

How the hospital environment can facilitate motor recovery after stroke?

Abstract

Objective: To identify factors within the hospital environment that can facilitate maximal motor recovery after stroke.

Comments: A challenging and movement oriented hospital environment can stimulate early, active and intensive patient participation in functional activities of daily living always including during non-therapy times. Regular participation in activities also prevents secondary complications such as muscle contractures. Rearranging the ward routine reduces the inactive times during hospital stay, redesigning physical structures within the ward encourages weight bearing, adopting constraint induced therapy concepts will facilitate upper limb recovery for performance of activities of daily living and embracing technological devices motivates patient to move regularly. Better utilization of family visitation times to use satellite rehabilitation locations may enhance the importance of self-practice. Hospital staff and rehabilitation therapists should review the practice of no rehabilitation during weekends and public holidays as it may facilitate early discharge. Physiotherapists should regularly lead a creative team of health care professionals to re-design the hospital environment to be challenging and motivating for maximal motor recovery after stroke.

Keywords: stroke, hospital environment, participation, recovery, non-therapy

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Introduction

The ultimate aim of any neurological rehabilitation program is to maximize motor recovery within the shortest period of time and at the lowest health care cost. The method of rehabilitation, the eagerness of the patients to recover and the structure of the hospital environment can influence recovery¹. Rehabilitation techniques are postulated to strengthen synaptic chains, guide axonal sprouting, and facilitate return of function by the unmasking of latent synapses after stroke.² Rehabilitation techniques such as exercises and functional activities, Proprioceptive Neuromuscular Facilitation (PNF) and Bobath (NDT) are equally effective in achieving motor outcome.³ Early active and intensive patient participation in a comprehensively structured rehabilitation program that focuses on functional motor task training can optimize maximal recovery.⁴ A challenging and movement orientated environment can influence recovery by providing appropriate and timely feedback to the patient on their performance.⁴ Scientific evidence indicate that constraint induced movement therapy (CIT) has a beneficial effect of maximizing and restoring motor function of individuals with neurological dysfunction (40). This review will discuss how restructuring the hospital environment may stimulate early patient participation towards achieving maximal motor recovery after stroke.

Early patient participation

Evidence indicates that the physiological properties of muscles can be altered within days after stroke. Inadequate recruitment of the agonist elbow extensor muscles on the hemiplegic side⁵ and reduced electromyography muscle activity on both the affected and non-affected upper limbs has been reported⁶ early after stroke. Altered muscle recruitment around the scapulo-thoracic and glenohumeral joints occurs even among individuals who suffered mild stroke.⁷ Fast twitch (type II) muscle fibers atrophy significantly more than

slow twitch (type I) muscle fibers⁸ and account for the slowness in performing upper limb activities⁹. Animal studies have report that fixating the muscle in a shortened position causes a 40% reduction in number of sarcomeres and an increase in relative number of Type II muscles fibers.¹⁰ The results is lost of strength and increased fatigability after stroke.¹¹ Muscles immobilised in a shorten position also increased the relative amount of connective tissue and stimulate the remodeling of endomysium¹¹ while the perimysium deforms and realigns to increase resistance to movement.¹² These changes are difficult to reverse once established.

Early active rehabilitation after stroke may prevent or best minimize some of these physiological changes to skeletal muscles. Sustained stretch for 6 hours a day was required to maintain the length of soleus muscle among children with cerebral palsy.^{12,13} Performing active functional activities such as standing and walking regularly may be more effective in preventing shortening of ankle plantarflexors than passive range of motion exercises or resting splints and encourages neuromotor control. The performance of upper limb activities such as combing their hair stretches and strengthens trunk and upper limb muscles. Rehabilitation therapists should discourage where appropriate passive range of motion exercises or over-head pulleys to stretch muscles and encourage weight bearing and functional activities as more effective strategies to prevent muscle shortening and facilitate active motor recovery.

Hospital environment

As early as 1968, Keith expressed the view that the hospital environment does not physically and mentally challenges the patient who suffered a stroke to achieve maximal recovery.¹⁴ More than 30 years later, patients still spent more than 70% of their day in hospital performing activities unrelated to physical outcome.¹⁴⁻¹⁷ Rehabilitation session accounted for only 43 minutes of activity per

day and unlikely to translate to other settings.^{16,17} Patients after stroke have been reported to be inactive nearly two-thirds of their time each day¹⁵.

