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Effectiveness of Finger Expander Exerciser Along with Conventional Physiotherapy in Chronic Stroke Patient: A Case Study

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Abstract

Background: Stroke, an acute cerebrovascular disease, results from either a sudden rupture of intracranial vessels or vascular obstruction, leading to brain tissue damage. Post-stroke, many individuals suffer from spasticity, a motor dysfunction characterized by excessive muscle tension in the hands and feet. Hand impairments are prevalent, with many patients experiencing long-term disability. Understanding the complex neurophysiological mechanisms of hand function recovery is crucial for developing effective rehabilitation interventions. Devices like finger expanders and conventional physiotherapy techniques are essential for enhancing grip strength, dexterity, and overall hand function in stroke survivors.

Objective: To evaluate the effectiveness of a finger expander exerciser in conjunction with conventional physiotherapy on hand function in a patient with chronic stroke.

Methodology: A 60-year-old male patient with chronic stroke participated in the study. The intervention consists of 30-45 minute therapy sessions, 6 days a week, over 6 weeks. The patient performed exercises using a finger expander exerciser in addition to received conventional physiotherapy. Outcome measures included Fugl-Meyer Assessment (FMA) for motor function, and a hand-held dynamometer for grip strength and range of motion.

Results: Post-intervention assessments demonstrated improvements in motor function, as indicated by increased Fugl-Meyer Assessment scores. Grip strength, measured by the handheld dynamometer, showed a marked enhancement. Additionally, range of motion in the affected hand improved notably, contributing to better overall hand functionality.

Conclusion: The study concluded that finger expander exerciser and conventional physiotherapy improved motor function, grip strength, and ROM in a chronic stroke patient. This case study suggests that incorporating specific hand-strengthening exercises may be a beneficial adjunct to standard stroke rehabilitation protocols.

Keywords: Stroke,Finger expander, Grip strength,ROM

INTRODUCTION

Stroke is an acute cerebrovascular disease caused by sudden rupture of intracranial vessels or vascular

obstruction preventing blood from flowing into the brain and thereby leading tobrain tissue damage. Based on its pathological pattern, stroke can be classified into ischemicstroke (IS) and hemorrhagic stroke (HS). The Global Burden of Diseases, Injuries, and Risk Factors Study 2017 (GBD 2017) reported that stroke resulted in 6.17 million deaths and is the second leading cause of death and disability worldwide[1]

Motor impairment at the hand is common after stroke. At 6 months after severe stroke, one third of people develop wrist and hand contracture (loss of passive joint range of motion) and more than 50% of people with hand impairments do not regain function. The loss of functional hand movement is disabling and can persist for many years. The neurophysiological mechanisms underlying the recovery of hand function are complex, interdependent, and occur at different periods of time after onset of stroke. For example, hand impairments in chronic stroke are related in part to a decreased ability to control voluntary muscle activity and the abnormal recruitment of contralateral cortico- reticulospinal pathways. Greater understanding of the mechanisms of recovery after stroke is needed to develop effective interventions to improve hand function after stroke.[2]

A finger expander exerciser is a device designed to strengthen and rehabilitate the muscles and tendons in the fingers, hands, and forearms. It typically consists of a series of springs or elastic bands connected to individual finger loops, allowing users to perform various resistance exercises to improve grip strength, dexterity, and overall hand function. These exercisers are commonly used by athletes, musicians, and individuals recovering from hand injuries or conditions such as arthritis.[3]

Conventional physiotherapy plays a crucial role in hand rehabilitation by focusing on restoring function, mobility, and strength to the hands and upper extremities. Conventional physiotherapy employs a variety of techniques including exercises, manualtherapy, splinting, and education to address conditions such as hand injuries, post-surgical rehabilitation, arthritis , tendonitis, and nerve disorders.[4]

CASE STUDY

A 60-year-old male patient presented with a chief complaint of difficulty in opening his left hand, which has persisted since he experienced an ischemic stroke in 2019. This impairment has severely impacted his ability to perform daily activities and maintain functional independence. The patient specifically reports difficulty in extending his left ring finger and little finger. Patient exhibits a frozen shoulder on the left side, a hemiplegic gait, and muscle weakness in both the upper and lower limbs on the left side. On the initial assessment using Fugl-Meyer Assessment(FMA)Scale, the patient showed partial dysfunction, range of motion being reduced at thumb, ring and little finger. The patient demonstrates a grip strength of up to 5 kg as measured by a hand-held dynamometer.

To establish a supportive environment, the therapist initially held the patient's hands, providing physical assistance and guidance throughout the session. The finger expander device was given to the patient, guiding the process of wearing it correctly. With the device in place, the therapist encouraged the patient to engage in finger expander exercises, promoting increased strength and flexibility in the fingers.

Moving on to wrist and hand exercises, a series of controlled movements including wrist flexion and extension, wrist circling exercise, and peg board exercises was given for the patient. These exercises are crucial for improving wrist mobility and stability, wrist and hand range of motion and coordination promoting greater flexibility of the wrist and fingers. By focusing on these key areas, the therapist aims to optimize rehabilitation outcomes and promote greater independence and functionality for the patient.

Figure:1 The patient wear finger expander exciser.

As shown in Figure 1: The patient wears a finger expander exerciser, a device designed to facilitate finger extension and strengthen the muscles responsible for the hand movement. During the use of finger expander exerciser as the patient opens his hand, the expander exerts a gentle outward force, causing the device to expand and consequently opening the ring and little fingers. This expansion occurs through the elastic resistance provided by the device, which gradually stretches the muscles and tendons associated with finger extension. As a result, the patient is able to perform exercises aimed at improving the range of motion and strength in the affected fingers. The controlled resistance provided by the expander enables targeted rehabilitation of the specific muscle groups responsible for finger extension, contributing to improved functional abilities and overall hand function over time.

