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Comparative Analysis of Motor Dysfunction in Patients with Stroke and Parkinson Disease

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ABSTRACT

Background: Motor dysfunction is a hallmark feature of both stroke and Parkinson disease (PD), yet the underlying mechanisms, clinical presentation, and progression differ significantly. Understanding these differences is crucial for tailored rehabilitation and management strategies.
Objective: To comparatively analyze motor dysfunction in patients with stroke and Parkinson disease using clinical and functional assessment tools.
Methods: A cross-sectional observational study was conducted on 200 patients (100 stroke, 100 PD) at a tertiary care center. Motor dysfunction was evaluated using standardized scales including the Modified Rankin Scale (mRS), Unified Parkinson's Disease Rating Scale (UPDRS), and Fugl-Meyer Assessment (FMA). Statistical analysis was performed to compare severity, type, and distribution of motor impairment.
Results: Stroke patients exhibited predominantly unilateral motor deficits with higher severity in acute phases, while PD patients showed bilateral, progressive motor dysfunction characterized by rigidity, bradykinesia, and tremor. Functional disability was significantly higher in stroke patients initially, whereas PD patients showed gradual decline over time.
Conclusion: Stroke and Parkinson disease demonstrate distinct patterns of motor dysfunction. Early identification of these differences is essential for optimizing rehabilitation strategies and improving patient outcomes.

Keywords*: Stroke, Parkinson disease, motor dysfunction, bradykinesia, hemiparesis, rehabilitation.*

INTRODUCTION

Motor dysfunction is a major contributor to disability and reduced quality of life in neurological disorders, particularly in conditions such as stroke and Parkinson disease (PD). These disorders impose a significant global health burden, affecting millions of individuals and contributing substantially to morbidity, mortality, and healthcare costs (1–3). In the Indian context, the burden is further amplified due to demographic transition, increasing life expectancy, and disparities in healthcare access (4).

Stroke is defined as an acute neurological deficit resulting from interruption of cerebral blood flow, either due to ischemia or hemorrhage, leading to focal brain injury (5,6). It is one of the leading causes of mortality and long-term disability in India, with incidence rates ranging from 119 to 145 per 100,000 population annually (4,7). Indian studies have reported that a majority of stroke survivors suffer from residual motor deficits, with hemiparesis being the most common clinical presentation (7,8). Motor dysfunction following stroke is typically characterized by unilateral weakness, impaired coordination, and altered muscle tone due to damage to motor pathways such as the corticospinal tract (6,8).
The severity and pattern of motor impairment in stroke depend on lesion location, extent of neuronal damage, and timing of therapeutic intervention (6,9). Early post-stroke phases often involve flaccidity, followed by spasticity and abnormal motor synergies that limit voluntary movement and functional recovery (9). In India, delayed hospital presentation and limited access to specialized rehabilitation services significantly influence the degree of long-term motor disability (10).

Recent Indian data highlight substantial gaps in stroke rehabilitation infrastructure, particularly in rural and resource-limited settings (10,11).

Neuroplasticity plays a central role in post-stroke recovery, enabling reorganization of neural pathways and partial restoration of motor function (12). Emerging Indian research has also explored innovative rehabilitation strategies, including home-based therapy models, robotic-assisted rehabilitation, and integration of traditional practices such as yoga and Ayurveda, which have shown promising outcomes in improving motor function (11,13).

In contrast, Parkinson disease is a chronic, progressive neurodegenerative disorder primarily affecting the basal ganglia and extrapyramidal motor system (2,14). It is characterized by degeneration of dopaminergic neurons in the substantia nigra pars compacta and accumulation of α-synuclein in Lewy bodies (14,15). The cardinal motor features of PD include bradykinesia, resting tremor, rigidity, and postural instability (15,16).

The prevalence of Parkinson disease in India is estimated to range between 15 to 43 per 100,000 population, with higher rates observed in elderly individuals (17,18). Indian epidemiological studies have also highlighted regional variations in disease prevalence and presentation, possibly due to genetic, environmental, and lifestyle factors (18). The disease typically begins insidiously and progresses gradually, leading to cumulative motor disability over time (16,19).

Recent Indian studies have emphasized that PD is often underdiagnosed in early stages due to lack of awareness and limited access to neurologists, particularly in rural areas (20). Additionally, motor symptoms in Indian patients are frequently accompanied by non-motor manifestations such as cognitive impairment, autonomic dysfunction, and sleep disturbances, which further complicate disease management (19,20).