Increasing the time the patient spends with the rehabilitation therapists improved muscle strength, but did not lead to shorter patient's length of hospital stay.¹⁷ Length of hospital stay could be shorten if patients take responsibility in their own recovery rather than depend on professional staff or their family for assistance. They may want to explore making their own bed, bath and groom themselves daily. A more alert and compliant patients can walk to the toilet with guidance rather than be dependent on a commode, urinal or disposal diapers. As patients gain body control over activities of daily living, they realize that they are not hopeless and motivate themselves towards maximal recovery. Patients with spinal cord injuries who were active participants during in-patient rehabilitation program continued to be active when they returned home.¹⁸

The physical design of wards also contributes to early motor recovery.¹⁷ Laminated white strips on the floor encouraged longer step length¹⁹ while auditory environmental clues facilitated better gait among dementia and patients after stroke.^{20,21} Grab-rails facilitate unaided walking⁴ while walking aids encouraged asymmetrical weight distribution during standing and walking.²² Activity rooms can place adjustable height chairs near grab rails to facilitate patients practicing independent sit-to-stand and vice-versa without fear. Regular standing stretch the lower limbs muscles groups at risk of contractures due to prolonged sitting. Wall mirrors and video cameras can provide feedback for patients for self practice especially during non-therapy times.¹⁶ However, contrasting colored floor tiles misguide and threaten the balance of patients with visual deficits.²³

The hospital environment should also stimulate socialization and conversation. Sommer found that when chairs in the lounge were facing each other, a marked increase in conversation was noted among a group of elderly women in a nursing home.¹⁴ Hospital beds should be rearranged differently to encourage conversation and prevent spatial neglect. Televisions and telephones should be positioned in common areas such as the activity room to encourage the stroke patient to be more functionally active and socialization.

Families and trained volunteers are under-utilized human resources that could be empowered with basic knowledge and skills to supervise semi-structured group programs designed by rehabilitation therapists.^{16,19} Group sessions may be conducted during inactive periods especially during the weekends and after 5 p.m. Known benefits of structured and appropriate self-practice group sessions include motivating patients to take responsibility to practice more,¹⁵ encourage co-operation between patients and even monitor each other progress in performing complex motor task.¹⁹ During sessions, practice in a random order should be encouraged as it results in better learning and facilitate problem solving to a greater extent than blocked order pattern practice.²⁴ Bilateral exercises have been hypothesised to activate the contralateral motor cortex via the corpus callosum²⁵ reduce the severity of unilateral neglect and learned non-use especially in the upper limb.²⁶ A videotaped self-practice session permits patients to observe their movement errors; this has been shown to enhance motor learning more than viewing a skill performance.²⁴ Reciting the action while performing, a principle employed in conductive education programs is another useful strategy.

Esmonde et al.¹⁶ reported that patients spend more than 50 per cent of non-therapy times in the recreation room and bedroom. Lee et al.²⁷

also reported that most of their time during the day was spent in solitary behavior in bed or the ward area. These areas should be targeted for change in the hospital setting. Board games such as bridge, scrabbles, mahjong and cards commonly found in the day room should modified to permit stroke patients with limited upper limb control to actively participate with other patients instead of passively sitting around or watching television.¹⁵ Computer rooms and business centers in hospitals may encourage patients to better utilize their non-therapy times and also facilitate active bilateral upper limb movement. Other areas such as food bars, shops and mini-gardens could be located close to the wards so that the stroke patients can be encouraged to walk with their family or staff to these locations for purchases or relaxation. These areas should be considered as "therapeutic" where the patient might spend more time during non-therapy times.¹⁵ Simple technological items can be utilised to motivate the patient to move regularly. Timers or vibrators placed under patient's chairs would compel them to stand up and walk to a designated area frequently to switch it off. Patient's watch can be set with an hourly buzzer to initiate the performance of a particular set of active exercises recommended by the rehabilitation therapists. More practice of functional activities could lead to speedy functional recovery and thus, reduce their length of hospital stay.

Weekend and public holidays without therapy will probably not facilitate the on-going motor recovery occurring in the brain and also increase the level of patient's anxiety towards recovery.²⁸ For example, if a patient was admitted with stroke on a weekend where minimal rehabilitation takes place may experience delay motor recovery and predispose the patient to more secondary complications such as chest infections and shortening of muscles. It was reported that patients who received both weekend and traditional 5 to 6 days per week physiotherapy after undergoing a total hip or knee arthroplasty had a shorter length of stay of 10.84 days compared with 53 days for those who only received the traditional physiotherapy treatment.²⁹ Ruff et al.²⁸ found that a 6 days per week program was as effective as a 7 days per week rehabilitation program for patients who suffered a stroke. This may imply that a day of rest may facilitate the effectiveness of rehabilitation therapy.

