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# Flaccidity to Functionality of Upper Extremity in Stroke Patients: A Retrospective Case Series

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**Abstract:** ***Background: Stroke, as defined by the World Health Organization, is a leading cause of disability and mortality (1). Rehabilitation plays a crucial role in optimizing upper limb function and quality of life in stroke patients. However, limited research exists on recovery progress in the Indian context. Objective: This retrospective case series aims to explore the phase-wise recovery of upper extremity function in adult stroke patients, emphasizing the transition from flaccidity to voluntary movement and functional use in a tertiary care centre. Methods: Clinical records of adult stroke patients admitted for rehabilitation between 2024 and 2025 were reviewed. Inclusion criteria included adults (18–50 years) presenting with upper limb flaccidity,6 months rehabilitation duration, and unilateral stroke. Exclusion criteria were presence of additional neurological or psychiatric conditions. Recovery was tracked using Brunnstrom Staging of Motor Recovery, Modified Ashworth Scale, and Fugl-Meyer Upper Extremity Assessment. Results: 59% reached the pre-functional phase within 3 months, and 33% attained consistent functional use of the upper limb by 6 months. Outcomes correlated positively with therapy intensity and patient engagement. Conclusion: Early rehabilitation, reassessment, and long-term support are essential for optimizing recovery. This study adds context-specific evidence for stroke rehabilitation pathways in India. Descriptive statistics with sample size of 10 was used to analyse the percentage of recovery according to Age, Stroke type, Severity, Location of Injury, Side affected and Rehab months.***

**Keywords**: Upper Extremity Rehabilitation, Stroke Recovery, Phase-wise Motor Recovery, Flaccidity to Functionality, Occupational Therapy, Brunnstrom Staging

## 1. Introduction

Stroke is a leading cause of mortality and long-term disability worldwide. It is the fourth leading cause of death and the fifth leading cause of disability globally, with an increasing burden in India due to lifestyle-related risk factors. Upper extremity dysfunction is one of the most common and disabling consequences of stroke, leading to dependency in Activities of Daily Living (ADLs). Rehabilitation is therefore essential for improving motor recovery and functional outcomes.

Several international studies have explored the natural course of recovery and the impact of rehabilitation strategies. However, there is a paucity of research in the Indian context that specifically addresses the transition from flaccidity to functionality of the upper extremity. This paper aims to bridge that gap by analysing retrospective data from a tertiary rehabilitation centre.

Stroke incidence in India is **not only high**, but also **rising**, especially in urban areas and among younger age groups. Upper limb flaccidity post-stroke severely limits Activities of Daily Living (ADL) and degrades quality of life.

Limited comprehensive studies exist in the Indian context regarding specific interventions and recovery trajectories.

## 2. Objective

1) To explore and characterize the phase-wise recovery of upper extremity function in adult stroke patients.
2) To specifically track the transition from flaccidity to voluntary movement, and ultimately to consistent functional use of the affected limb.

## 3. Methods

**Location of the study:**
The study was conducted from Mar 2024–April 2025 at a Tertiary Care Centre (All India Institute of Physical Medicine and Rehabilitation, Mumbai).

**Study Design:**
The study is a retrospective case series with sample size of 10 patients with stroke. It is an observational study to track and characterize the phase wise transition from flaccidity to functionality in patients with stroke.

**Population of the Study:**
Inclusion Criteria: Adults aged 18–50 years, diagnosed with unilateral stroke, presenting with initial upper extremity flaccidity, and having completed a minimum of 6 months of continuous rehabilitation.

Ethical Approval was taken from institutional Ethical Committee.

**Inclusion criteria:**
- Adult patients aged 18–50 years.
- First-ever unilateral stroke with initial upper limb flaccidity.
- Minimum rehabilitation duration of 6 months.

