THE USE OF FUNCTIONAL ACTIVITIES IN THERAPY

AN INTEGRATION OF THE PRINCIPLES OF MOTOR CONTROL AND THE LEARNING PROCESS

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INTRODUCTION

Following a CVA, a person remains an individual who must function within the surrounding environment and community. Daily life represents a constant challenge and the individual will have to acquire new skills or re-acquire previous skills if they are to cope effectively. These skills may be physical, cognitive, psychological, emotional or social in nature.

Movement is seen as a means by which an individual interacts with the environment – a means by which problems are solved[1,2]. Daily tasks present a wide variety of demands to the individual; if the person is to function effectively he will not only have to possess certain basic abilities, but he will also have to be an effective problem-solver.

Therapists are interested in the development of competence and in how this degree of competence is reflected in the individual's behaviour and function[1]. However, since it is not possible to cover each precise requirement of the wide range of daily tasks facing the client, the therapist will have to integrate treatment principles and techniques aimed at improving motor skills with those aimed at promoting problem-solving skills. As such, the physiotherapist is not merely a coach of specific movements, "but is in essence a designer of the learning situations"[3].

ABSTRACT

The successful rehabilitation of a patient following a CVA is largely dependent on the effective relearning of previous motor skills or the learning of new skills. An understanding of the components of motor function and control and the principles of the learning process is therefore essential. Functional activities may be used as an optimal means of combining these principles so as to improve the efficacy of physiotherapy treatment. Two case studies are used to illustrate this approach.

ABSTRAK

Suksesvolle rehabilitasie van die pasiënt na SVO is grootliks afhanklik van die effektiewe aanleer van vorige vaardighede of die aanleer van nuwe vaardighede. Dit is van uiterste belang dat die terapeut die komponente van motorfunksie en beheer en die beginsels van die leerproses verstaan. Die effektiwiteit van die fisioterapeutiese behandeling kan verbeter word deur die gebruik van funksionele aktiwiteite. Hierdeur kan bg. beginsels optimaal geïntegreer word. Die benadering word deur die gebruik van twee gevalle studies uitgelig.

This view has two key features:

- in addition to therapeutic skills, knowledge of motor behaviour is required, as well as an understanding of the principles underlying the learning process and
- the modern trend of incorporation of specific tasks or activities within treatment sessions should not be limited to the clinical setting, but should be extended to include both the client's home environment and his home-programme.

MOTOR BEHAVIOUR

The classic view of motor behaviour is based on the existence of motor engrams which are specific to each motor skill[4]. These engrams are taken to be stored in the memory and to contain detailed muscle-specific information for each movement. A consequence of this view, however, is that there would have to be as many motor programs as there are possibilities to move. Thus the concept of such a rigid motor system has been rejected in favour of a more flexible model, namely the distributive model of motor control[5]. This relies on the concept of central pattern generators (groups of neurons distributed throughout the central nervous system) responsible for the execution of motor programmes. It is these motor programmes that then result in functional movement synergies which are flexible enough to adapt to similar tasks under different or varying conditions.

According to Sabari[2], a person needs intact motor programmes, motor memory, feedback mechanisms and feedforward mechanisms for effective motor functioning. However, it is precisely these mechanisms which are damaged in cases of brain injury.

Following a CVA a person will attempt to function using undamaged neural systems. By using these compensatory mechanisms to achieve his goal, alternative central pattern generators are established and the partially damaged systems will not be stimulated to recover[5]. This type of fixed compensatory pattern could greatly limit the persons ability to achieve their full potential.

One of the main aims of therapy is to re-establish normal movement patterns. An understanding of the principles of learning will enable the therapist to facilitate stimulation of these partially damaged central pattern generators optimally.

RELEVANT ASPECTS OF THE LEARNING PROCESS

"A large part of therapy can be seen as a learning process during which clients must master new skills (eg. propelling a wheelchair) or must reacquire old skills (eg. walking)"[3]

"Learning is seen as a set of processes associated with practice or experience and leading to a relatively stable change in behaviour"[3].

"Motor learning is not the learning of muscle control or movement control, but the acquisition of programming rules that enable the subject to behave flexibly under different conditions"[3]. In this article we will focus on elements of learning that can be manipulated by the therapists. In the authors' opinion, there are four crucial elements which will influence the acquisition of these programming rules:

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- Environmental aspects or context[2,6]
- Nature of the task[6,7]
- Type of feedback[4,7,8]
- Design of the practice schedule[7,8]

ENVIRONMENTAL ASPECTS:

The familiarity of the environment as well as the type of environment (physical, social and cultural) can influence learning. Information that can easily be related to previous knowledge, experience and skills will be more easily learned and remembered. Furthermore, knowledge of and familiarity with the task affects both processing speed and strategy selection[6]. Subsequent to a CVA, an individual may have difficulty in accessing previous knowledge and experiences, associating new information with previous experiences, or in being able to elaborate new information. Subsequently, an unfamiliar, crowded environment, filled with visual and auditory distractions, can affect the learner's ability to draw on previous knowledge as well as their attitude towards and ability to process and monitor information.