Nakayama & Jorgensen et al.³⁰ reported that most of the motor recovery after stroke in the upper limb occurred within 6 weeks after a mild paresis and up to 11 weeks after a severe paresis. Failure to recover measurable grip strength before 24 days was reported to be associated with the absence of useful arm function.²¹ Thus, the window of time for motor recovery is short and active rehabilitation should commence once the medical condition has been stabilized. Moreover, early intensive therapy has been reported to speed up motor recovery.^{31,32} Based on animal studies, it has been proposed that a "use-it-but-don't-overuse-it" strategy may be more effective to restore function.³³ Before discharge, patients should be introduced to leisure activities such as tai-chi, yoga, swimming and simple stretching exercises to maintain mobility and muscle strength. Regular leisure activities also motivate them to maintain a positive view of their life. After the experience, stroke patients may become advocates for support stroke support groups and organization imparting the message of prevention and management of risk factors to the public.

Constrained induced movement therapy

Ninety percent of those who suffer a cerebral vascular accident experience upper limb deficits.³⁴ Operant behavioral concepts that encourage usage of the impaired upper limb while restraining the

unaffected upper limb have demonstrated favourable motor recovery among somatosensory deafferented monkeys.³⁵ Forced-use of the impaired upper limb reversed the behavioural phenomena of learned non-use. Rehabilitation approaches that advocate learned non-use of the impaired upper limb would not facilitate maximal recovery of motor function after a neurological insult.

Two weeks of daily forced-use of the impaired upper limb resulted in improvement in performance time, better quality of movement and increased ability to perform activities of daily living.²⁶ It translated into mastery of activities of daily living including brushing teeth, combing hair, picking up a glass of water to drink, eating with a fork and spoon and writing even up to 2 years after participating in the forced-use programme. Furthermore, side of hemiparesis or time since stroke did not influence the effectiveness of CI movement therapy. When performing bilateral functional activities, the right hemisphere role is to generate forces for movement changes in the left upper limb while the left hemisphere controls the timing and changes in direction of forces in both upper limbs. An increased size of the cortical motor areas representing the muscle activity of the impaired abductor pollicis brevis muscles in the damaged hemisphere was observed after CI Therapy.³⁴ The neural activity in the hemisphere became almost identical six months after CI therapy indicating increase synaptic efficiency without deterioration of function.³⁴ Enhanced and intensive therapy also accelerated motor recovery in the acute stage of neurological assault.^{36,37}

Conclusion

The pathway towards recovery starts at the acute care hospital and stroke unit continues at the community hospital and day rehabilitation center and end at the hands of stroke patients and their family. Unfortunately, the current environment in hospitals continues to promote long periods of inactivity and probably does not function as a positive learning environment for patients after stroke. Can we create a cohesive health science teams whom are committed to structuring the hospital environment which can facilitate early, active and regular patients participation and to maximize the use of stroke patient's non-therapy times? Stroke patients must be regularly motivated to be in control of their own recovery to discourage learned helplessness. The content of this paper stimulate us to review our present hospital environmental layout and practices towards quality rehabilitation care and reduce the cost of hospitalization for patients after stroke.

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Conflict of interest

The author declares no conflict of interest.

