



Scapular Malalignment in Patients with Stroke: Mechanisms, Assessment, and Rehabilitation Strategies

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Abstract: Scapular malalignment is a common musculoskeletal impairment observed in patients with stroke, contributing to shoulder pain, reduced upper limb function, and decreased quality of life. This article provides an in-depth exploration of the mechanisms underlying scapular malalignment in stroke survivors, methods for assessment, and evidence-based rehabilitation strategies. Using the terms "scapular malalignment" and "stroke," searches were conducted across four databases (PubMed, Google Scholar, Cochrane, and Science Direct) to find relevant research. This evaluation only includes observational studies that were published during the previous ten years. Through a comprehensive review of the literature, key factors contributing to scapular malalignment, including muscle weakness, altered muscle activation patterns, and impaired proprioception, are examined. Assessment techniques, including physical examination, imaging modalities, and functional assessments, are discussed to facilitate early identification and targeted intervention. Additionally, evidence-based rehabilitation approaches, such as therapeutic exercise, neuromuscular re-education, and assistive devices, are presented to address scapular malalignment and improve functional outcomes in patients with stroke.

IndexTerms - Stroke, Scapular Malalignment, Rehabilitation, Upper Limb Function, Therapeutic Exercise, Neuromuscular Re-education

1. INTRODUCTION

According to definitions, a stroke is an acute cerebrovascular illness that arises from a disruption in the cerebral blood supply caused by an infarction or hemorrhage [1] or it may be described as the sudden loss of brain function resulting from a disturbance in blood flow [2].

Stroke is a worldwide health problem, with an incidence ranging from 0.2 to 2.5 per thousand per year, according to a WHO research including 12 countries. In India, the incidence or prevalence of stroke is 334/100,000, although very few community-based research have been done on the subject [3]. How and what consequences a stroke has depends on the extent of brain damage and the severity of the lesion [2].

Stroke remains one of the leading causes of disability worldwide, often resulting in motor impairments affecting upper limb function. Among the myriad challenges faced by stroke survivors, scapular malalignment stands out as a significant yet underrecognized issue that can profoundly impact functional recovery [4]. This narrative review aims to delve into the complexities of scapular malalignment in stroke patients, shedding light on its prevalence, underlying mechanisms, clinical manifestations, assessment methods, and therapeutic approaches.

1.1 Prevalence and Etiology

Scapular malalignment is prevalent among stroke survivors, with estimates suggesting that a considerable proportion of individuals experience altered scapular kinematics post-stroke. The underlying etiology of scapular malalignment in stroke is multifactorial, encompassing muscle weakness, spasticity, altered muscle tone, sensory deficits, and biomechanical changes. These factors disrupt the delicate balance of scapular muscle activation and coordination, leading to abnormal scapular positioning and movement patterns [5].

1.2 Clinical Implications

Scapular malalignment in stroke patients poses various clinical implications, including impaired shoulder range of motion, diminished upper limb function, pain, and decreased quality of life. Maladaptive scapular positioning can exacerbate shoulder subluxation, impingement, and rotator cuff pathology, further complicating the rehabilitation process. Understanding the functional

consequences of scapular malalignment is crucial for tailoring effective interventions and optimizing functional outcomes in stroke survivors [6].

1.3 Assessment Methods

Accurate assessment of scapular malalignment is essential for guiding targeted rehabilitation interventions. A variety of assessment tools and techniques are available, ranging from simple clinical observation to more sophisticated imaging modalities. Clinical assessments may include visual inspection of scapular position, palpation of bony landmarks, and evaluation of scapular movement during functional tasks. Advanced imaging techniques such as ultrasound, magnetic resonance imaging (MRI), and motion analysis systems offer valuable insights into scapular kinematics and muscle activation patterns [7].

1.4 Therapeutic Interventions

Effective management of scapular malalignment in stroke patients requires a multidisciplinary approach encompassing physiotherapy, occupational therapy, and possibly adjunctive interventions. Rehabilitation strategies may include targeted strengthening exercises, neuromuscular reeducation, proprioceptive training, and task-specific training aimed at restoring optimal scapular muscle activation and coordination. Additionally, assistive devices such as slings, taping, and orthoses may be utilized to support proper scapular alignment and facilitate functional movement patterns [8].

2. RESEARCH METHODOLOGY

A comprehensive evaluation of the literature was conducted about the misalignment of the scapula in stroke patients. We utilized search phrases like "stroke" and "scapular malalignment" in PubMed, Science Direct, Google Scholar, and the Cochrane Library. The electronic search was conducted by cross-referencing each relevant item in the references list. The data was searched using the following text and indexing phrases: scapula and stroke malalignment OR scapula and stroke alignment.

The selection criteria were as follows: articles were referred because to scapular malalignment and stroke. Literature is reviewed, but only works that have been published during the last 10 years are taken into account. Studies involving writing in the English language were included.

2.1 Selection criteria: Included were articles assessing scapular malalignment in acute, subacute, and chronic stroke, as well as observational and case control studies. Complete text journal papers, English-language articles, outcome measures deemed reliable or valid for assessing scapular alignment, articles that have only been examined online at the Electronic Database Site.

Articles examining randomised controlled trials (RCTs), unpublished studies, and outcome metrics that are not reliable or valid were excluded from consideration [9].