Allowing a person to practise skills within an environment with which they are familiar or which at least bears a close resemblance to a known environment can assist in the retrieval or accessing of previous knowledge. It has been argued that if what is taught is abstract and removed from the context and conditions of its application, not only will it be unrelated to previous experience, but it will be learnt as an isolated, fragmented entity[6]. A person should therefore be trained in the environment most appropriate to the type of task and to where the task will be performed in the real world.

THE NATURE OF THE TASK

The environment places certain demands on motor actions because it influences the choice of motor strategies. As the environment, ie. the surface (terrain), objects and people, may remain stationary or be in motion, tasks may be classified as being either closed or open tasks.

Closed tasks: Examples of these tasks include eating, drinking and self-care activities. These tasks can be successfully trained or relearnt by repetition in a stationary environment. Transfer occurs relatively easily.

Open tasks: Examples of these tasks include crossing a street, ball games, sitting in a moving train or taxi. These tasks cannot be trained successfully by repetition in a stationary environment. Transfer does not occur spontaneously.

Since the nature of tasks differ, the demands on postural control and dexterity differ. Also, even in the same task, the conditions of the environment may change between two consecutive performances or even between two successive trials. Therefore therapists cannot limit their clients to practising movements eg. flexion/extension, in isolation in the clinical setting with the goal of improving task performance. Instead, practising or relearning of tasks or part of tasks should be used in different environments and is the only way to improve task performance.

TYPE OF FEEDBACK

Feedback may broadly be divided into three areas:

- information available prior to movement
- information available to guide an ongoing response
- information available as a result of the movement.

Intrinsic feedback is inherent sensory information from receptors in the muscles, joints, tendons and skin as well as receptors in the visual and auditory systems. Intrinsic feedback may occur during or after movement production, eg. a patient senses his weight is equally distributed over both legs whilst standing.

Extrinsic feedback is information from an external source that augments the intrinsic feedback, eg. the therapist. Two kinds of extrinsic feedback can be given: knowledge of results (KR) and knowledge of performance (KP).

Knowledge of results might be verbal feedback about movement outcome that is given after a movement. This provides information about errors and will assist the learner in knowing how to modify the movement on the next attempt, eg. "Your feet are too close together." or "You're sitting in a slumped position." Knowledge of performance is verbal feedback about the nature of the movement that is given during a response, eg. "You need to shift more weight to your left leg." or "Your strides are not of equal length." Therapists more often use this type of feedback as it is aimed at correcting the movement pattern rather than merely the outcome.

Either type of feedback can facilitate and accelerate the learning process.

DESIGN OF THE PRACTICE SCHEDULE

During a treatment session, the therapist uses a specially designed practice schedule. The therapist can manipulate several factors of a practice schedule, namely:

- rest periods,
- the order of skills practised,
- conditions of the task and
- the amount of task that is being practised.

Compared with sportsmen who may train eight hours a day or more to perfect skills, therapists usually spend no longer than one hour per day retraining motor skills in stroke victims. Considering the fact that "skill increases directly in relation to the amount of practice"[7], one realises that what happens outside therapy is as important as what happens during treatment. It is clear that an effective and relevant home-programme should be introduced as early as possible to ensure maximal transfer of functional skills practised in therapy.

Rest periods: A rest period of more than the practice period (distributive practice) is appropriate for rehabilitation in the acute stage. Massed practice (rest time less than practice time) is appropriate for final rehabilitation. The practice time refers not only to the treatment session, and therefore should include a full-time, appropriate and integrated home programme.

Order of tasks: Practising different tasks at random (random practice), rather than maintaining the same order (blocked practice) improves learning as it improves concentration and motor memory.

Conditions of the task: Variability of the task also improves learning, as the environmental demands made on the person change continuously – thereby demanding heightened concentration and at the same time acting as a random practice trial.

Amount of task: A task can be practised as a whole, or just as a part of a task. Practising components of a task is useful when relearning complicated tasks, eg. retraining components of gait before having the patient walking functionally. Part-task training can be used in early rehabilitation, when certain aspects of the task can be used to achieve relevant aims even though execution of the entire task may be too difficult or complicated at that stage; supported standing while dusting is effective since the client is learning to cope with the postural demands of the upright position required in preparation for independent dynamic standing balance.

Two case studies will be used to illustrate the above.

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CASE 1

History

Mrs I A is a 72 year old lady who suffered a CVA on 7 March 1990, resulting in a left sided hemiplegia. She was referred to the Centre for Care and Rehabilitation of the Disabled by a community nurse more that five years after the incident. Before admission, two home visits were made in order to start retraining during the time that she was on the waiting list for admission. She was admitted for in-patient rehabilitation on 12 June 1995 and discharged after seven weeks. A home visit was done subsequent to discharge.

