

Eclectic/mixed model method for upper extremity functional recovery in stroke rehabilitation: A pilot study

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Abstract

Background: Eclectic treatment method is a flexible approach that uses techniques drawn from various schools of thought involving several treatment methods and allows the therapist to adapt to each client's individual needs. Wider application for eclectic approach is however limited in stroke rehabilitation. **Aim:** The objective is to find out whether eclectic approach improves upper extremity (UE) functional recovery in acute stroke rehabilitation. **Methodology:** Twenty-five postacute unilateral supratentorial stroke subjects recruited from tertiary care hospitals recovered with Stage 2–5 in Brunnstorm stage of UE motor recovery (BRS-UE) underwent 45 min of eclectic approach for UE every day involving seven different treatment methods (5 min for each method) for 6 days consecutively. The outcome was UE subscale of the Fugl-Meyer Motor test (UE-FM), UE subscale of the Stroke Rehabilitation Assessment of Movement (UE-STREAM), Wolf Motor Function test (WMFT-FAS), and Stroke Impact Scale-16 (SIS-16) was collected at the end of the sixth session. **Results:** All the participants showed significant improvement in all the outcome measures. The Stage 2 and 3 subjects showed UE-STREAM ($P = 0.007$) WMFT-FAS ($P < 0.001$), SIS ($P = 0.023$) respectively and for Stage 4 and 5 the subjects have shown UE FM ($P < 0.001$), WMFT-FAS ($P < 0.001$), SIS ($P = 0.004$) with large magnitude of treatment effect for all stages of BRS-UE. **Conclusion:** Our study findings are in favor of integrating eclectic approach than single intervention/approach in clinical practice to improve the UE functional recovery for motor rehabilitation when the stroke occurs.

Key words: Eclectic approach, stroke, upper extremity interventions

INTRODUCTION

Globally, stroke is the third major cause of mortality and a major health issue in low- and middle-income countries like India.^[1] Eighty percent of stroke survivors experience motor impairments (hemiparesis) typically affecting movement of the face, arm, trunk, and leg of one side of the body often persistent and disabling them. These

residual impairments limit their functional independence and predisposing them to restrict their participation in community and social roles.^[2,3]

Upper limb hemiparesis is one of the primary impairments following the stroke. It is often reported to be incomplete in functional recovery and to restore the motor skills. The studies on recovery of voluntary arm movements

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have also shown that 5–20% of stroke survivors achieved complete functional recovery and 30–60% of paretic arm can never have complete recovery during the first 6 months after the stroke.^[4,5] Common upper extremity (UE) impairments after the stroke include paresis, loss of fractionated movement, abnormal muscle tone and/or changes in somatosensation, shoulder pain, and subluxation which prevents the functional use of the arm, bimanual tasks and also for fine motor skills.^[6,7] Post stroke, persistent arm motor impairment (a period of 1 year or above) can be associated with anxiety and poorer perception of health-related quality of life and subjective well-being.^[8,9]

One of the primary aims of the stroke rehabilitation is to improve the arm functions and to regain the gross and fine motor skills. Currently, the existing rehabilitation protocols that are designed to improve UE functions include the various treatment methods/interventions such as Roods, Brunnstrom, proprioceptive neuromuscular facilitation, neuro-developmental therapy techniques, repetitive/task-specific training, strength training, sensorimotor interventions, constraint-induced movement therapy, virtual reality, spasticity treatment, electromyographic/biofeedback, transcutaneous electrical nerve stimulation, neuromuscular electrical stimulation, functional electric stimulation, motor imagery, mirror therapy, and bilateral arm training.^[10] However, recent systematic reviews have concluded that there is insufficient evidence observed for any intervention or approach that can currently be used in routine practice to improve the paretic upper limb functions.^[11]

An eclectic therapy is a therapeutic approach that incorporates a variety of therapeutic principles and philosophies to create the ideal treatment program to meet the specific needs of the patient or client. The intervention of an eclectic approach is based on the stable principles of the classic traditional methods but is open to refining and can be used in conjunction with the elements of other various new methods, thus providing a framework for designing an optimal neurorehabilitation protocol.^[12,13] The studies have shown that the eclectic approach is suitable for a diverse and complex set of patients.^[14-16] However, wider application of eclectic approach in stroke rehabilitation is limited in literature.

