



EFFECT OF CLOSED KINETIC CHAIN EXERCISES IN PATIENTS SUFFERING FROM DIFFUSED AXONAL INJURIES FOR GAIT AND FUNCTIONAL RECOVERY

Dr. Aishwarya Rai¹, Dr. Amit Kumar Goel², Dr. Ishika Saxena³, Dr. Esha Sharma⁴

- 1- Assistant Professor, JRPSCPT
- 2- Associate Professor, JRPSCPT
- 3- Assistant Professor, JRPSCPT
- 4- Consultant Physiotherapist, QI Spine

Address Correspondance to: Dr. Aishwarya Rai, Assistant Professor, Jyotirao Phule Subharti College of Physiotherapy, Swami Vivekanand Subharti University, NH-58, Delhi Haridwar Bypass Road, Meerut 250 005.

ABSTRACT

BACKGROUND: Diffused Axonal Injuries (DAI) are types of traumatic injuries that render the patients with dire consequences. A major obstacle that surfaces for therapists during the rehabilitation of such patients is their functional recovery along with their movement patterns. Hypertonicity is major complication that poses as a menace to the healing process of the patient. Closed Kinetic Chain (CKC) exercises

PURPOSE: To establish that patients that undergo CKC exercises as part of their mobility training show better functional outcomes.

METHODOLOGY: An experimental study was conducted in which it was observed that patients that underwent closed kinetic chain exercises showed better outcomes in terms of gait and functional recovery compared to patients that did not perform CKC exercises as part of their treatment regime. Modified Dynamic Gait Index (mDGI) and Barthel Index (BI) were used to measure the functional outcome. A total of 60 patients were incorporated in the study. Mean age of the patients was 30.35 and male to female ratio was 29:31.

RESULT: Patients belonging to Group-B showed better outcomes when compared with patients of Group-A.

CONCLUSION: The study concludes that incorporating CKC exercises in the treatment regime leads to better outcomes in patients affected with DAI

Keywords: CKC, DAI, Gait, Functional Recovery

INTRODUCTION

Traumatic brain injuries are a source of utmost grief and misery to patients as it leaves the patient with lifelong disabilities. Of these Diffused Axonal Injuries (DAI) are those that usually have a poor prognosis. It is caused due to acceleration-deceleration forces which leads to the motion of the head changing from rest to moving, and then again at rest such as in motor vehicle collisions. Shearing forces cause immediate mechanical damage to the axons. Over subsequent 48 hours, further damage results from release of excitotoxic neurotransmitters which

cause Ca^{2+} influx into cells and triggers a phospholipid cascade. Depending on the severity of the injury, effects may range from mild coma to death or even persistent neurovegetative state. Mortality after DAIs is as high as 50%. Diffuse axonal injury is clinically defined by coma lasting 6 h or more after traumatic brain injury (TBI), excluding cases of swelling or ischemic brain lesions. They are usually characterized by loss or changes in level of consciousness, coma and abnormal posturing. DAIs cause microscopic damage to the brain tissues leading to significant mortality and morbidities. These injuries lead to changes in behavior, cognition or even physique. However, the condition of the patient may get better as the neural connections are impaired and not destroyed and thus clinically as the patient stabilizes, they begin to regain normal function as the brain tissue remodel due to neuroplasticity. Closed kinetic chain exercises are those in which an exercise or movement pattern where the distal aspect of the extremity is fixed to an object that is either stationary or moving.

Closed kinetic chain exercise is a movement wherein the distal part is fixed, as when the sole of the foot makes contact with the ground or the exercise equipment. With the distal part fixed, movement at any one joint in the kinetic chain requires motion as well at the other joints in the kinetic chain. Thus both proximal and distal parts receive resistance training at the same time. In the case of the lower limb, CKC exercises are more functional, as weight bearing is, by definition, a closed kinetic chain activity of the lower limb. CKC exercise has been cited as producing superior eccentric contraction and co-contraction of muscles, as well as reducing shear forces while adding compressive forces to the joints, thereby enhancing joint stability.¹

The ability to maintain balance, one of the important factors in performing everyday activities, is derived from complex interactions among the nervous system, musculature, and skeletal system². Important parameters of balance performance include range of motion, muscle strength, somatosensory function, and the size and quality of the base of support.³ Many researchers have concluded that the knee muscle strength and proprioceptive function are closely related to gait function.⁴

MATERIALS AND METHODS

An experimental study was conducted which included 60 patients that were diagnosed by the neurosurgeon with diffused axonal injury and resided in Meerut City were incorporated in the study based on inclusion and exclusion criteria. The purpose and procedure of the study were explained in detail to either the subject or their proxy and consent was obtained. The patients included in the study were divided into groups A and B. The patients were randomly divided into two groups A and B. Patients of group A were the control group and underwent traditional methods and patients of group B underwent CKC exercises as part of their treatment regimen. The entire session lasted for 60 minutes. All patients incorporated in the study completed all 15 sessions.

PATIENT ENROLMENT

Inclusion Criteria: Age between 20 – 40 years. Hemiparesis. Oriented and able to communicate independently (Mini Mental Scale Examination > 24). Both sub-acute and chronic subjects were included. Both genders included. Acquired informed consent from the patient

Exclusion Criteria: Severe cognitive, communicative perceptual, or sensory problems preventing from understanding or follow the verbal instructions (Mini Mental Scale Examination < 24). Other neurological, cognitive, psychiatric problems, or impairments causing difficulties to follow the program. Unstable cardiovascular and ventilatory problems. Having withdrawn consent before, during or after the treatment.

