants compared with the right side hemiplegic participants.

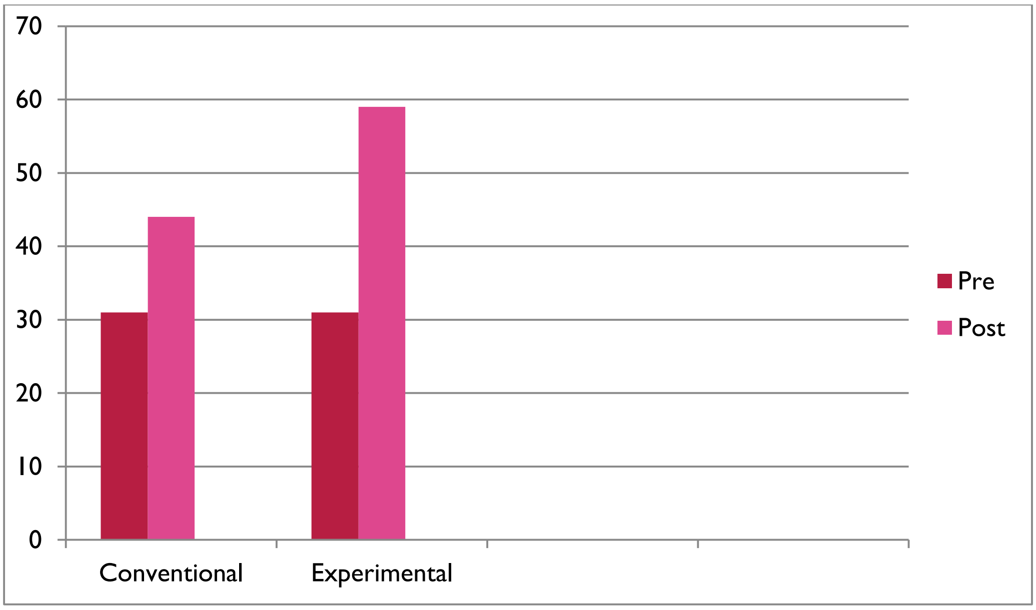


Table 1	Conventional	Experimental	P- Value
STREAM PRE	31.07± 2.645	47.6± 4.867	
STREAM POST	32 ±2.645	59.9± 5.385	0.05

Table 1 and graph 2 shows the pre and post values of the STREAM scale used to analyse the pre and post values while administrating the conventional and experimental treatment protocol in post stroke survivors with a mean and SD of 59.9± 5.385 for the post outcome in the experimental group with a p value of <0.05.

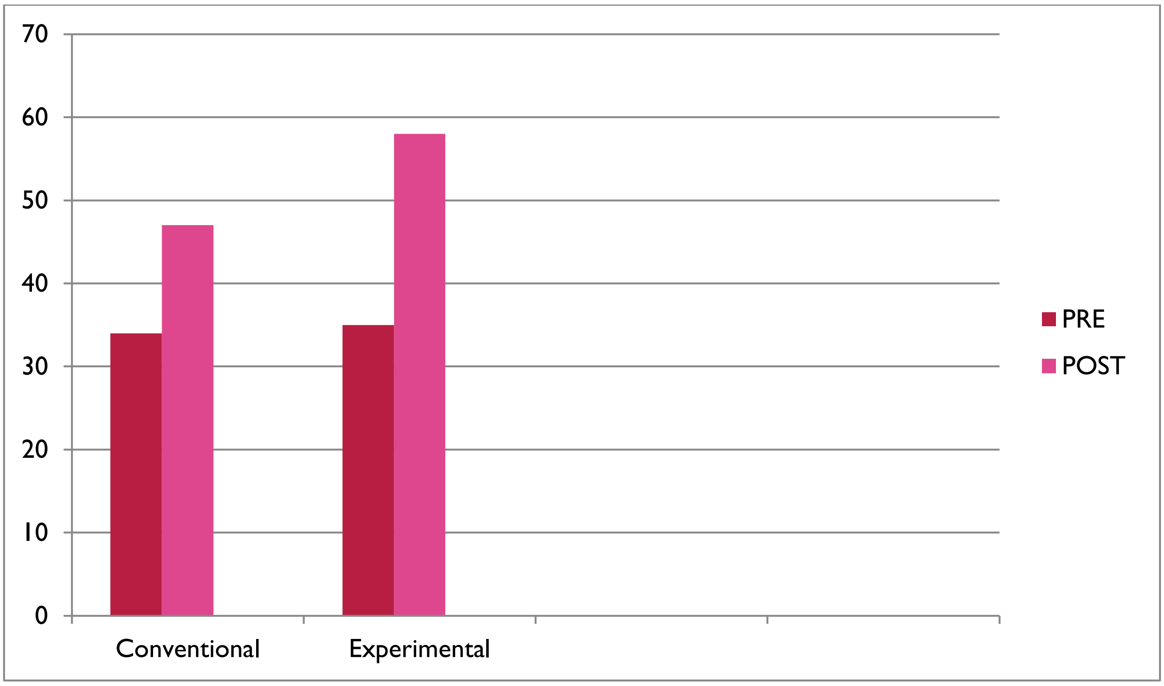


Table 1	Conventional	Experimental	P- Value
FUGL MAYER PRE	36.07± 2.845	45.6± 4.432	
FUGL MAYER POST	37 ±3.785	64.1± 5.061	0.05