**Exclusion criteria:**
- Additional neurological or psychiatric conditions.

**Outcome Measures:**
- Brunnstrom Stages of Motor Recovery
- Modified Ashworth Scale (MAS) for tone assessment
- Fugl-Meyer Upper Extremity (UE) Assessment

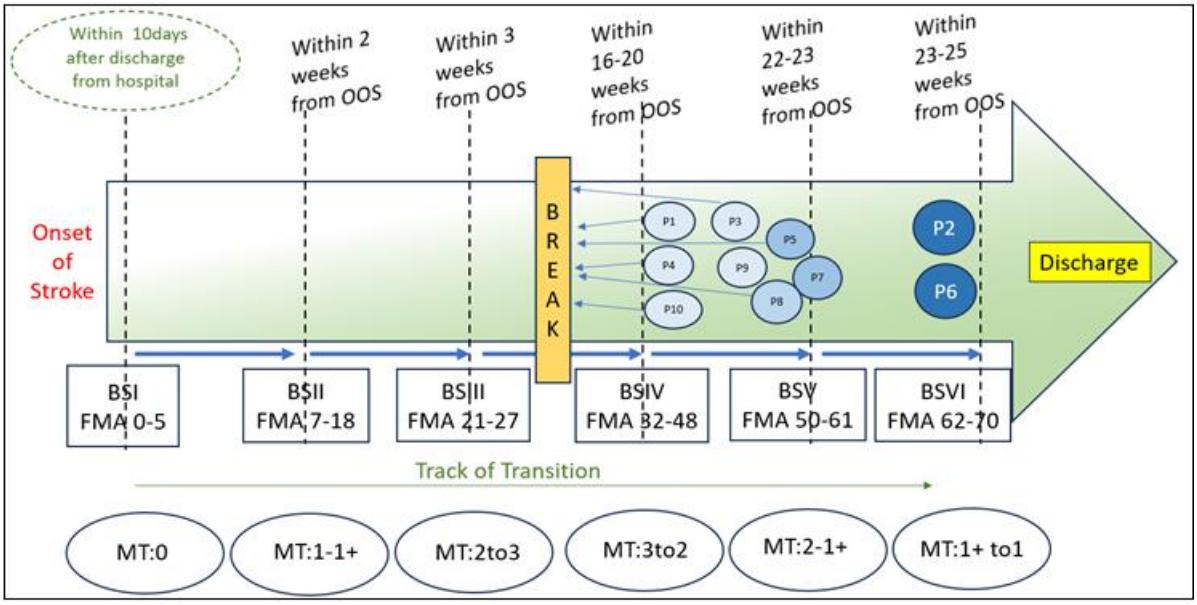
## 4. Method of Study

This retrospective case series reviewed the clinical records of stroke patients admitted for rehabilitation at a tertiary Physical Medicine & Rehabilitation (PMR) centre in India during 2024–2025.The data's were included in the study according to inclusion and exclusion criteria.10 days after stroke, when the patient became stable and was being admitted to the rehabilitation set up since then the records are documented. The regular Occupational Therapy programme as per NDT Approaches and client specific approach (5) was undergoing during the span of admission by the Occupational Therapy in a common routine pattern. Brunnstrom stages of motor recovery (2), Muscle Tone and Fugl Meyer Upper Extremity assessment was measured in repeated intervals (2wks, 3wks, 16-20wks, 22-23wks, 23-25wks) and the recovery was tracked from flaccidity to voluntary movement, and ultimately to consistent functional use of the affected limb. The tracking was done through measuring the 3 scales of recovery already mentioned. The scores for the scales were taken as an when significant improvement was seen till discharge.

**Diagram A** shows the method of study and phase wise patient recovery post stroke. The abbreviated forms in the diagram is explained below:-

**OOS-Onset of stroke**
**BS-Brunnstrom Stages**
**FMA-Fugl Meyer Upper Extremity Assessment**
**MT-Muscle Tone**
**P-Patient**

**Diagram A**




## 5. Result

The study revealed that the majority of patients demonstrated meaningful recovery patterns:

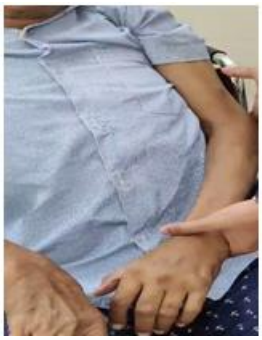
- 59% achieved the pre-functional phase within 3 months of rehabilitation.
- 33% attained consistent functional use of the affected upper extremity by 6 months.
- Functional outcomes were positively correlated with therapy intensity and patient engagement.

