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FITT-Based Physiotherapy in Chronic Stroke: A Case Report on Functional Recovery

Aulia Farah Maharani[1], Umi Budi Rahayu[2], Salma Muzarroh[3]

[1,2,3]Professional Physiotherapy Education Program, Faculty of Health Sciences, Universitas Muhammadiyah Surakarta, Indonesia

Corresponding author:
Name: Aulia Farah Maharani
E-mail: arsipfileaulia@gmail.com

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Abstract

Background: Stroke is a leading cause of long-term disability, frequently resulting in neuromuscular impairments such as muscle weakness, spasticity, balance deficits, and reduced functional independence. Structured physiotherapy interventions based on the FITT (Frequency, Intensity, Time, Type) principle are essential for optimizing rehabilitation outcomes.
Objective: To evaluate the effects of a FITT-based physiotherapy program on pain, spasticity, muscle strength, balance, and functional independence in a patient with chronic stroke.
Methods: This prospective case report involved a 45-year-old female with chronic non-hemorrhagic stroke (1-year post-onset) presenting with left-sided hemiparesis. The intervention was conducted over 3 weeks, consisting of infrared therapy (10–15 minutes), passive–active range of motion exercises (10–15 repetitions), static stretching (10–15 seconds, 5 repetitions), functional strengthening (sit-to-stand), and balance training. Outcomes were assessed pre- and post-intervention using the Verbal Rating Scale (VRS), Manual Muscle Testing (MMT), Modified Ashworth Scale (MAS), Four Square Step Test (FSST), and Barthel Index.
Results: Pain decreased from 5 to 2 (−60%), spasticity reduced from MAS 2 to 1 (−50%), muscle strength improved from MMT grade 3 to 4 (+33%), FSST time improved from 22 to 15 seconds (−31.8%), and the Barthel Index increased from 60 to 80 (+33.3%).
Conclusion: A structured FITT-based physiotherapy program resulted in clinically meaningful improvements in neuromuscular function and functional independence in chronic stroke.

Keywords
Stroke; Exercise Therapy; Physical Therapy Modalities; Spasticity; Postural Balance; Activities of Daily Living

Introduction

Stroke remains a major global health burden and is one of the leading causes of long-term disability worldwide. It occurs due to disruption of cerebral blood flow, resulting in neuronal injury and persistent neurological deficits.[1,2] Recent global estimates indicate that stroke continues to contribute substantially to morbidity and disability-adjusted life years (DALYs), particularly in low- and middle-income countries where access to comprehensive rehabilitation remains limited.[2–4]

Post-stroke impairments commonly include muscle weakness, impaired motor control, spasticity, and balance dysfunction, all of which significantly affect functional independence.[5] These neuromuscular deficits directly impact the patient's ability to perform activities of daily living such as walking, transferring, and self-care.[5,6] If not addressed through appropriate rehabilitation, these limitations may lead to prolonged dependency, increased caregiver burden, and reduced quality of life.

Rehabilitation is therefore a critical component in the continuum of stroke management, aiming to maximize functional recovery and minimize long-term disability.[7] Physiotherapy plays a central role in this process through structured therapeutic exercise interventions designed to improve strength, flexibility, coordination, and functional performance.[8] Evidence from systematic reviews demonstrates that progressive and task-specific physiotherapy interventions significantly enhance motor recovery and functional outcomes in stroke patients.[9]

A key determinant of successful rehabilitation is the appropriate prescription of exercise dosage. The FITT principle (Frequency, Intensity, Time, Type) provides a structured framework for designing individualized and progressive exercise programs.[10] By systematically adjusting these parameters, physiotherapists can ensure that the intervention is both safe and sufficiently challenging to stimulate neuromuscular adaptation and functional recovery.[11] Recent studies (2023–2025) emphasize that structured exercise prescription using FITT parameters improves adherence, optimizes training load, and enhances rehabilitation outcomes in neurological populations.[12–14]

In addition to exercise prescription, the International Classification of Functioning, Disability and Health (ICF) framework offers a comprehensive approach to patient assessment and intervention planning.[15,16] This framework integrates body function, activity, and participation domains, allowing clinicians to evaluate not only physiological improvements but also meaningful functional gains in daily life.[17] The integration of FITT-based exercise prescription with the ICF framework is increasingly recognized as a best-practice approach in neurorehabilitation.[18]

Despite the growing body of evidence supporting physiotherapy interventions in stroke rehabilitation, there remains a lack of detailed clinical reports describing the practical implementation of FITT-based programs, particularly in patients in the chronic phase of stroke. Most existing studies focus on group-based interventions or controlled trials, with limited reporting on individualized dosage progression, clinical reasoning, and real-world application in clinical settings. This gap is especially evident in Indonesian healthcare contexts, where documentation of structured physiotherapy programs based on FITT principles is still scarce.