The pathophysiological mechanisms underlying motor dysfunction differ significantly between stroke and PD. Stroke results in focal structural damage to motor pathways, whereas PD involves progressive neurodegeneration and neurotransmitter imbalance within basal ganglia circuits (2,14,21). Consequently, stroke-related motor deficits are typically acute in onset, unilateral, and potentially reversible with rehabilitation, whereas PD-related deficits are chronic, bilateral, and progressive (21,22).

Assessment of motor dysfunction in these conditions relies on standardized clinical tools. The Fugl-Meyer Assessment (FMA) is widely used for evaluating motor recovery in stroke patients, while the Unified Parkinson's Disease Rating Scale (UPDRS) is considered the gold standard for assessing motor symptoms in PD (9,23). Functional disability is commonly measured using the Modified Rankin Scale (mRS), and mobility is assessed using performance-based tests such as the Timed Up and Go (TUG) test (23,24).

Despite the high prevalence and clinical importance of both stroke and Parkinson disease, limited studies—particularly from India—have directly compared motor dysfunction patterns between these two conditions. A comparative analysis is essential to better understand disease-specific impairments, address healthcare disparities, and optimize rehabilitation strategies in both global and Indian settings (11,25).

Therefore, the present study aims to comparatively analyze motor dysfunction in patients with stroke and Parkinson disease using standardized clinical and functional assessment tools.

MATERIALS AND METHODS

The present study was designed as a hospital-based cross-sectional observational study conducted in the Department of Neurology at a tertiary care center over a period of 12 months. The study aimed to comparatively evaluate motor dysfunction in patients diagnosed with stroke and Parkinson disease (PD). A total of 200 patients were included in the study, comprising two groups: 100 patients with stroke and 100 patients with Parkinson disease. The sample size was determined based on feasibility and patient availability during the study period.

Patients aged 40 years and above, of either gender, with a confirmed diagnosis of stroke or Parkinson disease were considered eligible for inclusion. Stroke patients were diagnosed based on clinical presentation supported by neuroimaging techniques such as computed tomography (CT) scan or magnetic resonance imaging (MRI), which confirmed either ischemic or hemorrhagic stroke. Parkinson disease patients were diagnosed according to established clinical diagnostic criteria, including the presence of cardinal motor symptoms such as bradykinesia, rigidity, resting tremor, and postural instability. Patients with mixed neurological disorders, severe cognitive impairment, psychiatric illness, or those who were unable to cooperate with clinical examination were excluded from the study.

Data collection was carried out after obtaining informed written consent from all participants or their caregivers. Ethical clearance for the study was obtained from the Institutional Ethics Committee prior to the commencement of the study. A detailed clinical history was obtained from each patient, including demographic details, duration of illness, comorbidities,

and treatment history. A thorough neurological examination was performed with particular emphasis on motor system evaluation.

Motor dysfunction was assessed using standardized and validated clinical scales. Functional disability in both groups was evaluated using the Modified Rankin Scale (mRS), which categorizes patients based on the degree of dependence in daily activities. Motor performance in stroke patients was assessed using the Fugl-Meyer Assessment (FMA), a stroke-specific scale that evaluates motor functioning, balance, sensation, and joint functioning. For patients with Parkinson disease, motor symptoms were assessed using the Unified Parkinson's Disease Rating Scale (UPDRS), particularly Part III, which focuses on motor examination. Mobility and functional ambulation were further assessed in both groups using the Timed Up and Go (TUG) test, which measures the time taken by a patient to stand up from a chair, walk a short distance, turn, and return to the seated position.

All assessments were conducted by trained clinicians to minimize inter-observer variability. Patients were evaluated during their stable clinical state, and in the case of Parkinson disease, assessments were preferably conducted during the "on" phase of medication to ensure consistency. The severity of motor dysfunction was categorized into mild, moderate, and severe based on standard scoring criteria of the respective scales.

The collected data were systematically recorded and entered into a database for analysis. Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) software version 25.0. Continuous variables were expressed as mean and standard deviation, while categorical variables were presented as frequencies and percentages. Comparative analysis between the two groups was carried out using appropriate statistical tests such as the Chi-square test for categorical variables and the independent t-test for continuous variables. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 200 patients were included in the study, comprising 100 patients diagnosed with stroke and 100 patients with Parkinson disease (PD). The data were analyzed to compare demographic characteristics, patterns of motor dysfunction, severity, functional disability, and mobility outcomes between the two groups.

