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Enhancing Motor Function and ADLs through Task-Oriented Training with Proprioceptive Training in a Post Craniotomy Patient :- A case report

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Abstract

Objective: To evaluate the effectiveness of combining proprioceptive stimulation and task-oriented training (TOT) on motor recovery and functional independence in a post-craniotomy patient.
Design: Single-subject case study.
Setting: Deep Hospital and Research Centre, Jaipur, Rajasthan.
Intervention: An 8-week physiotherapy program consisting of phased proprioceptive training (stable, dynamic, and functional stages) followed by structured TOT targeting upper- and lower-limb functional movements. Sessions were conducted 5 days per week for 45–60 minutes. **Outcome Measures:** Fugl-Meyer Assessment (FMA) and Motor Assessment Scale (MAS), recorded pre- and post-intervention.
Results: Post-intervention scores showed substantial improvement in motor control, balance, and functional task performance. FMA scores increased from 78 to 118 and MAS scores improved from 18 to 42, indicating enhanced motor function and greater independence in ADLs. **Conclusion:** The combined proprioceptive and task-oriented training approach was effective in promoting early motor recovery and functional independence following craniotomy, suggesting its applicability in neurorehabilitation settings.

INTRODUCTION

Traumatic Brain Injury (TBI) is defined as an acute alteration in brain function resulting from the transmission of mechanical energy to the head due to external forces.[1] Globally, TBI remains a major public health concern and has been described as a "silent epidemic."[3] In the United States alone, an estimated 1.5–2 million individuals experience TBI annually, with nearly 80% treated in emergency departments.[2] Despite advancements in surveillance, significant gaps remain in understanding the epidemiology of TBI, especially in community settings and among under-represented groups.[3],[1]

Subdural hemorrhage (SDH), the most common type of intracranial hemorrhage, is characterized by blood accumulation in the subdural space.[1] It typically results from the stretching and tearing of bridging cortical veins caused by sudden acceleration–deceleration forces.[2–4] SDH often presents radiologically as a crescent-shaped collection between the dura and arachnoid membranes and may contain cerebrospinal fluid if the arachnoid layer is breached.[2–5] Acute SDH exceeding 10 mm in thickness or causing a midline shift greater than 5 mm warrants urgent surgical evacuation, regardless of Glasgow Coma Scale (GCS) score.[6]

Craniotomy is the standard surgical approach for management of acute SDH, involving elevation of a bone flap, hematoma evacuation, and replacement of the flap.[7] Historically, craniotomy has been used for the relief of symptoms due to intracranial pressure and traumatic lesions, with documented use dating back to prehistoric times.[8] Decompressive craniectomy is an alternative technique but is associated with additional complications and the need for delayed cranioplasty.[9],[10] The decision between craniotomy and craniectomy remains largely surgeon-dependent due to the absence of universal guidelines.[10] Post-craniotomy rehabilitation is essential for addressing neurological deficits, motor dysfunction, impaired balance, and reduced quality of life.[11] Patients commonly present with physical, cognitive, and psychological impairments following brain surgery, all of which require individualized, multidisciplinary rehabilitation.[12] Early and structured rehabilitation programs have shown significant improvements in functional independence, balance, and motor recovery.[11–13]

Given the necessity of targeted rehabilitation following craniotomy, the present study was undertaken to evaluate the effectiveness of task-oriented training combined with proprioceptive stimulation in enhancing motor function and

activities of daily living (ADLs) in a post-craniotomy patient.

Case summary

A 47-year-old male, with no known history of hypertension or diabetes mellitus, and working as a small-scale clothing businessman, presented with complaints of sudden onset of severe headache. The pain was described as sharp and shooting in nature, persisting throughout the day, and not relieved by medication. Due to the intensity and persistence of symptoms, the patient was taken to the hospital for further evaluation. A Computed Tomography (CT) scan of the brain revealed an acute subdural hematoma (SDH) with a maximum thickness of approximately 13 mm over the convexity of the right cerebral hemisphere, along with a midline shift towards the left side. Additionally, an extra-axial hematoma of approximately 6 mm thickness was noted over the convexity of the left frontal lobe.

Based on the radiological findings, the patient was diagnosed with acute SDH and was immediately admitted for surgical intervention. A craniotomy was performed at Deep Hospital and Research Centre for the evacuation of the hematoma. Postoperatively, the patient was monitored in the intensive care unit (ICU) for stabilization. Following surgery, the patient exhibited weakness in both upper and lower limbs, indicating possible neurological involvement due to pressure effects prior to decompression.