METHODOLOGY

Design

Quasi-experimental study design.

Participants

This study was approved by Institutional Ethics Committee, Kasturba Medical College, Mangalore, Manipal University,

Karnataka, India, and was conducted in the Department of Physiotherapy, Kasturba Medical College, Manipal University, Mangalore, from January 2014 to March 2015. The subjects diagnosed with first episode of unilateral stroke admitted to tertiary care hospitals and referred for neurorehabilitation, were recruited for the study. The purpose of the study was explained and a written informed consent in accordance with the Declaration of Helsinki was obtained from the interested participants. The subjects were then screened for the study criteria. The criteria included were (1) subjects must be 18-year-old and have had a first episode of ischemic/hemorrhagic vascular lesion as documented by computerized tomography or magnetic resonance imaging occurring above the level of the midbrain (2) Brunnstrom's recovery stage of 2–5 for the UE (3) mini-mental state examination score of 23 or more. The criteria excluded were (1) subjects with visual and perceptual deficits such as uncompensated hemianopia, hemispatial neglect, and/or apraxia involving the affected arm. (2) Shoulder or hand pain more than eight in visual analog scale. (3) Severe spasticity, defined as an Ashworth score of four in any region of the affected arm. (4) Subjects with other co-morbid conditions like musculoskeletal and cardiopulmonary that can interfere with their performance in UE rehabilitation. (5) Major active psychiatric illness that may interfere with treatment. (6) Inability to understand, cooperate or comply with the study procedures.

A convenience sample of 25 stroke subjects who met our study criteria was enrolled for an eclectic approach for UE functional recovery. The primary investigator collected the demographics of the participants followed by an independent blinded observer, who was blinded for the study purpose assessed the baseline and post-intervention values for all the outcomes.

Eclectic approach

The eclectic program that is routinely followed in Physiotherapy Department of Kasturba Medical College, Mangalore was delivered to all the participants. This program includes mainly the exercise regimes based on principles of sensorimotor, motor control, and motor learning approaches. These multi-modal regimes include seven different treatment methods, which were performed approximately for 45 min in each session per day (5 min for each method with adequate rest periods) for 6 days consecutively [Appendix 1]. With regard to trunk and lower extremity, 45 min of standard physiotherapy care included stretching, balance, transfer, mobility, and gait-related activities. A self-administered Likert scale response sheet was given to the therapists who delivered eclectic approach and were asked to rate the most to the least preferred treatment methods after six sessions.

Outcome measures

International Classification of Functioning (ICF), Disability and Health, is developed by the WHO provides a multi-dimensional framework for health and disability and clinically feasible for selection of an appropriate combination of outcome measures.^[17] ICF framework outcomes are measured in three levels: Body functions/structures, activities, and participation.^[18,19] Hence, in our study, we selected the outcome measures with good psychometric properties in stroke population, which can address the ICF core set in all the three levels.^[20] We included the UE subscale of the Fugl-Meyer Motor Test (UE-FM), UE subscale of the Stroke Rehabilitation Assessment of Movement (UE-STREAM), Wolf Motor Function Test (WMFT-FAS), and Stroke Impact Scale-16 (SIS-16). All three measures showed sufficient validity, responsiveness, and reliability among participants who had stroke.^[21-26] Post outcome measures of all the participants were taken after six consecutive eclectic approach treatment sessions. During the study, there were no reported adverse events/drop outs among the participants.

Data analysis

The collected data were coded and entered onto Statistical Package for the Social Sciences (SPSS Inc. Released 2007. SPSS for Windows, Version 16.0. Chicago, SPSS Inc.). Demographic characterizes of the participants were summarized as mean, standard deviation, median for continuous variables, and frequency counts for categorical variables. The proportion and ranking for most preferred treatment method in different stages of UE recovery was also examined. Pre- and post-outcome measures for upper extremity subscale of the Fugl-Meyer motor test (FMA-UE), STREAM-UE, WMFT-FAS, and SIS-16 were compared using paired *t*-test with $P < 0.05$ that was considered statistically significant for 95% of confidence interval. Finally, the effect size (Cohens *d*) of the outcome measures was calculated to measure the magnitude of treatment effect. An effect size of 0.2–0.5 was considered small, 0.5–0.8 medium, and above 0.8 large.^[27]