RESULT

A handheld dynamometer was used to measure the muscle strength before and after a treatment or intervention. Initially, the muscle strength was recorded as 5 PRR (Peak Repetitive Response). Following the treatment, the muscle strength increased to 8.7 PRR.

The Fugl-Meyer Assessment (FMA) was used to evaluate motor function before and after treatment. Before treatment, the assessment indicated partial recovery of motor function, After treatment, the FMA results demonstrated a complete recovery of motor function in all the four areas of the upper extremity function namely Stability at 15^0 wrist extension with elbow at 90^0, Repeated wrist extension or flexion with elbow at 90^0, Stability at 15^0 wrist extension with elbow 0^0 and Wrist circumduction. This improvement highlights the effectiveness of the treatment in restoring motor ability.

Table-1Range of Motion

Joint	Action	Pre-Range of Motion	Post-Range of Motion
	Flexion	0-76	0-89

Wrist		Extension	0-60	0-78
		Radial Deviation	0-6	0-13
		Ulnar Deviation	0-20	0-34
Thumb	IP	Hyper Extension	0-2	0-5
		Flexion	0-52	0-67
	MCP	Hyper Extension	0	0
		Flexion	0-40	0-56
Index Finger	DIP	Extension	0-8	0-15
		Flexion	0-68	0-79
	PIP	Extension	0	0
		Flexion	0-86	0-100
	MCP	Hyper Extension	0-25	0-34
		Flexion	0-75	0-88
Long Finger	DIP	Extension	0-10	0-20
		Flexion	0-65	0-79
	PIP	Extension	0	0
		Flexion	0-90	0-102
	MCP	Hyper Extension	0-20	0-37
		Flexion	0-73	0-85
Ring Finger	DIP	Extension	0-12	0-19
		Flexion	0-67	0-80
	PIP	Extension	0	0
		Flexion	0-82	0-94
	MCP	Hyper Extension	0-16	0-29
		Flexion	0-68	0-86
Little Finger	DIP	Extension	0-9	0-14
		Flexion	0-55	0-75
	PIP	Extension	0	0
		Flexion	0-83	0-96
	MCP	Hyper Extension	0-25	0-33
		Flexion	0-58	0-80

There was an increase in range of motion (ROM) in both the wrist and all fingers following treatment. Prior to treatment, wrist flexion ranged from 0 to 76 degrees. Post-treatment, wrist flexion increased to a range of 0 to 89 degrees, marking improvement of 13 degrees. Similarly, ROM for all fingers showed a comparable increase. These findings underscore the effectiveness of the treatment in enhancing flexibility and movement in the wrist and fingers. Additionally, ROM for the little finger exhibited notable enhancements: DIP extension increased from 0-9 degrees pre-treatment to 0-14 degrees post-treatment, while flexion improved from 0-55 degrees to 0-75 degrees, respectively. These findings demonstrate significant enhancements in ROM following the prescribed treatment regimen.(Table-1)

DISCUSSION

The patient attended regular physiotherapy sessions at the department. Each session lasted for 30 to 45 minutes over a period of 6 weeks. During the initial stage of the treatment, the therapist allocated approximately 10 minutes to educate the patient about finger tightness and the utilization of a finger expander. This session also covered the benefits of conventional therapy, emphasizing the advantages of stretching exercises in improving range of motion and overall finger flexibility.Following this, the patient underwent conventional physiotherapy sessions over the course of six weeks. These sessions focused on range of motion exercises aimed at increasing flexibility and mobility in the fingers. Each exercise was carefully selected and guided by the therapist to ensure proper form and technique. Throughout the six-week period, the therapist closely monitored the patient's progress and made necessary adjustments to the treatment plan as needed. The sessions were designed to gradually increase the intensity and difficulty to facilitate optimal improvement in finger function and mobility. Overall, the combination of education, tailored exercises, and ongoing guidance from the therapist contributed to the patient's rehabilitation journey, ultimately leading to improved finger function and reduced tightness. The structured nature of the sessions, combined with ongoing guidance from the therapist, facilitated measurable improvements in the patient's finger wrist and finger function. The education provided at the beginning of the treatment fostered a better understanding of the exercises and their benefits, which likely contributed to the patient's adherence to the therapy regimen. The gradual progression of exercises helped in achieving optimal gains in finger mobility and flexibility. Overall, the combination of targeted education, tailored exercise interventions, and continuous therapist support led to significant improvements in the patient's finger function. The structured and progressive nature of the therapy was effective in addressing the finger tightness. . The Fugl-Meyer Assessment showed a transition from partial to complete motor function recovery post-treatment. Additionally, grip strength measured by a hand-held dynamometer increased from 5 kg before treatment to 8.7 kg after treatment.

CONCLUSION

The study concluded that the use of a finger expander, in conjunction with conventional physiotherapy is effective in improving motor function and strength in chronic stroke patients. These study suggest that incorporating a finger expander into rehabilitation programs can enhance recovery outcomes for chronic stroke patients.

Conflict of interest: None

LIMITATION

The study's results may be constrained by the simple case study design and the absence of follow-up beyond the six-week intervention period. Challenges such as restricted resources or infrastructure could also have restricted the ability to employ more robust study designs or conduct comprehensive assessments.

FUTURE SCOPE

Continuing the study to evaluate how treatment effects persist beyond the initial six-week intervention period could offer valuable insights into the lasting advantages of finger expander exerciser for chronic stroke patient. Investigating whether specific patient subgroups, such as those with different stroke

severities or demographic characteristics, exhibit diverse response to finger expander exerciser combined with conventional physiotherapy, could facilitate the development of personalized rehabilitation approaches tailored to individual stroke patient.

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