After one week of stabilization, a physiotherapy rehabilitation program was initiated focusing on early mobilization, prevention of complications such as joint stiffness and contractures, and retraining in Activities of Daily Living (ADLs). The physiotherapy sessions included passive and active-assisted movements, bed mobility training, balance exercises, and gradual strengthening. Within one week of physiotherapy intervention, the patient showed remarkable improvement, regaining the ability to perform basic ADLs independently.

Rehabilitation was continued for one month, emphasizing progressive resistance training, coordination, and endurance exercises. By the end of the physiotherapy program, the patient demonstrated significant functional recovery, improved muscle strength, and better coordination.

This case emphasizes the critical role of early surgical management and structured physiotherapy rehabilitation in achieving favorable outcomes in patients with acute subdural hematoma post-craniotomy. Early physiotherapeutic intervention played a key role in restoring motor function and promoting overall recovery, enabling the patient to return to near-normal daily activities within a short period.

METHODOLOGY

Study Design

A single-case study design was employed to evaluate the effectiveness of task-oriented training combined with proprioceptive stimulation on motor function and activities of daily living (ADLs) in a post-craniotomy patient.

Study Setting

The study was conducted at Deep Hospital and Research Center, Jaipur, Rajasthan.

Pre-Intervention Assessment

The initial assessment was carried out in the hospital ward immediately after the patient underwent a craniotomy for acute subdural hematoma. At the time of evaluation, the patient was conscious, alert, and oriented, with stable vital parameters. Inspection revealed surgical sutures over the right fronto-parietal region. Neuromuscular examination demonstrated reduced muscle strength and mild hypotonia in all four limbs, with greater impairment on the left side. Deep tendon reflexes were decreased, whereas sensory responses remained intact.

Functionally, the patient required assistance for bed mobility, transfers, and basic ADLs. Sitting balance was poor, and independent ambulation was not feasible. Standardized assessment tools—the Fugl-Meyer Assessment (FMA) and Motor Assessment Scale (MAS)—were administered to determine baseline motor function and establish rehabilitation goals.

Intervention Procedure

Duration and Frequency

- **Total duration:** 8 weeks (2 months)
- **Frequency:** 5 sessions per week
- **Session duration:** 45–60 minutes each

For the first five days, the patient received gentle passive range of motion (PROM) exercises to maintain joint mobility and reduce the risk of contractures. After that proper protocol was prepared for intervention.

Phase 1: Proprioceptive Training

Proprioceptive training was initiated early due to post-surgical weakness, impaired motor control, and reduced joint position awareness. The program consisted of three progressive stages—stable, dynamic, and functional—designed to enhance postural control, balance, and sensory–motor integration. The training structure was adapted from the protocol described by Chae et al. (2017).[14]

Stage 1: Stable Stage (Stable Surface)

Performed on a firm floor, focusing on static balance:

- Standing with eyes open (EO) and eyes closed (EC): 4 minutes per set
- Static standing: 10 seconds × 5 repetitions
- Heel raises: 10 seconds × 5 repetitions
- Single-leg stance: 10 seconds × 5 repetitions alternately

Stage 2: Dynamic Stage (Unstable Surface)
Conducted using an Airex balance pad to increase proprioceptive challenge:

- Standing with EO/EC: 6 minutes per set
- Heel raises: 10 seconds × 5 repetitions
- Single-leg stance: 5 seconds × 10 repetitions
- Forward stepping: 10 seconds × 5 repetitions

Stage 3: Functional Stage
Focused on integrating proprioceptive control into functional tasks:

- Standing on Airex surface: 10 minutes
- Marching in place: 6 minutes
- Feet-together and tandem stance: 10 seconds × 5 repetitions
- Sit–squat–stand transitions: 1 minute

Progression was individualized based on tolerance, balance control, and task performance. All sessions were supervised to ensure safety and correct technique.