Furthermore, few case reports comprehensively describe the integration of FITT parameters with functional outcomes aligned to the ICF framework, including spasticity, balance, and functional independence. As a result, there is limited clinical guidance for physiotherapists regarding how to operationalize FITT-based interventions in daily practice for chronic stroke patients.

Therefore, this case report aims to provide a comprehensive clinical description of the effects of a FITT-based physiotherapy program on neuromuscular function, balance, and functional independence in a patient with chronic stroke. By presenting detailed

intervention parameters and clinical outcomes, this study seeks to contribute practical evidence to support the implementation of structured physiotherapy programs in real-world clinical settings.

Methods

This study employed a prospective descriptive case report design with a pre-test and post-test approach. The study was conducted in accordance with the CARE (CAse REport) guidelines to ensure comprehensive and transparent reporting of clinical information. This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. As this report describes a single clinical case without experimental intervention beyond routine physiotherapy care, formal ethical committee approval was not required according to institutional policy. Written informed consent was obtained from the patient for participation in the physiotherapy program and for publication of anonymized clinical information, including clinical findings and outcomes. All personal identifiers were removed to ensure patient confidentiality and privacy.

The study was conducted at the Physiotherapy Unit of RSUD Bung Karno Surakarta, Indonesia, between July and August 2025. During this period, the patient underwent a structured physiotherapy program based on the FITT principle. The subject was a 45-year-old female diagnosed with non-hemorrhagic stroke one year prior to the intervention (chronic phase). The patient presented with left-sided hemiparesis, characterized by muscle weakness, increased muscle tone, impaired balance, and reduced functional independence. The main complaints included difficulty in standing and walking, impaired balance during transfers, and dependence in daily activities. Additional symptoms included left shoulder pain (VRS score of 5), muscle stiffness, and early fatigue during physical activity. The patient had no severe cognitive impairment and was able to follow verbal instructions adequately. No significant comorbidities or relevant family history were reported.

Initial physiotherapy assessment was conducted using standardized clinical instruments. The findings indicated moderate functional impairment with neuromuscular deficits affecting the left side of the body. Table 1 presents the baseline clinical characteristics of the patient prior to intervention.

Table 1. Baseline Clinical Characteristics

Parameter	Measurement	Interpretation
Pain (VRS)	5	Moderate pain
Muscle strength (MMT)	Grade 3	Active movement against gravity
Spasticity (MAS)	Grade 2	Marked increase in tone
Balance (FSST)	22 seconds	Impaired dynamic balance
Functional independence (Barthel Index)	60	Moderate dependency

From an ICF perspective, the patient demonstrated impairments in body function (muscle weakness, spasticity, pain), activity limitations (difficulty walking, standing, transferring), and participation restrictions (dependence in daily activities). Inclusion criteria were: (1) clinically diagnosed stroke, (2) stable medical condition, (3) presence of motor and balance impairments, and (4) ability to follow simple instructions. Exclusion criteria included severe cognitive impairment, significant medical complications, and musculoskeletal disorders that could interfere with the intervention.

The physiotherapy intervention was designed based on the FITT principle (Frequency, Intensity, Time, and Type) to ensure a structured, individualized, and progressive approach tailored to the patient's clinical condition. The program was administered at a frequency of 5–6 sessions per week, with each session lasting approximately 30–45 minutes, resulting in a total exercise dose of approximately 150–270 minutes per week. The intensity of the intervention was maintained at a low-to-moderate level and was continuously adjusted according to the patient's tolerance to prevent exacerbation of pain or excessive fatigue.

The intervention program comprised multiple therapeutic components, including infrared therapy administered for 10–15 minutes, passive to active-assisted range of motion exercises performed for 10–15 repetitions per joint, and static stretching with a duration of 10–15 seconds per repetition for five repetitions. In addition, functional strengthening exercises, particularly sit-to-stand movements ranging from 5 to 15 repetitions, were incorporated to improve lower limb strength and functional mobility. Balance training was also included, consisting of static standing exercises and dynamic stepping activities to enhance postural control and coordination.

To ensure reproducibility, the infrared modality was applied using a wavelength range of approximately 700–1400 nm, with a treatment distance of 45–60 cm from the target area. The intervention was progressively modified on a weekly basis according to the patient's clinical response, including adjustments in exercise complexity, level of assistance, and number of repetitions. To ensure clarity and reproducibility, the progression of the intervention is summarized in Table 2. Table 2 presents the structured progression of the FITT-based intervention across three weeks.