**Table 1:** Patient Demographics (Sample)

| Patient ID | Age (in years)/ Sex | Stroke Type | Severity | Location | Side affected | Rehab Months | Outcome |
|---|---|---|---|---|---|---|---|
| 1 | 49/M | Ischemic | Moderate | Cortical Infarct | Lt side | 6 | Pre-functional |
| 2 | 47/F | Ischemic | Moderate | Lacunar Infarct | Rt side | 8 | Functional use |
| 3 | 43/M | Ischemic | Moderate | Lacunar Infarct | Rt side | 6 | Pre-functional |
| 4 | 48/M | Haemorrhagic | Severe | Brainstem | Lt side | 9 | Pre-functional |
| 5 | 45/F | Ischemic | Moderate | Internal capsule | Lt side | 9 | Pre-functional |
| 6 | 50/F | Ischemic | Moderate | Subcortical infarct | Rt side | 6 | Functional use |
| 7 | 35/M | Haemorrhagic | Moderate | Intraventricular hemorrhage | Lt side | 10 | Pre-functional |
| 8 | 41/M | Ischemic | Moderate | Lacunar infarct | Lt side | 8 | Pre-functional |
| 9 | 50/M | Ischemic | Moderate | Cortical infarct | Rt side | 6 | Pre-functional |
| 10 | 36/M | Haemorrhagic | Moderate | Thalamic | Lt side | 6 | Pre-functional |

Table 1 shows the demographics of 10 patient data's related to Age, Sex, Stroke type, Location, Side affected and Rehab Months. It also revealed the percentage of Pre- functional and Functional stage of recovery.

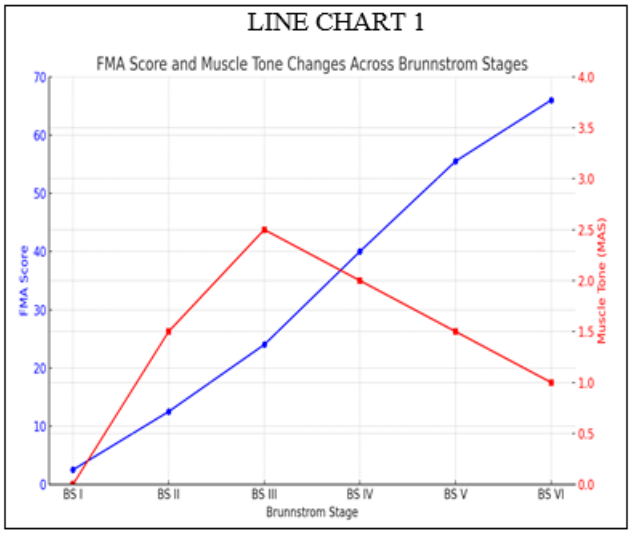
These findings indicate that while some recovery is achievable within months, full functionality remains limited without sustained rehabilitation. The images below shows the Brunnstrom stages of recovery.


Flaccid stage

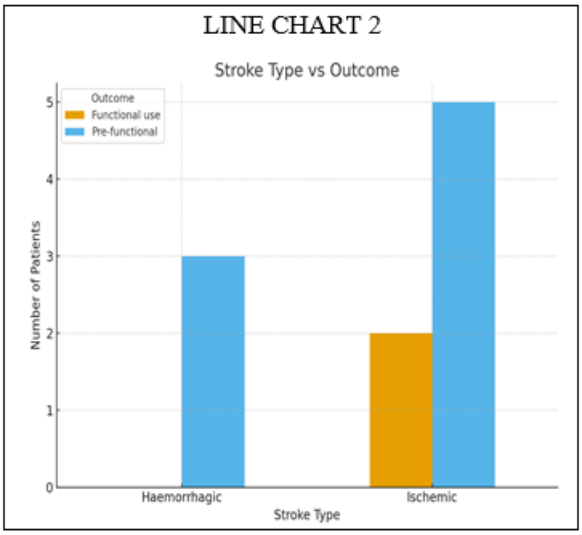

Synergy Breaking Pattern


Voluntary Movement

**Brunnstrom Stage Progression**




The line chart illustrates the average progression through Brunnstrom Stages over 6 months of rehabilitation.




The line chart illustrates the average progression through Brunnstrom Stages over 6 months of rehabilitation.

## 6. Discussion

The present framework (Diagram A) illustrates the longitudinal motor recovery trajectory of patients (P) following **onset of stroke (OOS)** through different post-stroke phases, integrating **Brunnstrom Stages (BS)**, **Fugl-Meyer Assessment – Upper Extremity (FMA-UE)** scores, and **Muscle Tone (MT)** progression. The model captures structured assessment points from the acute phase through discharge (up to 23–25 weeks), highlighting functional transition and variability in recovery patterns.