Phase 2: Task-Oriented Training (TOT)
Task-oriented training was incorporated following proprioceptive conditioning to promote functional motor recovery. Training objectives were based on the patient's preferred tasks and functional needs, adapted from validated TOT protocols.[15]

Selected Upper Limb Functional Tasks
Three of the following tasks were practiced per session:

- Drinking water from a glass
- Lifting a glass to 90° shoulder flexion
- Moving objects (crystals) from table to box
- Wiping the table with extended elbow
- Grasping and releasing a tennis ball
- Combing hair

Lower Limb and Whole-Body Functional Tasks
Additional exercises were adapted from standard task-oriented programs:[3]

1. Reaching in multiple directions beyond arm's length
2. Stepping forward, backward, and sideways on a step
3. Knee flexion/extension on an elevated step
4. Stepping over obstacles of varying heights
5. Sit-to-stand, walk 4 steps, touch stool, and return
6. Sitting on Swiss ball with trunk and UE movements
7. Double-leg standing (10 seconds)
8. Tandem standing (10 seconds)
9. Sit-to-stand without arm support
10. Tandem walking forward and backward

Sensory Condition Variations
Exercises were performed under progressively challenging sensory environments:

- Eyes open + hard surface
- Eyes open + soft surface
- Eyes closed + hard surface
- Eyes closed + soft surface

Progression was based on increasing repetitions, raising step height (10–20 cm), and adding ankle weights (2–4 lbs) as tolerated.
Each training session included 20 minutes of upper- and lower-limb functional task practice and 30 minutes of balance and mobility tasks, totaling 50 minutes [16]

Post-Intervention Assessment
After the 8-week rehabilitation program, the FMA and MAS were re-administered to evaluate functional gains. Improvements in motor control, balance, and ADLs were compared with baseline assessments to determine the effectiveness of the combined intervention.

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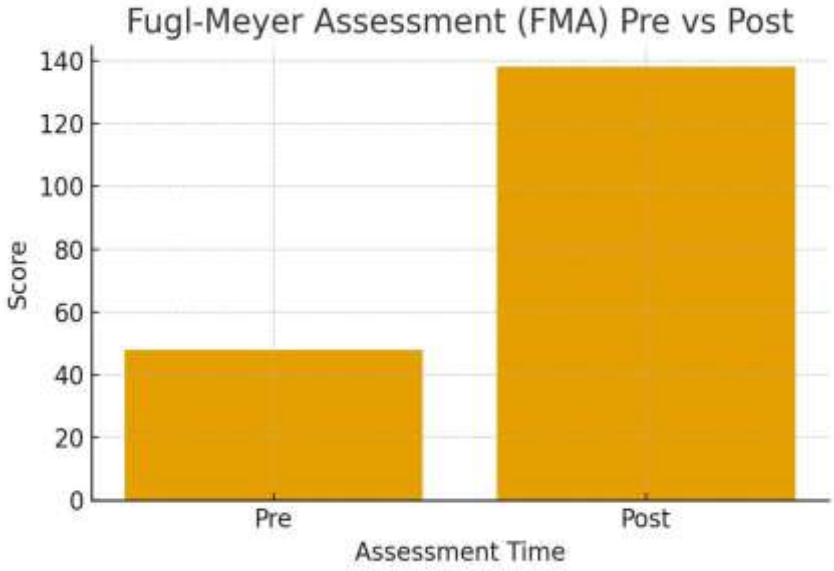
RESULTS

Table 1- Pre- and Post-Intervention Outcome Measures

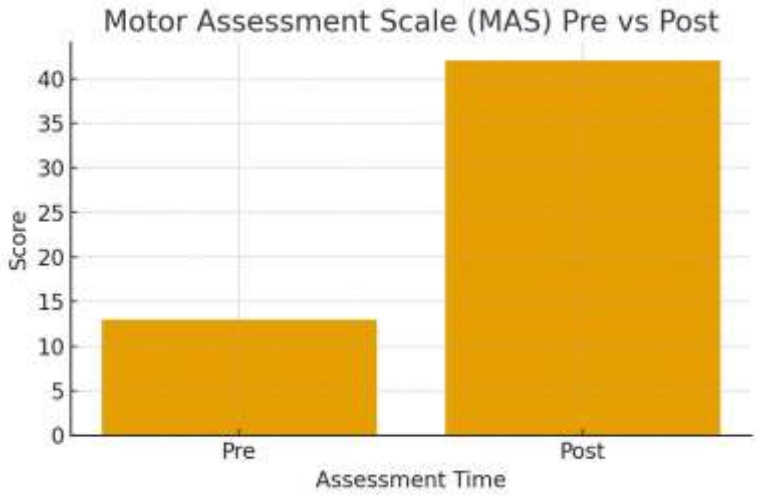
Outcome Measure	Pre-Intervention Score	Post-Intervention Score	Inference
Fugl-Meyer Assessment (FMA)	48/226	138/226	Significant improvement in motor control, coordination, and limb function.
Motor Assessment Scale (MAS)	13/54	42/54	Marked improvement in functional tasks, balance, transfers, and ADLs.