Table 2. Weekly Progression of FITT-Based Physiotherapy Program

Week	Focus	Intervention Details	Progression
Week 1	Pain reduction and spasticity inhibition	Infrared, passive-assisted ROM, static stretching, bed mobility	Full assistance
Week 2	Motor control and initial strengthening	Active ROM, sit-to-stand, static balance training	Reduced assistance
Week 3	Functional training and dynamic balance	Gait training, FSST-based exercises, dynamic balance	Minimal assistance

Progression was achieved by increasing repetitions, reducing assistance, and introducing more complex functional tasks. Clinical outcomes were assessed before and after the intervention using standardized and validated measurement instruments to capture changes in pain, neuromuscular function, balance, and functional independence. Pain intensity was evaluated using the Verbal Rating Scale (VRS), while muscle strength was assessed using Manual Muscle Testing (MMT). Spasticity was measured using the Modified Ashworth Scale (MAS), and dynamic balance was evaluated using the Four Square Step Test (FSST). Functional independence in activities of daily living was assessed using the Barthel Index. All assessments were conducted by the same physiotherapist to ensure consistency and reduce inter-rater variability.

Measurements were performed under similar conditions at baseline (pre-test) and immediately after completion of the 3-week intervention period (post-test). These instruments are widely used in stroke rehabilitation and have demonstrated acceptable validity and reliability in both clinical and research settings. The VRS is recognized as a simple and reliable tool for assessing subjective pain intensity. The MMT is commonly used to evaluate muscle strength and has demonstrated good clinical applicability despite its ordinal nature. The MAS is a standard clinical tool for assessing spasticity, although it primarily reflects resistance to passive movement rather than neural components alone. The FSST has been shown to be a reliable and valid measure of dynamic balance and fall risk in neurological populations. The Barthel Index is a well-established instrument with strong reliability and validity for assessing functional independence in patients with stroke. To enhance interpretability of the findings, outcome changes were

analyzed by comparing pre- and post-intervention values and calculating percentage change for each parameter, providing a clearer representation of clinical improvement.

Patient adherence to both supervised physiotherapy sessions and home exercise was monitored through direct observation and patient self-report. The patient demonstrated good adherence, completing the prescribed sessions without interruption. No adverse events, such as increased pain, fatigue, or injury, were reported during the intervention period. Data were analyzed descriptively by comparing pre- and post-intervention values for each outcome measure. Percentage change was calculated to provide a clearer representation of clinical improvement.

Results

Clinical outcomes were evaluated before and after a 3-week FITT-based physiotherapy intervention. Changes were observed across all measured parameters, including pain intensity, muscle strength, spasticity, balance performance, and functional independence. To provide a clear comparison of clinical outcomes, the pre- and post-intervention results, along with percentage changes, are presented in Table 3.

Table 3. Clinical Outcomes Before and After Intervention

Parameter	Pre-test	Post-test	% Change
Pain (VRS)	5	2	−60%
Muscle strength (MMT)	3	4	+33.3%
Spasticity (MAS)	2	1	−50%
Balance (FSST, seconds)	22	15	−31.8%
Functional independence (Barthel Index)	60	80	+33.3%

Pain intensity decreased from a score of 5 (moderate) to 2 (mild). Muscle strength improved from grade 3 to grade 4, indicating the ability to perform movement against moderate resistance. Spasticity decreased from grade 2 to grade 1. Balance performance improved, as reflected by a reduction in FSST completion time from 22 seconds to 15 seconds. Functional independence increased from a Barthel Index score of 60 to 80.

To comply with CARE guidelines, the clinical course of the patient, including intervention phases and outcome assessments, is summarized narratively as follows. The patient underwent baseline assessment prior to intervention, followed by a structured physiotherapy program over three weeks with progressive adjustments in exercise intensity and complexity. Outcome evaluation was conducted at the end of the intervention period using the same measurement instruments.

Patient adherence to the physiotherapy program, including both supervised sessions and prescribed home exercises, was reported as good throughout the intervention period. The patient completed all scheduled sessions without interruption. No adverse events, including increased pain, fatigue, or injury, were reported.

Discussion

This case report demonstrates that a structured physiotherapy program based on the FITT principle resulted in clinically meaningful improvements in pain, spasticity, muscle strength, balance, and functional independence in a patient with chronic stroke. These findings highlight the potential effectiveness of individualized and progressive exercise prescription in promoting neuromuscular recovery.

The reduction in pain observed in this study may be attributed to the combined effects of infrared therapy and active therapeutic exercises. Infrared application is known to enhance local circulation and promote muscle relaxation, thereby reducing nociceptive input and muscle tension.[10] In addition, active movement and functional exercises may facilitate endogenous pain modulation mechanisms, contributing to improved patient comfort and increased tolerance to rehabilitation.[19,20] The observed decrease in pain likely played a supportive role in enabling greater participation in the exercise program.

