

Review of Literature on the Effect of Constraint induced Movement Therapy along with Proprioceptive Neuromuscular Facilitation in Upper Limb Fine Motor Skills in Chronic Stroke Patients

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Abstract: ***Aim:** Patients with chronic strokes are most frequently impacted by upper limb dysfunction over a prolonged period of time, which further contributes to a person's deterioration of fine motor skills. This review's objective was to assess the literature and studies on the effects of CIMT and PNF on the upper limb fine motor skills of chronic stroke patients. **Methods:** A thorough search using the keywords constraint-induced movement therapy, proprioceptive neuromuscular facilitation, upper limb, fine motor skills, chronic stroke, dexterity, sollerman-hand function test, box and block test, post-stroke, rehabilitation, AND, OR, IN was conducted in the databases of PubMed, PEDro, and Google Scholar. Since 2007, case-control trials, comprehensive reviews, meta-analyses, randomized control trials, and quasi-experimental studies. **Results:** There were 13 studies in total. According to this review's findings, CIMT and PNF have both significantly improved the fine motor abilities in the upper limbs of chronic stroke patients. **Conclusions:** the conclusion from the analysis of this review, that when PNF (Proprioceptive Neuromuscular Facilitation) is applied in combination with CIMT (Constraint Induced Movement Therapy) can exemplify the favorable impacts and results in improving the upper limb fine motor skills. **Implications:** By combining CIMT and PNF and designing them in a way that enhances a person's dexterity, we can maximize the process of development for upper limb fine motor skills in chronic stroke patients.*

Keywords: CIMT, PNF, chronic stroke, upper limb

1. Introduction

- 1) Stroke is currently the foremost weakening of all medicine diseases, inflicting harm, incapacity and in some cases, death.
- 2) For decades the definition of stroke has been supported the United Nations Agency (World Health Organization) definition from 1980, that is “rapidly developed clinical signs of focal (or global) disturbance of cerebral operate, lasting quite twenty four hours or resulting in death, with no apparent cause aside from of vascular origin”. [1] [2]
- 3) Stroke is that the second reason behind death, inflicting some 116 million individuals worldwide to be disabled or impaired. The bulk of strokes occur in developing countries or generally called developing countries.

Impairments are classified as follows by the International Classification of Functioning, Disability and Health (ICF):

- a) Impairments of biological process i. e., loss of functions associated to neuromusculo skeletal or movement, like impairments associated with muscle power, tonus.
- b) Body structure issues, like changes within the nervous system's structure or movement connected structures like arm and hand.

As a result, a stroke victim could expertise each variety of impairments. [3]

- The contralateral upper limb hemiparesis is that the most current complication of stroke and it causes upper extremity motor impairment such as muscle weakness or contracture, changes in muscle tone, joint negligence, attenuated motor control, and impaired fine motor abilities. This has an impact on the individual's activities of daily living. [4]
- Upper extremity pathology is tougher to treat than lower extremity dysfunction. What is more, some individuals attempt to utilize their unaffected arm, which causes additional contracture and deterioration of the affected side. They merely forget a way to begin movement from the gashed aspect.
- As a result, appropriate treatment procedure ought to be initiated to forest all permanent incapacity, notably within the acute or moderate phases. In step with behavioral study, the useful implications that induce upper limb function impairment are learned nonuse, learnt bad-use and forgetting (*in step with Preeti Raghavan*).

CIMT (Constraint Induced Movement Therapy)

- Constraint Induced Movement Therapy (CIMT) is a rehabilitation technique that is primarily used to promote

the functional use of weaker arm in a variety of neurological conditions involving sensorimotor deficiency.

