Advances in the Application of Positioning in Rehabilitation of Stroke Patients with Hemiplegia

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Abstract

Stroke refers to vasospasm, occlusion, or rupture resulting from lesions in the cerebral arterial system, leading to acutely developing local cerebral circulatory disturbances and limb functional impairments predominantly characterized by hemiplegia [1]. Proper limb positioning is currently one of the primary interventions in the rehabilitation nursing of hemiplegic stroke patients in clinical practice, characterized by strong feasibility and significant importance for disease recovery and prognosis improvement. However, the clinical compliance rate of proper limb positioning is currently not high. To promote the high-quality implementation and application of proper limb positioning in stroke patient populations, this article reviews the application value, current application status, influencing factors, intervention timing, and methods of proper limb positioning for hemiplegic stroke patients, and subsequently proposes new strategies to facilitate the implementation of proper limb positioning, in order to provide suggestions and insights for future research.

Full Text

Preamble

Stroke is defined as a clinical phenomenon in which acute cerebral circulation 障碍 causes localized or diffuse cerebral functional deficits in a short period. According to data from the Global Burden of Disease Study (GBD), stroke is the leading cause of death among Chinese residents [2] and is characterized by a high disability rate of 70%–80%. Approximately three-quarters of patients experience sequelae with varying degrees of loss of working capacity, severely impacting their quality of life [3]. Hemiplegia after stroke, also known as half-body paralysis, refers to motor dysfunction of the upper and lower limbs, facial muscles, and lower part of the tongue on one side of the body [4]. Hemiplegia can lead to motor impairment on the hemiplegic side and may even result

in bedridden status and complete loss of self-care ability. Proper limb positioning, also known as anti-spastic positioning, is a temporary and therapeutic posture [5]. As a clinical rehabilitation nursing method, it involves placing the limbs in specific positions and special postures to ensure patients can effectively maintain good limb function. This approach promotes specific responses to individual stimuli despite dissociative disorders. Early implementation of proper limb positioning in rehabilitation nursing can effectively prevent complications such as pressure ulcers, deep vein thrombosis, urinary tract infections, and foot inversion [6], while improving limb function, motor function, and activities of daily living. It holds significant importance for disease recovery, prognosis improvement, and enhancement of patients' quality of life. This article reviews the research progress on proper limb positioning in the rehabilitation nursing of stroke patients with hemiplegia, aiming to promote its high-quality implementation and application in this population.

1. Application Value of Proper Limb Positioning

Stroke patients with hemiplegia experience central nervous system damage leading to central paralysis, with clinical symptoms evolving from a flaccid state to a spastic state. Most patients exhibit spasticity characterized by flexor dominance in the upper limbs and extensor dominance in the lower limbs. In rehabilitation nursing, proper limb positioning employs static and continuous control to prevent abnormal movements, demonstrating significant effectiveness in controlling muscle spasticity and providing strong support for the emergence of isolated movements. Early implementation of proper limb positioning can effectively prevent complications such as shoulder subluxation, muscle contracture, and foot inversion in hemiplegic limbs, while positively influencing shoulder joint preservation [7]. Some scholars' clinical research indicates that proper limb positioning can stabilize patients' joints and effectively prevent spasticity in muscles including the brachialis, forearm muscles, semimembranosus, semitendinosus, and adductors, thereby preventing pathological movement patterns [8]. Additionally, through multi-position adjustment nursing, proper limb positioning can effectively reduce the incidence of pressure ulcers and deep vein thrombosis, significantly improving patients' quality of life.

2. Current Application Status of Proper Limb Positioning

Proper limb positioning is currently an important nursing technique in the rehabilitation field and has been applied clinically. However, its practical implementation is influenced by factors including nurses' knowledge-attitude-practice levels regarding positioning, patient autonomy, muscle strength and positional differences, and inadequate supervision. As a result, some patients fail to properly execute positioning requirements, making it difficult to achieve expected limb function rehabilitation outcomes. Qi Zhihua et al. [9] surveyed 152 nurses and found that less than 10% had complete mastery of proper limb positioning knowledge, while 70% lacked understanding—a finding consistent with Si Xiaona

et al. [10]. Ni Biyu et al. [11] investigated patient compliance with positioning and found an execution rate of only 28.95%. Xiao Qian et al. [12] reported compliance rates of less than 40% among nurses implementing positioning. Pan Sailan [13] surveyed 168 nurses and found that their knowledge-attitude-practice levels regarding proper limb positioning needed further improvement, similar to the findings of Xie Jiaxing et al. [14] who investigated rehabilitation nursing knowledge-attitude-practice levels among nurses across 31 provinces.