Physical status

Even though active, selective movements were present in both the upper and lower limb, she had a high degree of spasticity. Together with severe loss of proprioception and tactile sensation in both affected limbs, this often caused her to ignore the left upper limb and it would pull up into a mass flexion spastic pattern. At discharge, she was able to inhibit the mass patterns and use the arm functionally, even though components of the mass pattern were still visible.

Social background

Mrs I A shares a house with her daughter and granddaughter who is in primary school. Her daughter works full time. After the CVA, Mrs I A resumed her household chores without assistance.

Two activities will be discussed, namely, wiping the sink and hanging up the washing.

Fig 1: Wiping the sink

Standing in walk-stance, left leg forward, supporting on left upper limb, wiping surface with right upper limb. Segmental flexion and rotation are present in the trunk, depending on how far is being reached with right hand. Both affected limbs are in inhibitory patterns. Note the presence of associated reactions in the second and fifth fingers. There is mobile weight bearing on both limbs. Weight is being transferred laterally and anteriorly from the right leg behind, onto the left leg in front, preparing for weight shift during gait. One should be careful that the patient is not only bearing weight on the right hand side. The left upper limb should not be a medial rotation. There should be no retraction of the left side of the pelvis, nor should the left knee be hyperextended.

Hanging up washing

The two illustrations show incorrect patterns (Fig. 2) and improved patterns (Fig. 3).

In figure 2 it is evident that the associated reactions of the upper and lower limbs result in complete and marked asymmetry. The task is difficult, demanding very good dynamic standing balance, as well as distal function. As the task is difficult, the tone increases considerably all throughout the body. As she is not using the left upper limb functionally it is in the mass spastic position, increasing the asymmetry. The pelvis is notably retracted on the left side, with inversion, plantarflexion of the foot. If spasticity during difficult activities is not controlled, spasticity will increase over time, decreasing function at the same time.

Figure 2: Hanging up washing – incorrect patterns

Figure 3: Hanging up washing – correct patterns

In addition, the patient demonstrates poor back care techniques and kinetic handling skills.

In figure 3, Mrs I A is repeating the action. Her starting position is unchanged, but she is now using both upper limbs.

The upper limb is now used functionally, despite increased tone still being present. Because of the improved activity in the upper limb, the trunk is now symmetrical. There is still asymmetry present in the lower limb, but less than before.

Ideally, the basin should be lifted onto a chair or stool. The problem is that the patient cannot carry a big object like that herself, nor does she want to leave anything outdoors. Back care should be introduced into her home programme.

CASE 2

History

Mr G v B is a 26 year old teacher. On 31 August 1995 he suffered a CVA, resulting in a right sided hemiplegia. At the time of the incident, he was admitted to a private medical clinic and from there referred to the Centre for Care and Rehabilitation of the Disabled. He spend three weeks at home prior to his admission at the Rehabilitation Centre. In-patient rehabilitation lasted seven weeks.

Physical status

On discharge, Mr G v B had good, active, selective movement in his upper limb. Even though proximal tone was slightly decreased, distal tone in hands and fingers was slightly increased. The lower limb had slightly decreased tone, with underlying increased tone, only visible during hard physical activity.

Social background

Mr G v B is unmarried and lives with his parents. He shares a bedroom with his brother. Apart from teaching, Mr G v B also has to help with household chores, such as gardening. In his spare time, he reads a lot.

Two activities will be discussed, namely, mowing the lawn and reading.

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Figure 4: Mowing the lawn

Figure 5: Reading – incorrect posture

Figure 6: Reading – correct posture

Mowing the lawn (Fig 4)

This activity allows the upper limb to be in a reflex inhibiting position. The weightbearing control of the lower limb is facilitated by the fact that the trunk remain supported and symmetrical.

Reading (Fig 5 and 6)

In the uncorrected posture (Fig 5), the trunk is slumped and the arm is in a non-functional position in the mass spastic pattern. In the leg, the components of the extensor synergy pattern are visible.

In the improved posture (Fig 6), the trunk is active with extension and increased rotation to the right. The neck is less rotated. Both arm and leg are in good alignment, with no evidence of increased tone.

CONCLUSION

The advantages of using a functional approach which incorporates both the components of motor functioning and control and the principles of the learning process have been highlighted in the above discussion. Initially, integrating this approach into daily therapy may demand extra thought and planning from the therapist but the benefit should soon be apparent, as such an approach assists in the effective transfer of functional tasks according to the demands of the environment.

Since the approach is not only aimed at improving motor skill but also at equipping one's client with problem-solving skills, retention and transfer of that which is learned in therapy sessions should be facilitated.

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