References

- Carr JH, Shepherd RB. The motor learning model for stroke rehabilitation. *Physiotherapy*. 1989;75(7):372–380.
- Kidd G, Lawes N, Musa I. Understanding neuromuscular plasticity: a basis for clinical rehabilitation. Edward Arnold England; 1992.
- Dickstein R, Hocherman S, Pillar T, et al. Stroke rehabilitation: three exercises therapy approaches. *Phys Ther*. 1986;66(8):1233–1238.
- Ada L, Canning C, Westwood P. The patient as an active learner. In: Ada L, Canning C, editor. *Key issues in Neurological Physiotherapy*. UK: Butterworth Heinemann; 1990. p. 99–124.
- Gowland C, deBruin H, Basmajian JV, et al. Agonist and antagonist activity during voluntary upper-limb movement in patients with stroke. *Physical Therapy*. 1992;72(9):624–633.
- Gardiner SJ, Stevenson TJ, Ivanova T. Postural response to unilateral arm perturbation in young, elderly, and hemiplegic subjects. *Arch Phys Med Rehabil*. 1997;78(10):1072–1077.
- Rajaratnam BS. EMG study of the motor recruitment pattern in hemiparetic shoulder during active shoulder abduction. Paper presented at the 13th International Congress of WCPT: Japan; 1999. p. 23–28.
- Bourbonnais D, Vanden Noven S. Weakness in patients with hemiparesis. *Am J Occup Ther*. 1989;43(5):313–319.
- Canning CG, Ada L, O'Dwyer N. Slowness to develop force contributes to weakness after stroke. *Arch Phys Med Rehabil*. 1999;80(1):66–70.
- Gossman MR, Sahrmann SA, Rose ST. Review of length-associated changes in muscles. *Phys Ther*. 1983;62(12):1799–1805.
- Ada L, Canning C, Dwyer T. Effects of muscle length on strength and dexterity after stroke. *Clinical Rehabilitation*. 2000;14(1):55–61.
- Tardieu G, Lespargot A, Tabary G. For how long must the soleus muscle be stretched each day to prevent contractor? *Developmental Medicine & Child Neurology*. 1988;30:3–10.
- Gajdosik RL. Passive extensibility of skeletal muscle: a review of the literature with clinical implications. *Clin Biomech (Bristol, Avon)*. 2001;16(2):87–101.
- Mackey F1, Ada L, Heard R, et al. Stroke rehabilitation: are highly structured units more conducive to physical activity than less structured units? *Archives of Physical Medicine & Rehabilitation*. 1996;77(10):1066–1070.
- Newall JT, Wood VA, Hewer RL, et al. Development of neurological rehabilitation environment: an observational study. *Clinical Rehabilitation*. 1997;11(2):146–155.
- Esmonde T1, McGinley J, Wittwer J, et al. Stroke rehabilitation: patient activity during non-therapy time. *Aust J Physiother*. 1997;43(1):43–51.
- Ada L, Mackey F, Heard R, Adams R. Stroke rehabilitation: does the therapy areas provide a physical challenge? *Aust J Physiother*. 1999;45(1):33–38.
- Norris BC, Stephens MA, Rintala DH, et al. Patient behavior as a predictor of outcome in spinal cord injury. *Arch Phys Med Rehabil*. 1981;62(12):602–604.
- Morris ME, Iansek R, Matyas TA, et al. Stride length regulations in Parkinson's disease: Normalisation strategies and underlying mechanisms. *Brain*. 1996;119(2):551–568.
- Oddy R. Promoting mobility in patients with dementia: some suggested strategies for physiotherapists. *Physiotherapy Practice*. 1987;3(1):18–27.
- Prassas S, Thaut M, McIntosh G. Effects of auditory rhythmic cueing on gait kinematic parameters of stroke patients. *Gait & Posture*. 1997;6(3):218–223.
- Tyson SF. Hemiplegic gait symmetry and walking aids. *Physiotherapy Theory & Practice*. 1994;10(3):153–159.
- Hewson L. When half is whole: Australia: Collins Dove; 1990.
- Sale D, MacDougall D. Specificity in strength training: a review for the coach and athlete. *Can J Appl Sport Sci*. 1981;6(2):87–92.
- Riddoch MJ, Humphrey WG, Bateman A. Cognitive deficits following stroke. *Physiotherapy*. 1995;81(8):465–473.
- Kunkel A, Kopp B, Müller G, et al. Constraint-induced movement therapy for motor recovery in chronic stroke patients. *Archives of Physical Medicine & Rehabilitation*. 1999;80(6):624–628.

27. Lee M, Pang KF, Kung BK. Behavior pattern of patients in an acute neurology unit. *Physiotherapy Singapore*. 1998;1(3):77–80.
28. Ruff RM, Yarnell S, Marinos JM. Are stroke patients discharged sooner if in-patient rehabilitation services are provided seven Vs six days per week? *Am J Phys Med Rehabil*. 1999;78(2):143–146.
29. Hughes K, Kuffner L, Dean B. Effects of weekend physical therapy treatment on postoperative length of stay following total hip and knee arthroplasty. *Physiotherapy Canada*. 1993;45(4):245–249.
30. Nakayama H, Jorgensen HS, Raaschou HO, et al. Recovery of Upper Extremity Function in Stroke Patients: The Copenhagen Stroke Study. *Archives of Physical Medicine & Rehabilitation*. 1994;75(4):394–398.
31. Sivenius J, Pyorala K, Heinonen OP, et al. The significance of intensity of rehabilitation of stroke—a control trial. *Stroke*. 1985;16(6):928–931.
32. Sunderland A, Tinson DJ, Bradley EL. Arm activity in everyday life after stroke: a randomized controlled trial. *J Neurol Neurosurg Psychiatry*. 1992;55(7):530–535.
33. Kozlowski DA, James DC, Schallert T. Use-dependent exaggeration of neuronal injury after unilateral sensorimotor cortex lesions. *Journal of Neuroscience*. 1996;16(15):4776–4786.
34. Heller A, Wade DT, Wood VA, et al. Arm function after stroke: measurement and recovery over the first three months. *J Neurol Neurosurg Psychiatry*. 1987;50(6):714–719.
35. Taub E. somatosensory deafferentation research with monkeys. *Behavioural Psychology and rehabilitation Medicine*, Williams, Wilkins Baltimore: Springer; 1980:371–401.
36. Mackey F, Ada L, Heard R, et al. Stroke Rehabilitation: Are highly structured units more conducive to physical activity than less structured units? *Arch Phys Med Rehabil*. 1996;77(10):1066–1070.
37. Connell BR. The physical environment of inpatient stroke rehabilitation. *Topics in Stroke Rehabilitation*. 1997;4(2):40–58.