Demographic Characteristics(Table1)

The mean age of patients in the stroke group was 62.4 ± 10.2 years, while in the PD group it was 65.8 ± 8.7 years. The difference in mean age between the two groups was not statistically significant (Independent t-test, $p = 0.08$). The gender distribution was also comparable, with males constituting 60% in the stroke group and 58% in the PD group, showing no significant difference (Chi-square test, $p = 0.76$). Both groups were demographically comparable, indicating minimal confounding due to age and gender.

Pattern of Motor Dysfunction(Table2)

The distribution of motor dysfunction differed markedly between the two groups. Hemiparesis was observed in 85% of stroke patients compared to only 5% of PD patients. In contrast, bradykinesia (90%), rigidity (85%), and tremor (80%) were predominantly seen in PD patients. Postural instability was also more common in PD (75%) compared to stroke patients (12%). The difference in distribution of motor features between the two groups was found to be highly statistically significant (Chi-square test, $\chi^2 = 145.6$, $p < 0.001$). Stroke is primarily associated with focal motor weakness, whereas PD is characterized by extrapyramidal features such as bradykinesia and rigidity.

Severity of Motor Dysfunction(Table3)

Motor dysfunction was categorized into mild, moderate, and severe based on clinical scoring systems. In the stroke group, 20% of patients had mild, 50% had moderate, and 30% had severe motor dysfunction. In contrast, in the PD group, 35% had mild, 45% had moderate, and 20% had severe impairment. The difference in severity distribution between the two groups was statistically significant (Chi-square test, $\chi^2 = 6.72$, $p = 0.034$). Stroke patients tend to present with more severe motor impairment initially compared to PD patients, who demonstrate relatively milder but progressive dysfunction.

Functional Disability (Modified Rankin Scale – mRS)(Table4)

Functional disability assessment revealed that 25% of stroke patients had mild disability (mRS 0–2), 50% had moderate disability (mRS 3–4), and 25% had severe disability (mRS 5). In comparison, PD patients showed 40% mild, 45% moderate, and 15% severe disability.

The difference in functional disability between the two groups was statistically significant (Chi-square test, $\chi^2 = 7.85$, $p = 0.02$). Stroke patients exhibit higher levels of functional disability compared to PD patients, especially in the early stages.

Mobility Assessment (Timed Up and Go Test – TUG)(Table5)

The mean TUG time in the stroke group was 22.5 ± 5.8 seconds, whereas in the PD group it was 18.3 ± 4.6 seconds. The difference was statistically significant (Independent t-test, $t = 5.64$, $p < 0.001$).Stroke patients demonstrated significantly poorer mobility compared to PD patients, likely due to muscle weakness and impaired balance.

Correlation Between Motor Dysfunction and Functional Disability(Table6)

A strong positive correlation was observed between severity of motor dysfunction and functional disability in both groups. In stroke patients, higher FMA impairment scores correlated significantly with higher mRS scores (Pearson correlation, $r = 0.68$, $p < 0.001$). Similarly, in PD patients, higher UPDRS scores showed strong correlation with increased disability ($r = 0.72$, $p < 0.001$). Increased severity of motor dysfunction is strongly associated with greater functional dependence in both conditions.

Table 1: Comparison of Demographic Characteristics between Stroke and Parkinson Disease Patients

Variable	Stroke (n=100)	PD (n=100)	Test Used	p-value
Mean Age (years)	62.4 ± 10.2	65.8 ± 8.7	Independent t-test	0.08(NS)
Male (%)	60 (60%)	58 (58%)	Chi-square test	0.76(NS)
Female (%)	40 (40%)	42 (42%)		

Table 2: Distribution of Motor Dysfunction in Stroke and Parkinson Disease

Motor Feature	Stroke (n=100)	PD (n=100)	χ^2 Value	p-value
Hemiparesis	85 (85%)	5 (5%)	145.6	<0.001(HS)
Bradykinesia	10 (10%)	90 (90%)		
Tremor	5 (5%)	80 (80%)		
Rigidity	8 (8%)	85 (85%)		
Postural Instability	12 (12%)	75 (75%)		

Table 3: Severity of Motor Dysfunction among Study Groups

Severity Level	Stroke (n=100)	PD (n=100)	χ^2 Value	p-value
Mild	20 (20%)	35 (35%)	6.72	0.034(S)
Moderate	50 (50%)	45 (45%)		
Severe	30 (30%)	20 (20%)		

Table 4: Functional Disability Assessment using Modified Rankin Scale (mRS)

mRS Score Category	Stroke (n=100)	PD (n=100)	χ^2 Value	p-value
0–2 (Mild)	25 (25%)	40 (40%)	7.85	0.02(S)
3–4 (Moderate)	50 (50%)	45 (45%)		
5 (Severe)	25 (25%)	15 (15%)		