INTERVENTION

Patients of Group-B received CKC exercises 40 minutes, for all 15 sessions. The exercise regime included an ergometer exercise, mini-squatting, step-up and step down, wall squat with balls, heel slides, quad sets, balance and reach exercises. The patients also received stretching exercises for hamstrings, gastrocnemius and soleus.

OUTCOME MEASURES

The Barthel Index for Activities of Daily Living is an ordinal scale which measures a person's ability to complete activities of daily living (ADL)⁵. It measures the degree of assistance required by an individual on a ten-mobility scale and self-care ADL items. Higher the score, more independent the patient is in completing the measured ADLs. A higher score also indicates a patient is more likely to return home, with

varying degrees of assistance, following hospital discharge. The lower the score, the more dependent a patient is in ADL completion, and requires care at the time of discharge.

The Dynamic Gait Index (DGI) tests the ability of the participant to maintain walking balance while responding to different task demands, through various dynamic conditions. It is a useful test in individuals with vestibular and balance problems and those at risk of falls. It includes eight items, walking on level surfaces, changing speeds, head turns in horizontal and vertical directions, walking and turning 180 degrees to stop, stepping over and around obstacles, and stair ascent and descent. Each item is scored on a scale of 0 to 3, with 3 indicating normal performance and 0 representing severe impairment. The best possible score on the DGI is a 24.⁶

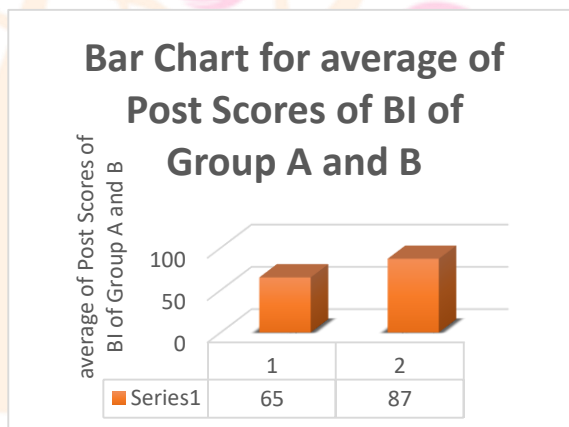
STATISTICAL ANALYSIS

All analysis were obtained using Microsoft Excel 2007 Demographic data of the patients including age and gender were summarized. Statistical analysis was performed using EZR Software Version 1.55. The dependent variables for the statistical analysis were pre- and post- Barthel Index scores. A level of 0.05 was used to determine the statistical significance.

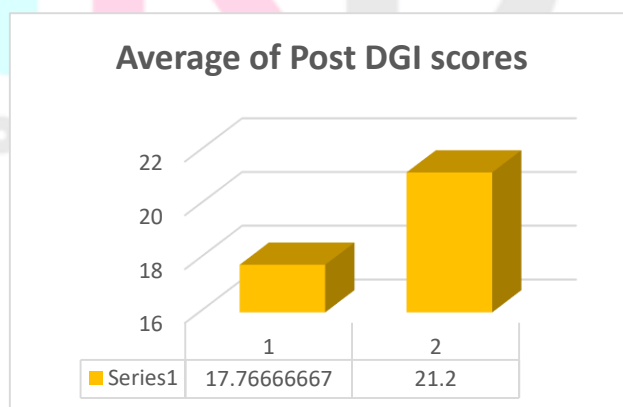
RESULTS

During the study period (September 2023 - January 2024), a total of 60 patients were enrolled in the study and was completed within 153 days. All the patients underwent fifteen sessions of physiotherapy. The results were analysed using two-tailed t-test by using EZR Software Version 1.55.

	Post BI Scores of Group-A	Post Scores of Group-B	BI of
Mean	65	87	
Variance	191.38	47.59	
SD	13.84	6.9	
Observations	30	30	
p(T<=t) two-tail	1.35204E-10		



	Post DGI Scores of Group-A	Post DGI Scores of Group-B
Mean	17.77	21.2
Variance	7.91	4.31
SD	2.82	2.07
Observations	30	30
p(T<=t) two-tail	1.391E-06	



DISCUSSION

The study aims to determine if closed kinetic chain exercises when incorporated into the exercise regime of patients affected with diffused axonal injuries yields better results and gives more efficient recovery in gait training and functional outcomes compared to patients who do not undergo such treatment. Review article by

Richard W. Bohannon have found that studies employing a regimen of repeated sit-to-stands as in this study have all demonstrated functional benefits. Studies that focused on such techniques have yielded favorable results. These also showed more enthusiasm in the sessions and thus CKC exercises are an effective treatment intervention and prove to be effective in improving the gait, strength, balance and functional abilities of the patient. It is necessary to develop various interventions that can be performed in CKC position.¹

RECOMMENDATIONS

Randomized control trials can be conducted for the same and also patients from various age groups can be included in future trials. Also, other patho-anatomies and physiologies can be included for future studies.

CONCLUSION

The study concludes that patients that are prescribed closed kinetic chain exercises in their treatment regime show better functional outcomes compared to those that may or may not perform the exercises. These patients also showed more interest in the sessions due to swift recovery.

ACKNOWLEDGEMENT

We want to thank Dr. Abhinav Bansal, Associate Professor and HOD, Department of Neurosurgery, SMC for his unwavering support. We also want to thank the patients along with their families for entrusting their faith in us. No funding was applied for the study.

AUTHORSHIP STATEMENT

Aishwarya Rai designed the study. Amit Kumar Goel recruited the patients for the study. Ishika Saxena helped in the treatment sessions by being a valuable member of the team. Aishwarya Rai prepared the manuscript for publication. No research funding was applied for the study. The manuscript was revised by all authors and approved for the final document.

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