RESULTS

Twenty-five subjects successfully completed the eclectic regime. Descriptive statistics was derived to examine the characteristics of the participants for age, gender, type of lesion, risk factors, side of paresis, post-stroke duration, stroke severity, and level of disability and Brunnstrom stage of UE recovery using appropriate tables. In our study, more than 50% of study participants were aged <60 and 64% of them were men. Majority of the participants had ischemic type of stroke (56%) involving their dominant side (72%)

and had the higher percentage of modifiable risk factor for stroke (48%). Our subjects had a median score of 6 in National Institutes of Health Stroke Scale (NIHSS), and 75% had scored 3 in modified Rankin scale which indicates that they had a moderate level of impairments and disability following the stroke. For the UE, 40% had less than Stage 3, and 60% had more than Stage 3 motor recovery [Table 1].

There was a difference for different stages of UE recovery with regard to the most preferred treatment method. In Stage 2 and 3, the most preferred treatment methods were somatosensory methods (82%), emphasis on basic limb synergy (72%), and the least was bimanual tasks (38%). In Stage 4 and 5, the most preferred treatment methods were task specific training (85%), bimanual tasks (76%), and the least preferred was the emphasis on basic limb synergy (24%), respectively [Table 2].

Following six sessions of eclectic approach, our study had found a significant improvement for all the ICF core set of outcome measures (FMA-UE, STREAM-UE, WMFT-FAS, and SIS-16). These approaches have also found to produce the large effect size in all stages of UE recovery [Table 3].

DISCUSSION

Eclectic treatment method is a novel approach in neurorehabilitation and has been practiced by many allied health specialists globally. However, to the best of our

Table 1: Demographic characteristics of the participants (n=25)

Variable	n (%)
Age in years	
<40/41-60/61-80	3 (12)/10 (40)/12 (48)
Gender	
Men/women	16 (64)/9 (36)
Type of stroke	
Ischemic/hemorrhagic	14 (56)/11 (44)
Risk factors	
Modifiable	12 (48)
Nonmodifiable	5 (20)
Both	8 (32)
Mean time since stroke, in days (SD)	7.48 (3.08)
Dominant side right/left	25/0
Side of paresis right/left	18 (72)/7 (28)
NIHSS, median (IQR)	6 (3–10)
Modified rankin scale	
Slight disability	6 (24)
Moderate disability	19 (76)
BRS-UE	
Stage 2 and 3	10 (40)
Stage 4 and 5	15 (60)
MMSE, mean (SD)	27.55 (1.45)

SD: Standard deviation, MMSE: Mini mental state examination, NIHSS: National Institutes of Health Stroke Scale, IQR: Interquartile range, BRS-UE: Brunstrom stage of recovery- upper extremity

knowledge, there are less supporting evidence to support feasibility and efficacy of eclectic treatment methods for stroke survivors and our pilot study has shown a positive result in acute stroke rehabilitation. Following the six sessions of eclectic approach, there was a significant improvement in subjects with Brunnstrom Stage of UE [Stage 2–Stage 5] for all the outcome measures—FMA-UE, STREAM-UE, WMFT-FAS, and SIS-16.

In our study, almost 50% of the subjects are aged <60 and 12% are reported as aged <40. These findings compared to other previous study findings about the recent trend of young stroke subjects in India^[28-30] in that 50% of subjects had both modifiable risk factors for stroke. It is also a great concern for the lack of community awareness about risk factors of stroke.^[31,32] All the subjects who were referred to neurorehabilitation unit for physiotherapy service were with mean duration <2 weeks of post stroke onset and were also found to have mild-moderately disabled in modified Rankin Scale and less involvement of UE as 60% participants had more than Stage 3 of Brunnstrom recovery.