**1) Early Phase (0–3 Weeks Post OOS)**

During the immediate post-stroke period (BS I–III; FMA 0–27), patients typically present with:

- Flaccidity (MT: 0 to 1+)
- Minimal voluntary control
- Emerging spasticity patterns

This phase corresponds to neural shock and early reorganization. The low FMA scores (0–5 progressing to 21–27) reflect limited voluntary motor output. The transition from MT 0 to MT 1+ and 2 indicates increasing tone and development of synergistic movements, consistent with Brunnstrom's recovery sequence.(5)

**2) Subacute Phase (3–12 Weeks)**

In BS IV–V (FMA 28–61), patients begin demonstrating:

- Decline in obligatory synergy patterns
- Improved selective voluntary control
- Gradual normalization or modulation of muscle tone

The diagram A shows multiple patients (P1–P10) clustered within this recovery window (16–23 weeks from OOS), suggesting variability in recovery velocity despite similar time frames. Muscle tone shifts from higher spasticity (MT 2–3) toward moderate or mild tone (MT 2–1+). This phase represents critical neuroplastic reorganization, where structured rehabilitation has maximal impact.

The "Break" phase indicated in the diagram likely represents a disruption (e.g., discharge gap, reduced therapy intensity, or environmental change), which may influence the slope of recovery. Despite this interruption, patients continue functional progression, emphasizing that recovery is dynamic rather than strictly linear.

**3) Late Subacute to Early Chronic Phase (16–25 Weeks)**

By BS VI (FMA 62–70), patients demonstrate:

- Near-normal movement patterns
- Greater dissociation of joint movements
- Functional use of upper extremity

Muscle tone trends toward normalization (MT 1+ to 1). The clustering of P2 and P6 near discharge suggests comparatively better recovery outcomes. However, inter-individual variability persists, highlighting that recovery is influenced by lesion characteristics, rehabilitation intensity, age, comorbidities, and psychosocial factors.

**4) Track of Transition**

The "Track of Transition" line demonstrates:

- Progressive improvement in FMA scores
- Gradual advancement across Brunnstrom stages
- Muscle tone modulation over time

Importantly, recovery does not strictly follow a uniform timeline. Some patients may plateau temporarily, while others accelerate depending on therapeutic interventions. The presence of varied MT progressions (0 → 1+ → 2 → 3 → 2 → 1+) reflects the classical evolution of post-stroke spasticity: initial flaccidity, peak spasticity, and partial resolution with motor recovery (5).

**5) Clinical Implications**

a) **Early Identification & Intervention:** Maximum gains occur in the early subacute phase; therefore, intensive upper extremity rehabilitation should be initiated early.
b) **Monitoring Using Standardized Tools:** The combined use of BS, FMA-UE, and MT grading provides a multidimensional understanding of motor recovery.
c) **Individualized Therapy Planning:** Patient clustering in mid-recovery stages suggests heterogeneity; rehabilitation should be tailored rather than protocol-driven.
d) **Continuity of Care:** The "break" period emphasizes the importance of minimizing therapy gaps to prevent stagnation.
e) **Prognostic Value:** Early FMA scores and tone progression can help predict functional outcomes at discharge.

The findings of this case series highlight the significance of structured rehabilitation in the transition from flaccidity to functionality in stroke patients. While international studies report variable outcomes in upper limb recovery, this study provides valuable insights specific to the Indian context, where resources and awareness may be limited.

The observed correlation between therapy intensity and outcomes aligns with the principle of neuroplasticity and the importance of task-specific practice. Only a third of patients achieved consistent functionality by 6 months, underscoring the need for long-term, individualized rehabilitation plans (3).

These results emphasize the importance of multidisciplinary care and continuous monitoring to maximize recovery potential.

## 7. Limitations

This study is limited by its small sample size and retrospective design. The absence of randomization and control groups limits the generalizability of findings. Additionally, self-reported engagement levels may have introduced bias. Despite these limitations, the findings provide valuable context-specific insights for Indian rehabilitation practices.

## 8. Conclusion & Clinical Implications

This retrospective case series reinforces the importance of early, structured, and sustained rehabilitation in stroke recovery. The transition from flaccidity to functional use of the upper limb is possible but requires individualized multimodal therapy and long-term follow-up.

The study adds to the growing body of Indian evidence supporting context-specific rehabilitation pathways, which are crucial for improving functional outcomes and quality of life among stroke survivors.

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