Table 2and graph 3 shows the pre and post values of the FUGL MAYER scale used to analyse the pre and post values while administrating the conventional and experimental treatment protocol in post stroke survivors with a mean and SD of 64.1± 5.061 for the post outcome in the experimental group with a p value of <0.05.

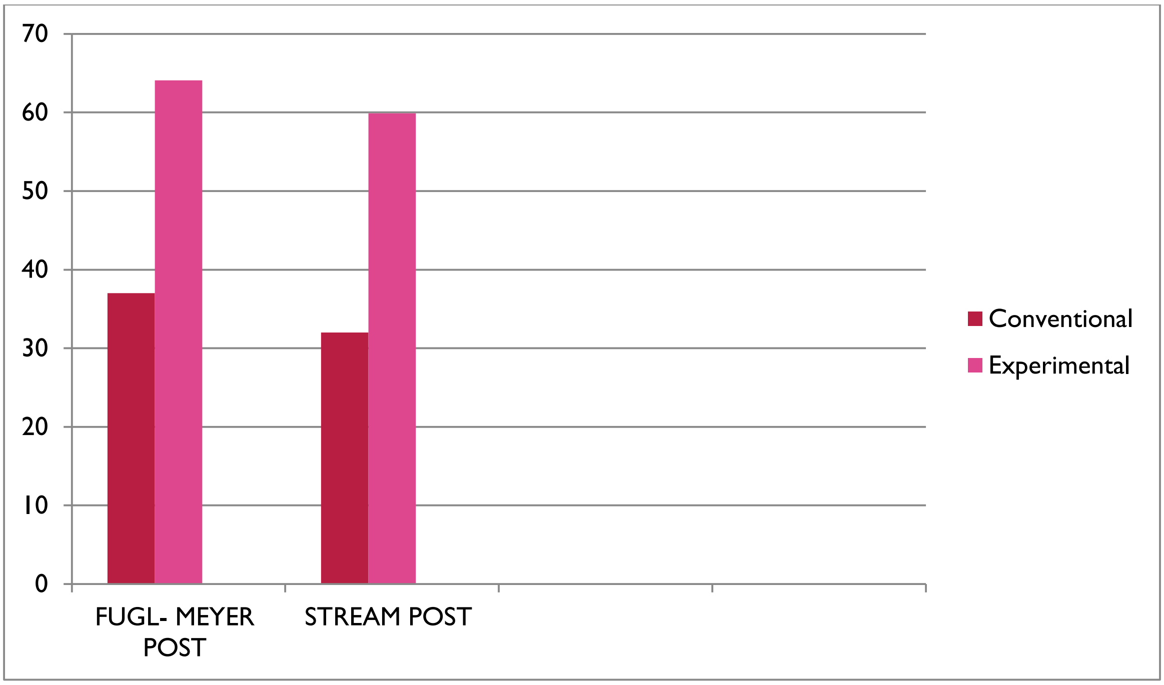


Table 3	Conventional	Experimental	P- Value
FUGL- MEYER POST	37±3.785	64.1± 5.061	0.05
STREAM POST	32 ±2.645	59.9± 5.385	0.05

Table 3 and graph 4 shows the post values STREAM and post values of the FUGL MAYER scale used to analyse the post values while administrating the conventional and experimental treatment protocol in post stroke survivors with a mean and SD of 64.1± 5.061 for fugl-meyer post and mean and SD of 59.9± 5.385 for STREAM post outcome in the experimental groups with a p value of <0.05.

4. DISCUSSION

To evaluate the impact of Constraint-Induced Movement Therapy (CIMT) and Structured Exercise Protocol (SEP) on enhancing shoulder control in stroke survivors. When comparing the effects of Constraint-Induced Movement Therapy (CIMT) and Structured Exercise Protocol (SEP) on shoulder control in stroke survivors, it is clear how important customized rehabilitation strategies are. While both SEP and CIMT show promise in developing shoulder control, CIMT might be more advantageous in terms of increasing motor function and range of motion. CIMT's emphasis on rigorous, task-specific practice and limb restraint may promote increased neuroplasticity and functional improvements, according to this. The severity of the stroke and individual differences, however, may affect the course of treatment, highlighting the necessity of individualized rehabilitation techniques.