3. Factors Influencing the Implementation of Proper Limb Positioning

Although proper limb positioning for stroke patients with hemiplegia has received increasing attention, its clinical execution rate and accuracy remain low. The reasons can be summarized into four main levels.

3.1 Clinical Department Level

Many hospital departments have not yet truly implemented rehabilitation nursing activities and lack professionally trained rehabilitation teams. At the departmental level, there is a shortage of materials for patient limb positioning, including standardized procedures and quality control evaluation criteria. Regular training sessions and lectures on positioning are not conducted systematically, assessment of clinical nurses is inadequate, and health education manuals for patients are unavailable. Additionally, appropriate assistive devices are lacking.

3.2 Clinical Nurse Level

Nurses' mastery of proper limb positioning knowledge and their supervision during rehabilitation nursing directly affect implementation and outcomes. With the proposal of the "prevention-treatment-rehabilitation" integrated health concept, rehabilitation medicine has developed rapidly in recent years [15]. Although rehabilitation nursing in China has made notable progress across various fields, its development history remains relatively short and its education system has numerous deficiencies, directly limiting the specialization level of clinical nursing staff. Some nurses lack adequate knowledge about proper limb positioning, implement it at incorrect times, or fail to provide sufficient education to patients and families due to heavy workloads and staffing shortages. Furthermore, nurses' educational background, professional level, work experience, and prior experience caring for hemiplegic patients all influence implementation effectiveness.

3.3 Patient Level

Most patients lack knowledge and understanding of the significance of proper limb positioning, and their persistence is poor. Implementation is also related to patients' consciousness and cognitive status.

3.4 Family Level

In stroke rehabilitation nursing, family members play a crucial role, and the time and effort they invest are often proportional to treatment efficacy. Some families demonstrate insufficient attention, lack encouragement and concern for patients, show impatience, or hold unsupportive and distrustful attitudes toward nursing care—all of which seriously affect rehabilitation outcomes and prognosis.

4.1 Intervention Timing

The Chinese Guidelines for Prevention and Treatment of Cerebrovascular Diseases state that rehabilitation should begin as early as possible. Stroke patients should receive proper limb positioning within 48 hours after their condition stabilizes to promote recovery and reduce disability rates [16].

4.2.1 Affected Side Lying Position

Place a soft pillow under the head at a comfortable height. The affected side should be down with the trunk slightly rotated backward. Place a soft pillow behind the back, and extend the affected shoulder forward to avoid compression. Externally rotate the forearm to maintain the affected upper limb in an abducted, extended position with shoulder flexion within 70° to prevent pain from prolonged pressure [17]. Extend the fingers forward with the palm facing up. Position the healthy upper limb on the chest, trunk, or a rear pillow in a relaxed state. Slightly extend the affected hip joint with the lower limb in mild flexion and the ankle in dorsiflexion to prevent foot drop. Place the healthy lower limb forward across the affected limb on a soft pillow with hip and knee flexion [18].

4.2.2 Healthy Side Lying Position

Place a soft pillow under the head at a comfortable height. The affected side should be up with the trunk slightly forward. Due to poor trunk stability, place a soft pillow or blanket behind the patient for auxiliary support to maintain a stable side-lying position. Place a soft pillow on the chest and position the affected upper limb on it in an extended position with the shoulder flexed at 90°. Fully extend the elbow, wrist, and finger joints with the palm facing down and the wrist in dorsiflexion. The healthy upper limb can be in a free position. Maintain mild flexion of the lower limbs with a soft pillow between the legs, avoiding plantar flexion, inversion, or hanging the ankle over the bedside.

4.2.3 Supine Position

Rotate the patient' s head toward the affected side with a soft pillow at a comfortable height. Maintain the thoracic spine in neutral position. Place a soft pillow under the affected scapula to slightly elevate the shoulder, and another under the affected upper limb in an elbow-extended position, maintaining a 20–

40° angle between the upper arm and trunk. Keep the elbow, wrist, and fingers naturally extended with the palm facing up [19]. Roll a long bath towel and place it under the outer thigh and hip joint of the affected side to accentuate the pelvis and prevent external rotation and abduction of the lower limb. Place a rolled towel or soft pillow under the affected knee to maintain knee extension. Position a soft pillow under the foot to maintain neutral ankle position and prevent plantar flexion.

4.2.4 Sitting Position

4.2.4.1 Bed Sitting Position

Support the back with soft pillows or blankets to help the patient maintain spinal extension and an upright trunk at approximately 90°. Place a table in front of the patient for bilateral upper limb placement. Maintain hip flexion with both lower limbs naturally extended. Place a rolled soft pillow or long towel under the outer lower thigh of the affected side to prevent external rotation and abduction. Place a soft pillow or rolled towel under the knees to maintain slight knee flexion, and use a foot support under the affected foot to maintain neutral ankle position in dorsiflexion.