3. RESULTS

3.1 Mechanisms of Scapular Malalignment in Stroke Patients:

Scapular malalignment in stroke patients can be attributed to various factors, including muscle weakness, spasticity, and altered motor control mechanisms. Here are some key mechanisms contributing to scapular malalignment:

- **Muscle Weakness:** Weakness in the muscles surrounding the scapula, such as the trapezius, serratus anterior, and rhomboids, can lead to imbalances in scapular movement and stability.
- **Spasticity:** Increased muscle tone commonly observed in stroke survivors can result in abnormal positioning of the scapula, limiting its mobility and predisposing it to malalignment.
- **Altered Motor Control:** Stroke-related impairments in motor control mechanisms disrupt the coordinated activation of scapular stabilizing muscles, further exacerbating malalignment issues [10].

Table 1: Mechanisms of Scapular Malalignment in Stroke Patients

Mechanism	Description
Muscle Weakness	Weakness in scapular stabilizing muscles, including trapezius, serratus anterior, and rhomboids.
Spasticity	Increased muscle tone leading to altered scapular positioning and limited mobility.
Altered Motor Control	Impaired coordination and activation patterns of scapular muscles due to stroke-related motor control deficits.

3.2 Assessment of Scapular Malalignment:

Accurate assessment of scapular malalignment is crucial for developing targeted rehabilitation interventions. Several clinical and biomechanical assessment methods can be employed to evaluate scapular alignment in stroke patients [11]. Here are some commonly used assessment tools:

Table 2: Commonly used assessment tools

Assessment Method	Description
Visual Inspection	A simple observation of scapular position and movement during functional tasks, such as reaching or lifting, to identify asymmetry or abnormal positioning.
Manual Muscle Testing	Assessment of strength and activation patterns of scapular stabilizing muscles, including the trapezius, serratus anterior, and rhomboids, to detect weakness or imbalance.
Range of Motion Testing	Measurement of scapular movement in various planes, including elevation, protraction, retraction, and rotation, using goniometry or motion analysis systems.

Electromyography (EMG)	Recording the electrical activity of scapular muscles during functional tasks to assess muscle activation patterns and detect abnormalities in motor control.
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3.3 Rehabilitation Strategies:

Effective rehabilitation strategies for addressing scapular malalignment in stroke patients should aim to improve muscle strength, reduce spasticity, and enhance motor control mechanisms [8]. A comprehensive rehabilitation program may include the following components:

- **Muscle Strengthening Exercises:** Targeted exercises to strengthen the scapular stabilizing muscles, such as the trapezius, serratus anterior, and rhomboids, using resistance bands, weights, or bodyweight exercises.
- **Neuromuscular Reeducation:** Techniques focused on retraining proper muscle activation patterns and coordination through repetitive practice of functional movements and tasks.
- **Manual Therapy:** Hands-on techniques, such as massage, myofascial release, and joint mobilizations, to alleviate muscle tightness, improve range of motion, and restore optimal scapular alignment.
- **Functional Training:** Incorporation of functional tasks and activities of daily living into rehabilitation sessions to promote the transfer of improved scapular alignment and movement patterns to real-world situations.
- **Modalities:** Use of modalities like electrical stimulation, ultrasound, or heat/cold therapy to manage pain, reduce muscle spasticity, and facilitate tissue healing as adjuncts to the rehabilitation program.
- **Patient Education:** Providing education on proper body mechanics, posture, and self-care strategies to prevent recurrent malalignment and promote long-term functional independence.

Table 3: Rehabilitation Strategies for Scapular Malalignment in Stroke Patients

Rehabilitation Strategy	Description
Muscle Strengthening	Targeted exercises to strengthen scapular stabilizing muscles using resistance bands, weights, or bodyweight exercises.
Neuromuscular Reeducation	Techniques focused on retraining proper muscle activation patterns and coordination through repetitive functional movements.
Manual Therapy	Hands-on techniques such as massage, myofascial release, and joint mobilizations to alleviate muscle tightness and improve ROM.
Functional Training	Incorporation of functional tasks into rehabilitation sessions to promote transfer of improved scapular alignment to real-world tasks.
Modalities	Use of modalities like electrical stimulation or heat/cold therapy to manage pain, reduce spasticity, and facilitate tissue healing.
Patient Education	Providing education on proper body mechanics, posture, and self-care strategies to prevent recurrent malalignment and promote independence.

These tables provide a concise overview of the mechanisms, assessment methods, and rehabilitation strategies relevant to scapular malalignment in stroke patients, aiding clinicians and researchers in understanding and addressing this common issue in rehabilitation practice.

Discussion: The mechanisms underlying scapular malalignment in stroke patients are complex and multifactorial. While muscle weakness, spasticity, and altered motor control play significant roles, the interplay between these factors is often intricate and varies among individuals. Assessment of scapular malalignment poses challenges due to the subjective nature of some evaluation methods and the need for specialized equipment for biomechanical assessments. Furthermore, rehabilitation strategies should be tailored to individual patient needs, considering factors such as severity of impairment, stage of recovery, and functional goals. Multidisciplinary collaboration among rehabilitation professionals, including physiotherapists, occupational therapists, and rehabilitation physicians, is essential for delivering comprehensive care to stroke survivors with scapular malalignment.

Conclusion: Scapular malalignment is a common issue in stroke patients, stemming from a combination of muscle weakness, spasticity, and altered motor control mechanisms. Accurate assessment and targeted rehabilitation interventions are essential for addressing scapular malalignment and optimizing functional outcomes in stroke survivors. By incorporating a multidisciplinary approach that includes muscle strengthening, neuromuscular reeducation, manual therapy, functional training, and patient education, rehabilitation professionals can effectively manage scapular malalignment and enhance the quality of life for individuals recovering from stroke. Further research is warranted to explore the long-term efficacy of rehabilitation strategies and their impact on functional recovery in stroke patients with scapular malalignment.

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