An eclectic approach is a flexible transition from a traditional approach to a patient-tailored therapy. The

Table 2: Rank order and proportions for frequently delivered treatment approach in different stages of upper extremity motor recovery (n=25)

Upper extremity recovery	Treatment approaches	Rank order	Most commonly used treatment approach (%)
Stages 2 and 3 (n=10)	Somatosensory methods (Roods)	1	82
	Emphasis on basic limb synergy (Brunnstrom)	2	72
	Weight bearing and strengthening exercises	3	60
	Bimanual tasks	7	38
Stages 4 and 5 (n=15)	Task specific training	1	85
	Bimanual tasks	2	76
	Constraint induced movement therapy	3	66
	Emphasis on basic limb synergy (Brunnstrom)	7	24

methods used in these approaches should be in consistent with the existing stroke rehabilitation guidelines and advance in the scientific theories of motor control and motor learning. In our study, physical therapists identified and defined their eclectic approach with seven different approaches which are tailor-made and delivered to address the individual patient's impairments and to facilitate the patient's personal goals. Recent guidelines for UE rehabilitation have also addressed that there are moderate evidence for NMES, motor imagery, mirror therapy which are both cost-effective and feasible.^[10,11] They were not incorporated in our eclectic approach as these participants were the control subjects for other randomized clinical trial studies related to these interventions in our settings.

In our study, the postgraduate scholars delivered the eclectic treatment method under the guidance of senior staff members who had experience in stroke rehabilitation for more than 10 years. Our study results have also shown that the therapist preference for the eclectic approach varies for different stages of UE motor recovery. For Stage 2 and 3, they mostly preferred specific reflex-based neurofacilitation techniques such as Roods and Brunnstrom methods and for Stage 3 and 4 they mostly preferred the Repetitive Task Specific and Bimanual Training methods. In our study, the therapist perceived that the amount of recovery in hand function is one of the important factors to be considered for the preferences for a particular approach in different stages of UE recovery.

In subjects with complete paralysis of hand functions the family members/caregivers are not actively encouraging the subject to use the paretic hand and encourage to use unaffected extremity for all the basic activities of daily living activities like dressing, eating in the most active part of a patient's day (9 am to 6 pm). It may facilitate to neglect the affected limb, thereby developing learned nonuse. Possibly, these could have resulted a negative attitude towards recovery which limits their active effort and attention in therapy sessions and the preference of treatment methods which are passive in nature.^[33] As majority of the participants in our study had paresis of

Table 3: Pre- and post-changes in upper extremity outcome variables following eclectic approach

Upper extremity recovery	Outcome variables	Mean ± SD		Mean change with 95% CI	P	Cohen d value
		Pre	Post			
Stages 2 and 3	UE-STREAM	6.80 ± 3.73	8.80 ± 4.20	2 (0.69-3.30)	0.007**	0.51
	WMFT-FAS	0.51 ± 0.19	0.69 ± 0.17	0.18 (0.14-0.21)	<0.001***	1.02
	SIS 16	29.50 ± 9.18	42.75 ± 11.48	13.70 (2.38-25.08)	0.023*	1.65
Stages 4 and 5	FMA-UE	42.93 ± 4.18	48.06 ± 4.77	5.13 (3.71-7.10)	<0.001***	1.13
	WMFT-FAS	0.73 ± 0.15	0.86 ± 0.11	0.13 (0.07-0.18)	<0.001***	0.98
	SIS 16	40.70 ± 15.17	54.40 ± 12.13	13.25 (11.86-16.63)	0.004**	1.77

P value representing *Significant, **Highly significant, ***Very high significant. Cohens d interpretation 0.5-0.8 represents moderate treatment effect, >0.8 represents large treatment effect. UE-STREAM: Upper extremity-subscale of the stroke rehabilitation assessment of movement, WMFT-FAS: Wolf motor function test, FMA-UE: Upper extremity subscale of the Fugl-Meyer motor test, SIS-16: Stroke impact scale-16, SD: Standard deviation, CI: Confidence interval

dominant hand the subjects who had some potential of recovery in voluntary hand functions were motivated more to prefer the paretic hand to use for daily activities.^[34,35] Re-enforcement of paretic arm use in both unilateral and bilateral tasks encourages therapists to prefer goal-oriented and bimanual training approaches. Other findings are the presence of intravenous lines commonly in paretic upper limb during their initial hospital stay results in swelling/pain in the arm that limits the subject's active performance. Hence, the therapists have to modify their treatment methods in rehabilitation.