Table-2 Statistical Interpretation of Pre- and Post-Intervention Outcomes

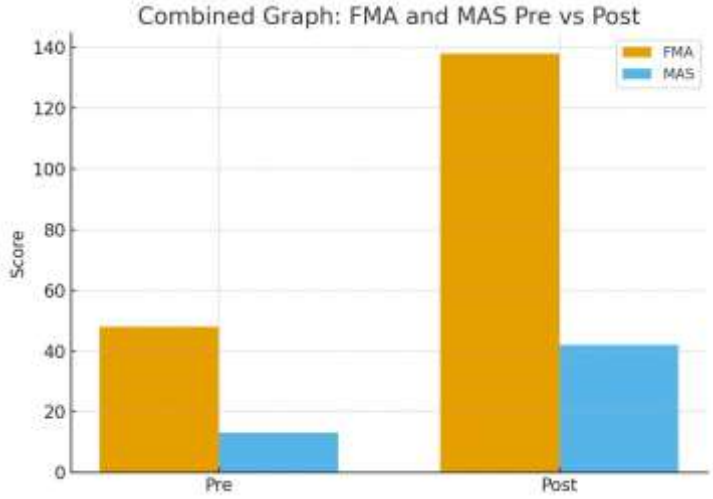
Outcome Measure / Item	Pre-Score	Post-Score	Absolute Improvement	Percentage Improvement (%)	Clinical Interpretation
Fugl-Meyer Assessment (FMA)					
Upper Extremity (UE)	16	47	+31	193.75%	Marked recovery of upper limb motor control.
Lower Extremity (LE)	7	20	+13	185.71%	Significant improvement in lower limb strength and coordination.
Sensation	18	22	+4	22.22%	Mild improvement in sensory integration.
Joint Range of Motion ROM.	32	40	+8	25.00%	Improved joint mobility and functional
Joint Pain	35	39	+4	11.43%	Reduction in pain and improved comfort in movement.
Total FMA Score (226) domains.	**48**	**138**	**+90**	**187.50%**	**Substantial motor recovery across all**
Motor Assessment Scale (MAS)					
Total MAS Score (48)	13	42	+29	223.08%	Major improvement in ADLs, transfers, and mobility.



Graph-1- Fugl-Mayer Assessment Pre and Post



Graph-2 MAS pre and psot



Graph 3- Result of both FMA and MAS Pre and post

DISCUSSION

This case study demonstrated that a combined program of proprioceptive training and task-oriented training (TOT) produced meaningful improvements in motor recovery and functional performance in a post-craniotomy patient following acute subdural hematoma. Post-intervention gains in Fugl-Meyer Assessment and Motor Assessment Scale scores indicate enhanced motor control, balance, and ADL performance.

The findings are consistent with earlier studies reporting that proprioceptive stimulation improves postural stability and sensory–motor integration in neurological conditions (Chae et al., 2017). Proprioceptive retraining likely supported restoration of disrupted cortical pathways caused by hematoma-related compression and surgical intervention. Similarly, the improvements in functional tasks align with evidence that TOT enhances motor relearning through repetitive, goal-directed, and context-specific activities (Thant et al., 2019; Arabzadeh et al., 2018).

Early initiation of therapy may have contributed to faster neuromuscular activation and reduced postoperative complications, in agreement with previous findings in post-craniotomy rehabilitation (Abdelmowla & Abd-Elmageed, 2021). Although based on a single case, the results support integrating proprioceptive and task-oriented approaches in early postoperative rehabilitation to optimize recovery. Larger controlled studies are needed to validate these findings.

Conclusions

The present case study demonstrated that combining proprioceptive stimulation with task-oriented training significantly enhanced motor recovery and functional independence in a post-craniotomy patient. Improvements were reflected in both Fugl-Meyer Assessment and

Motor Assessment Scale scores, indicating better motor control, balance, and performance of ADLs. The structured progression from proprioceptive re-education to functional, task-based activities facilitated meaningful neuro-motor adaptation. These findings support the effectiveness of an integrated rehabilitation approach in optimizing post-surgical neurological recovery.

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