Table 5: Comparison of Mobility using Timed Up and Go (TUG) Test

Parameter	Stroke (n=100)	PD (n=100)	t-value	p-value
Mean TUG Time (sec)	22.5 ± 5.8	18.3 ± 4.6	5.64	<0.001

Table 6: Correlation between Motor Dysfunction and Functional Disability

Group	Assessment Tool	Correlation Coefficient (r)	p-value	
Stroke	FMA vs mRS	0.68	<0.001	Strong positive correlation
PD	UPDRS vs mRS	0.72	<0.001	Strong positive correlation

DISCUSSION

he present study provides a comparative evaluation of motor dysfunction in patients with stroke and Parkinson disease (PD), highlighting differences in clinical presentation, progression, and rehabilitation outcomes. These findings are further strengthened by recent global and Indian studies published between 2024 and 2025.

Stroke patients in this study predominantly exhibited acute-onset unilateral motor deficits. Recent evidence from Indian and Asian collaborative research highlights that a large proportion of stroke survivors experience persistent motor disability, with motor weakness being the most common impairment affecting up to 70–75% of patients (26). Furthermore, Indian studies emphasize that delayed access to acute stroke care and rehabilitation services contributes significantly to long-term motor dysfunction (27). These findings are consistent with our observation of higher initial functional disability among stroke patients.

Neurorehabilitation strategies in India are evolving rapidly. A 2024 Indian study on stroke rehabilitation identified significant disparities in access to rehabilitation services, particularly influenced by socioeconomic and gender-related factors, which can affect motor recovery outcomes (27). Additionally, innovative rehabilitation approaches such as home-based robotic therapy, as explored in Indian centers like Christian Medical College, Vellore, have shown promising feasibility in improving motor outcomes (28). These advancements highlight the growing role of technology-assisted rehabilitation in the Indian healthcare context.

Recent Indian clinical trials have also explored integrative and alternative medicine approaches. A 2025 multicentric randomized controlled trial (RESTORE trial) demonstrated that Ayurvedic rehabilitation therapy may improve motor recovery and functional outcomes in ischemic stroke patients when compared with conventional physiotherapy (29). Similarly, studies from AIIMS have reported that integrated yoga and naturopathy interventions can enhance motor and cognitive recovery in post-stroke patients (30). These findings are particularly relevant in India, where complementary therapies are widely practiced and culturally accepted.

In contrast, Parkinson disease patients in this study exhibited progressive bilateral motor dysfunction. Indian research contributions, including studies from institutions such as IIT Jodhpur, have further elucidated the molecular and neurodegenerative mechanisms underlying PD, emphasizing its complex interaction with both motor and cognitive pathways (31). These studies reinforce that PD is not merely a motor disorder but involves widespread neurobiological changes.

Recent global and Indian evidence also highlights that PD management remains largely symptomatic, with no definitive disease-modifying therapy. Motor fluctuations, dyskinesias, and progressive disability remain significant challenges despite pharmacological advancements (32). Emerging research suggests that early detection using artificial intelligence and digital biomarkers may help identify motor dysfunction at preclinical stages, offering new opportunities for intervention (33).

Another important aspect emerging from recent literature is the overlap between vascular and neurodegenerative mechanisms. Indian and international studies suggest that cerebrovascular pathology may contribute to parkinsonian features, and stroke patients may have an increased risk of developing Parkinsonism (34). This overlap has important implications for diagnosis and management, particularly in elderly populations.

From a therapeutic perspective, recent evidence (2024–2025) indicates that advanced interventions such as stem cell therapy are being explored in India for enhancing motor recovery in stroke patients. A systematic review involving Indian institutions reported promising outcomes in terms of motor function improvement, although further large-scale trials are needed (35). These findings align with the concept of neurorestoration and regenerative medicine as future directions in stroke rehabilitation.

Overall, the findings of the present study are consistent with both global and Indian literature, demonstrating that stroke-related motor dysfunction is acute, focal, and potentially reversible with timely rehabilitation, whereas Parkinson disease is characterized by chronic, progressive motor decline. The inclusion of Indian studies highlights the unique challenges and innovations in the Indian healthcare system, including disparities in rehabilitation access, integration of traditional medicine, and emerging technological advancements.

CONCLUSSION

Motor dysfunction in stroke and Parkinson disease differs significantly in onset, pattern, and progression. Stroke leads to acute, often severe unilateral deficits with potential recovery, whereas Parkinson disease results in chronic, progressive bilateral impairment**.**

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