In contrast to conventional self-range of motion exercises, continuous passive motion (CPM) devices may enhance shoulder joint stability and lessen pain and tone in hemiplegic arms following a stroke.[7] Patients with chronic stroke who received Active-Passive Bilateral Therapy (APBT) saw long-lasting improvements in upper limb motor function as well as targeted, long-lasting alterations in motor cortex inhibitory function. We hypothesize that APBT might have helped the brain's plastic reconfiguration in reaction to motor treatment.[8] In chronic stroke patients, core strengthening and pelvic PNF improve trunk dysfunction, balance, and gait more effectively than trunk flexibility treatments alone.[9] The use of Reflex Inhibitory Splints (RIS) has been shown to be effective in reducing elbow and finger flexion tonus, increasing active wrist extension angle, and managing upper-limb spasticity following a stroke.[10]

Through increased range of motion and flexibility, shoulder muscle strengthening, improved proprioception and motor control, decreased muscular stiffness, and neuroplasticity, the structured exercise regimen can aid stroke patients in regaining shoulder control. Patient movement patterns can be improved by lowering stiffness and inflammation and boosting joint mobility. Rotator cuff muscle strengthening improves endurance and stability, enabling more controlled motions. Patients are able to feel and coordinate their motions more effectively when they have improved proprioception and motor control.

The Passive Range of Motion (PROM) for Shoulder joint stiffness is decreased and flexibility is increased with exercise. PROM exercises improve blood flow and lower inflammation.

The rotator cuff and other shoulder muscles are strengthened using Close Kinematic Chain (CKC) exercises. Joint stability and proprioception are enhanced by CKC exercises. The shoulder muscles become stronger and more resilient through the use of shoulder isometrics and heavy joint compression. Shoulder isometric exercises and heavy joint compression improve proprioception and joint stability.

Scapular movement and sustained stretch improve scapular mobility and stability. Muscle balance and spasticity are improved via inhibitory and facilitatory techniques. Activities that improve motor control and coordination include inhibitory and facilitatory techniques. The goal of this planned exercise program is to help stroke survivors gradually increase their shoulder control.

Stroke patients may benefit from therapy that combines electrical stimulation and the Bobath inhibitory technique to effectively reduce stiffness.[11] All things considered, the results of this study highlight how crucial it is to create thorough rehabilitation programs that take into account the various requirements of stroke victims. Rehabilitation specialists can assist stroke victims in regaining their independence in ADL and enhancing their general quality of life by implementing dual-task techniques and task-oriented proprioceptive training.[12] Home-based combined exercise programs yield the best long-term outcomes for increasing social participation in stroke survivors, whereas motor relearning programs are the most effective for enhancing immediate social involvement.[13]

For stroke survivors, Constraint-Induced Movement Therapy (CIMT) improves motor function, increases neuroplasticity, and improves functional capacity. By encouraging the injured limb to be used, it helps people overcome taught non-use and encourages the brain to reorganize in order to make up for damaged areas. Constriction of the unaffected limb forces the affected limb to be used, improves motor learning, and encourages brain adaptation, all of which improve cognitive function and everyday life tasks.

After an ischemic stroke, CIMT increases dendritic arborization and reestablishes axonal connections between the hemispheres, hence improving the quality of fine movements and effectively restoring damaged skilled movements.[14]

The results of studies have consistently demonstrated that following treatment and at long-term follow-up, both the original and modified forms of Constraint-Induced Movement Therapy (CIMT) show positive impacts on motor function, arm-hand activities, and self-reported arm-hand functioning in day-to-day living.[15] In patients with chronic stroke, modified constraint-induced therapy (mCIMT) considerably improves more afflicted arm use and function as compared to a time-matched exercise program or no-treatment control.[16] The use of modified Constraint-Induced Movement Therapy (mCIMT) has been shown to be beneficial for chronic stroke patients, offering an effective way to regain function and use of the more impaired arms, with regaining function requiring frequent, task-specific practice.[17]

Future studies should concentrate on quality of life, dose-response interactions, neuroimaging, home-based programs, long-term follow-up, comparative efficacy trials, and customized care. The development of evidence-based rehabilitation strategies to improve shoulder control in stroke survivors will be aided by these studies.

5. CONCLUSION

This study shows that both Constraint-Induced Movement Therapy (CIMT) and Structured Exercise Protocol (SEP) are useful for enhancing shoulder control in stroke survivors. CIMT, however, demonstrates more gains in shoulder motor function and range of motion. The results underline the significance of customized and evidence-based rehabilitation techniques by indicating that CIMT may be a more successful rehabilitation approach for improving shoulder control in stroke survivors.

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