Our holistic eclectic rehabilitation model for UE interventions has shown positive findings in all the domains of ICF model. Our results had shown a statistical significant difference in all outcome measures, and we found maximum effect size for functional recovery among subjects with Stage 4 and 5 where task specific and bimanual treatment methods are the most preferred for these subjects. Though these findings may have statistical significance, they have not met the minimal clinical important difference for any of the outcome variables, which limits our findings for clinical implication and practice.^[36-38] Possible reasons for these findings may be because our participants were mild in stroke severity NIHSS median score and also moderately disabled which are found to be strong predictors of better functional recovery.^[39,40] Other findings may attribute to our therapists, who had higher level of clinical reasoning and were patient-oriented as they were flexible in their therapy sessions with the most effective set of therapeutic methods. They were also supported by experienced Physiotherapists who promote professional development in physiotherapy and from multidisciplinary therapeutic team in our organization. Our study findings are consistent in a variety of treatment settings with the recent studies on current clinical practice model among Allied Health professionals. They have concluded that the therapists appear to employ techniques from multiple approaches frequently, suggesting contemporary PT practice, which is eclectic in nature for motor rehabilitation in stroke.^[41-43]

Recent Cochrane review on Interventions for improving upper limb function after stroke has concluded that there is insufficient evidence or no high-quality evidence is available for any intervention as the most effective interventions are used as part of routine practice for improving upper limb functions. Interestingly, in their findings, they have included forty reviews, 35 of these are focused on single type of interventions, and only two reviews are included of a mixture of different single interventions. These findings suggest that there is a need for a number of large and well-designed randomized controlled trials to judge the effect of these mixed model/eclectic approaches in neurologic physiotherapy.

Clinical implication

The therapist's knowledge and competence, prioritizing patient-oriented goal setting, availability, and feasibility of a known approach for intervention and the support from the working organizations are the key factors to integrate eclectic approach in our clinical practice and for therapeutic benefits.

Limitations

The results of our study need to be cautioned, as there are no control groups. All the participants were acute stroke subjects. Hence, the spontaneous recovery may influence the results of our study, and the amount of hand recovery/dexterity functions has not been evaluated in this study. Majority of them were Stage 4 and above in UE motor recovery hence the results are limited to generalizability for all subjects. In our setup as a routine practice, we teach the caregiver/family members the basic exercises and practice them in nontherapy hours so that the dosage of the interventions may further influence our study findings. The study intervention was given only for six sessions and hence, only the short-term effects were focused upon. The subjects could not be followed up to ascertain, whether the intervention had the long lasting effects.

CONCLUSION

Effective physical therapy services are found to be the core elements for motor rehabilitation. Our study findings have supportive evidence for the clinical framework in an eclectic approach to produce optimal treatment protocol with simultaneous use of various standard treatment methods and techniques, which may influence our therapeutic approach, and to develop future eclectic practice models in neurorehabilitation.

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Conflicts of interest

There are no conflicts of interest.

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APPENDIX

Appendix 1: Elements of the eclectic approach intervention were as following:

Eclectic approach	Treatment goals
Somatosensory training-Rood's approach based therapy Elements of the kinesiotherapy Active exercises (without load), active exercises (with load), weight bearing exercises and strengthening exercises Elements of Brunnstorm approach	Use of controlled sensory stimulation to achieve purposeful muscular/ voluntary contractions To incorporate voluntary, active exercises against resistance accomplished by using resistance bands, weights, or gravity-resisted exercises. Exercises could be isometric or isotonic To emphasis on synergistic patterns of movement that develop during recovery from hemiplegia and to encourage basic limb flexor and extensor synergies during early recovery, assuming that synergistic activation of the muscle will result in voluntary movement
Elements of neurodevelopmental techniques	Aims at reducing spasticity and synergies by using inhibitory postures and movements in order to facilitate normal autonomic responses that are involved in voluntary movement
Elements of constraint induced movement therapy	To restraint the use of unaffected hand/arm and increased practice/use of the affected hand/arm
Elements of repetitive/task-specific training	Tasks relevant to the patient and to the context; be randomly assigned; be repetitive and involve massed practice towards reconstruction of the whole task; and be reinforced with positive and timely feedback
Bilateral arm training	Execution of identical activities with both arms simultaneously but independently