4.2.4.2 Wheelchair Sitting Position

Instruct the patient to sit in a wheelchair with the buttocks positioned as far back as possible and the trunk close to the wheelchair backrest. Place folded towels or soft pillows behind the back to promote trunk extension with slight forward inclination. Position both upper limbs on the wheelchair table in front with extended fingers and flexed elbows, placing a soft pillow under the affected forearm. Maintain natural knee flexion with hips, knees, and ankles at approximately 90° without adduction or external rotation. Place a soft pillow between the legs and position both feet on wheelchair footrests or the floor with toes facing forward to maintain symmetrical foot placement [20] at shoulder width.

4.2.5 Standing Position

Maintain the patient in a standing position. Use the Bobath technique to support the affected upper limb or employ a shoulder sling to avoid swinging or natural hanging of the affected limb under traction, thereby preventing circulatory problems and shoulder dislocation [21].

5. New Strategies to Promote Proper Limb Positioning Implementation

With continuous scientific and technological development, emerging technologies are increasingly applied in clinical practice. Conventional proper limb positioning techniques often suffer from monotonous procedures and difficulty in maintenance. Combining proper limb positioning with mirror therapy, rehabilitation robots, brain-computer interface technology, or VR technology can

not only enhance rehabilitation efficacy for stroke patients with hemiplegia but also better mobilize patient initiative and enhance patient engagement [22-23], compensating for the limitations of conventional training.

Mirror therapy is a rehabilitation method that promotes brain neuroplasticity through simulated movements. By observing and imitating the movement of the healthy limb, it stimulates neuronal activity and promotes recovery of the paralyzed limb [24]. Watching mirrored actions can activate the patient' s motor cortex, elicit neuromuscular excitation, and promote muscle function recovery—findings consistent with Li Jianming [25] and Chen Qingmei et al. [26]. Research indicates that mirror therapy can serve as an adjunctive treatment for stroke rehabilitation, promoting patient motivation with certain clinical feasibility and integrative potential [27].

Rehabilitation robots can provide high-repetition, high-precision, adaptive, and quantifiable functional training for patients. Stroke patients with hemiplegia undergoing rehabilitation robot training based on proper limb positioning can effectively improve upper limb motor function, promote muscle activation and motor unit recruitment synchronization in the hemiplegic upper limb, and enhance activities of daily living [28].

Brain-computer interface (BCI) is a novel human-computer interaction technology that bypasses conventional peripheral neuromuscular output pathways by establishing a connection between the brain and computers or other devices, enabling direct control of external equipment through brain signals [29]. Multiple studies have shown that BCI technology can significantly improve neurological function, promote central nervous system remodeling in stroke patients, facilitate upper limb motor function rehabilitation [30-31], and improve hand function and daily living abilities in hemiplegic patients [32].

Virtual Reality (VR), supported by powerful computer and sensor technologies, creates an extremely realistic virtual world where users can obtain rich and authentic sensory feedback including auditory, visual, and even tactile sensations, as if immersed in a new environment indistinguishable from reality. VR has been proven effective in promoting limb function and cognitive recovery [33]. Chen et al.' s [34] meta-analysis of 42 randomized controlled trials found that VR-supported exercise therapy combined with conventional rehabilitation can improve hand dexterity.

Although these new technologies have been implemented clinically, large-sample statistical data on their combined application is still lacking. Future high-quality research is needed to further clarify the long-term efficacy of combining proper limb positioning with mirror therapy, rehabilitation robots, BCI technology, or VR technology in stroke hemiplegia rehabilitation.

6. Conclusion

Stroke is a clinically prevalent cerebrovascular disease with high annual incidence and disability rates. Hemiplegia, as the most common clinical symptom of stroke, not only severely affects patients' daily lives but also imposes a heavy burden on society and families. Therefore, medical professionals remain dedicated to researching rehabilitation nursing for stroke patients with hemiplegia. Proper limb positioning, as a crucial component of rehabilitation nursing, plays a vital role in improving motor function and daily living abilities. Despite its wide clinical recognition and implementation, its persistent, cumbersome, and detailed nature subjects it to numerous interfering factors in practice, reducing patient compliance. With the continuous emergence of new technologies, rehabilitation nursing for stroke patients with hemiplegia will undoubtedly receive greater attention. It is believed that with ongoing technological advancement, proper limb positioning technology will achieve higher-quality implementation and application in this patient population.

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Note: Figure translations are in progress. See original paper for figures.