- It entails Intensive Motor Training, particularly for the arm afflicted by the stroke, as well as limiting the usage of unaffected side. [5]

PNF (Proprioceptive Neuromuscular Facilitation)

- Due to sensorimotor impairment in upper limb, individual is unable to do voluntary movements, in which individual should know to initiate movement with the help of several muscle groups, so proprioceptive neuromuscular facilitation (PNF), plays a great role in training the patient to know how to initiate the movement and helps in training the motor control of the arm that is affected or also having impaired function.
- This rehabilitation technique was originally developed by Dr. Herman and Dr. Margaret Knott in 1950.
- It aims at engaging the proprioceptive system thereby activating or facilitating the neuromuscular system and thus helping in producing the desired movement and motor function. [6] [7]

So, basically both CIMT and PNF work on Neuroplasticity Phenomenon. [8] [9]

2. Methodology

- 1) Relevant studies from 2000 to 2022 were obtained from the following databases: Google Scholar, PubMed, and PEDro, cochrane library using keywords such as Stroke, motor impairment, upper extremity motor dysfunction, fine motor skills, pnf stretching, constraint induced movement therapy (CIMT).
- 2) Total 111 articles came out in search results out of which few were selected which met the following inclusion criteria:

- Published in English.
- Published from 2000-2022
- Sample population with acute and chronic stroke even after 9 to 10 months of the post stroke
- Articles discussing the effectiveness of pnf stretching in upper limb motor dysfunction post stroke.
- Articles discussing about the effectiveness of CIMT In improving upper limb motor impairment that further improves fine motor skills of the post stroke patients.
- Articles discussing about the combined or comparative studies between the pnf stretching and CIMT along with the conventional therapy in stroke patients

Exclusion Criteria

- Articles which discuss other than the upper limb motor dysfunction and fine motor skills development were excluded.
- Considering the inclusion criteria, out of 21 articles, 8 were included and explained.

Objectives

- To evaluate the efficacy of Proprioceptive neuromuscular Facilitation in improving the motor function and therefore improving fine motor skills of the upper limb of stroke patients in order to enhance their quality of life.
- To review and evaluate the effectiveness of CIMT on improving the fine motor skills of the upper limb of stroke patients.
- To evaluate the combined effects of PNF and CIMT in improving the fine motor skills of the upper limb in stroke patients.

3. Review of Literature

Sl. No.	Authors	Study design	Participants no.	condition	Treatment	Control group	Outcome measures	Result
1	Deepak Joshi & Jeba Chitra [10]	RCT	30	Hemiplegic patients	Scapular PNF on shoulder pain, ROM and upper extremity function	Nil	VAS, Shoulder ROM, Fugl Meyer Motor Assessment, lateral scapular slide test	Significant changes seen in scapular movement, ROM and also Improvement in UE function.
2	Zakrzewska Marlina, et al [11]	Experimental study	100	Ischemic stroke	PNF methods	50	MRS, Brunnstrom scale, functional index repty, RMA	About 40% disability decreased, more than 60 to 70% improvement in mobility of upper limb seen
3	Poonam Chaturvedi, et al [12]	RCT	90	Acute stroke	Early PNF	Nil	BI & QOL	Early implication PNF showed improvement in the motor scores and functional activities
4	Md Aliyu Abba, et al [13]	Quasi Experimental study	30	Upper limb function of Chronic stroke	Comparing CIMT & PNF	Nil	FMA	CIMT and PNF both were proved to be effective in improving upper limb function, but CIMT shows more significancy than PNF
5	Steven L Wolf, et al [14]	EXCITE Trial	106	Stroke patients	Effects of CIMT	Nil	WMFT, MAL	The intervention showed substantial improvement in mild-to moderately impaired post stroke patients.
6	Suellen M. Andrade [15]	Pilot RCT	60	Severe stroke	CIMT along with transcranial direct current stimulation	20	BI, FM, MAS, Box and Block test, MRC	Significant improvement shown in functional independence, in premotor and primary motor group