The decrease in spasticity from MAS grade 2 to grade 1 suggests modulation of hyperactive stretch reflexes, which are commonly associated with upper motor neuron lesions in stroke.[20] Repeated static stretching may enhance presynaptic inhibition and reduce alpha motor neuron excitability, leading to decreased muscle tone.[9,21] Furthermore, active and functional movements contribute to improved supraspinal control, reinforcing inhibitory pathways and promoting more coordinated motor output. These findings are consistent with previous studies demonstrating that structured physiotherapy interventions can effectively reduce spasticity in post-stroke patients.[9,10]

Improvements in muscle strength and balance performance indicate significant neuromuscular adaptation. The increase in muscle strength from MMT grade 3 to 4 reflects enhanced motor unit recruitment and improved neuromuscular coordination.[22,23] Similarly, the reduction in FSST completion time suggests improved dynamic balance and postural control. These changes can be explained by motor relearning processes and neuroplasticity, where repetitive, task-specific training induces cortical reorganization and strengthens neural pathways involved in movement control.[24,25]

The increase in the Barthel Index score further demonstrates that improvements at the level of body function translated into meaningful gains in functional independence. This finding aligns with the International Classification of Functioning, Disability and Health (ICF) framework, which emphasizes the relationship between impairments, activity limitations, and participation restrictions.[17] The integration of FITT-based exercise prescription with an ICF-oriented approach may therefore enhance the clinical relevance of rehabilitation outcomes by ensuring that physiological improvements lead to functional gains in daily life.[26]

Compared to previous studies, the findings of this case report are consistent with evidence suggesting that structured and progressive physiotherapy interventions improve motor recovery and functional outcomes in stroke rehabilitation.[9,24] However, unlike many controlled trials that focus on group-level outcomes, this case report provides a detailed description of individualized exercise prescription using the FITT framework, including progression of intensity, duration, and task complexity. This level of detail contributes to the practical applicability of the findings in clinical settings.[27,28]

An additional strength of this report lies in the integration of detailed intervention parameters with clinically meaningful outcome measures, allowing for better reproducibility and clinical translation. The structured progression of the intervention across three weeks reflects real-world physiotherapy practice and demonstrates how exercise dosage can be adapted based on patient response.[29]

Despite these positive findings, several limitations should be acknowledged. First, this study involved only a single subject, which limits the generalizability of the results. Second, the relatively short duration of the intervention (three weeks) may not fully capture the long-term effects of the physiotherapy program. Third, the absence of follow-up assessment prevents evaluation of the sustainability of the observed improvements.

In addition to objective outcomes, the patient reported subjective improvements in confidence and independence during daily activities. The patient expressed greater ease in performing transfers and ambulation, as well as reduced fear of falling. This patient perspective supports the clinical significance of the intervention and aligns with the CARE guideline recommendation to include patient-reported outcomes in case reports.

Future studies are recommended to investigate the effectiveness of FITT-based physiotherapy programs using larger sample sizes, longer intervention durations, and controlled study designs. Further research should also explore the integration of FITT principles with other rehabilitation approaches and assess long-term functional outcomes.

Conclusion

This case report demonstrates that a structured physiotherapy program based on the FITT principle can produce clinically meaningful improvements in pain, spasticity, muscle strength, balance, and functional independence in a patient with chronic stroke. The observed changes indicate that individualized and progressive exercise prescription may effectively support neuromuscular recovery and functional performance.

The integration of the FITT principle with the International Classification of Functioning, Disability and Health (ICF) framework provides a practical and clinically relevant approach for designing rehabilitation programs that not only target physiological impairments but also enhance activity and participation.

Although the findings are limited to a single case and a short intervention period, this report highlights the potential applicability of FITT-based physiotherapy in real-world clinical settings. Future studies with larger sample sizes, longer follow-up periods, and controlled designs are warranted to further establish the effectiveness and generalizability of this approach.

Author Contribution

Aulia Farah Maharani: Conceptualization, Methodology, Investigation, Data Curation, Formal Analysis, Writing Original Draft, Writing Review and Editing.
Umi Budi Rahayu: Supervision, Validation, Methodology, Writing Review and Editing.
Salma Muzarroh: Data Interpretation, Project Administration, Validation, Writing Review and Editing.

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Conflict of Interest Statement

The authors declare no conflict of interest.

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Ethics Statement

This study was conducted in accordance with the Declaration of Helsinki. As this report describes a single clinical case involving routine physiotherapy intervention, formal ethical committee approval was not required according to institutional policy. Written informed consent was obtained from the patient for participation and publication of anonymized data.

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