7	Varun Y, Vasudha, et al [16]	RCT	40	Sub-acute stroke patients	Modified CIMT along with hand arm bimanual induced therapy	Nil	FM & ARAT	Significant improvement in hand function shown in the group getting mCIMT
8	Michel, Verena, et al [17]	Experimental study	26	stroke	CIMT	Nil	Frenchay arm test, 9-hole peg test	After taking CIMT, group of people significantly get improved
9	Dae – Hyouk, et al [18]	RCT	24	Subacute stroke patients with moderate impairment	Action observation along with mCIMT	12	FMA-UE, ARAT, MBI, QOM	Significant improvement seen in experimental group with so many changes shown in posttest
10	Sharon Hakkennes and Jennifer L [19]	SR of RCT	Nil	Stroke	Effects of CIMT	Nil	PEDro scale	Use of CIMT is effective in improving upper limb function and so improving the quality of life of an individual.
11	Manting Cao, et al [20]	SR	Nil	Stroke	Effectiveness of applying mCIMT	Nil		Considering mCIMT as part of treatment protocol helps in improving upper limb function in stroke patients.
12	Christer Sollerman, et al [21]		59	tetraplegic	Assessment of hand function by using standardized testing method.	Nil		The sollerman hand function test is effective, reliable and reproducible in order to assess the patient's hand functions generally used for their activities of daily living.
13	Ratanapat Chanubol, et al [22]		40	Subacute stroke	Determine correlation between ARAT and BBT used for assessing upper extremity functions	Nil	Pre-post treatment ARAT and BBT scores	Both the assessment methods were valid for assessing the dexterity of stroke patients, but BBT seems more suitable means for UE function assessment especially in mildly to moderately affected stroke patients.

4. Discussion

Following the stroke, both PNF and CIMT have provided beneficial results in improving dexterity, fine motor skills and overall hand functions depending upon the stroke type and the severity of the condition. There are many studies or articles showing the effective results of either of the interventions but not so many articles on chronic stroke conditions are published.

Different RCTs by different publishers have been shown in this review on either of these interventions and also have shown the improved and effective results in improvement of hand functions.

Like RCT by *Deepak Joshi* et al. found that PNF when applied in chronic stroke condition showed statistically improved function of scapula, shoulder which further improve the upper limb hand function. They applied PNF hold relax technique by using protocol of 3 sets with 10 repetitions, approx.12 sessions were done, indicating that PNF if applied along with conventional therapy can show long lasting benefits. *Poonam Chaturvedi* et al. in her RCT found that early application of PNF in stroke (mild to moderate), can show improvement in the muscle tone, activities of daily living and quality of life of the patient but according to this study, PNF must be applied on first day after stroke. The RCT by *Varun Y* et al. showed effectiveness of applying CIMT in chronic stroke patients by targeting the wrist and fingers, mostly using Activity Arm Research Test as scale, in which they found that CIMT when

applied along with conventional therapies shows better results than that of HABIT i. e. hand arm bimanual induced therapy. The RCT by *Bang, Dae-Hyouk*, et al, showed the effectiveness of action observation in combination with modified CIMT, mostly done for upper extremity function and the activities of daily living. It was a single blinded RCT, in which they concluded that action observation when applied along with modified CIMT had shown great improvement in upper extremity function and further improved the dexterity of the patient. Another article which is related to the Systematic review of RCT, by *Sharon Hakkennes et al.* through this, they had shown that evidences supporting CIMT were rising or growing. According to them CIMT may help in improving the upper limb function.

The observational test done by *Christer Sollerman*, the well organized and standardized test done based on common hand grips techniques. It was done to test the reliability and validity of the test whether it is helping in assessing the hand function, dexterity of an individual. The test shows that this one proved to be the best hand function assessment method. Another study by *Ratanapat Chanubol, et al* did the study in order to test the correlation between Box and Block Test and Action Research Arm Test, in which they found the exceptional response towards both as both of them were useful in assessing the results of intervention of upper extremity function, but also they concluded that Box and Block Test appropriate method of assessing hand function mainly in mild to moderate condition.

5. Conclusion

I draw the conclusion from the analysis of this review, that when PNF (Proprioceptive Neuromuscular Facilitation) is applied in combination with CIMT (Constraint Induced Movement Therapy) can exemplify the favorable impacts and results in improving the upper limb fine motor skills which further can help to improve the dexterity of an individual suffering from subacute or chronic stroke condition. However, there is still a dearth of data demonstrating the beneficial impacts of these effects, particularly in chronic stroke conditions, necessitating further research into the function of PNF and CIMT in these situations.

6. Limitations

The majority of the studies didn't demonstrate the long-term advantages of any of the therapies, thus more research could have been done with a larger sample size and with better follow-up. Moreover, they haven't distinguished the groups properly. Only English-language publications were assessed due to a lack of resources.

7. Clinical Implications

By combining CIMT and PNF and designing them in a way that enhances a person's dexterity, we can maximize the process of development for upper limb fine motor skills in chronic stroke patients.

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