WITS UNIVERSITY

COMPARING THE EFFECTIVENESS OF TWO OCCUPATIONAL THERAPY STROKE UPPER LIMB HOME PROGRAMMES

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Declaration

I, Bhavika Harrilal Chhania, hereby declare that this research report, titled; "Comparing the effectiveness of two occupational therapy stroke upper limb home programmes" is my own work and that any assistance obtained has been only in the form of professional guidance and supervision. No part of this research report has previously been submitted to any other research institution of higher learning or university. Where someone else's work was used, due acknowledgement has been given and references have been made accordingly to the requirements of the Faculty of Health Sciences at Wits University. I claim complete responsibility for the conclusions drawn in this research study.

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Abstract

Keywords: Occupational therapy (OT), Occupational therapists (OTs), Traditional Exercise Home Programme (TEHP), Task-orientated home programme (TOHP), and activities of daily living (ADL), DASH (Disability of the Arm, Shoulder and Hand)

OTs treat stroke patients more than any other diagnostic group, thus it is essential to find ways in making therapy most effective. The benefits come from assisting the brain to reorganize itself through rehabilitation, which in turn helps the stroke patient to recover lost functions after brain damage.The desire to understand what types and intensities of rehabilitation strategies result in optimal and cost effective outcomes has been a stirring force behind research. There is mounting evidence that intervention strategies providing meaningful engagement, context relevant, in activities are more advantageous for skill achievement than rote exercise/passive modalities. Thus OTs should consider this in all aspects of their treatment. Patients are known not to be compliant with their exercises; therefore it is essential that home programmes contain more activities that they would do normally at home, which will ensure more compliancy. This study aims at comparing the effectiveness of a TEHP and a TOHP on the improvement of upper limb function through measurement with the DASH. This will guide OTs in their future designs of home programmes.

The controlled (TEHP) and experimental group (TOHP) both consisted of 22 participants each who were assessed using the DASH upon discharge after receiving OT intervention. Thereafter the patients were reassessed upon follow up, which was within 4 weeks post discharge. The mean discharge and follow up scores of both groups were compared. Both groups had better DASH scores upon follow up; however, the experimental group yielded a statistically significant difference in the overall DASH score.

The study indicates that the use of a TOHP, consisting of more of activities of daily living may have a greater impact on independence than the use of a TEHP in the treatment of acute stroke patients.

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List of abbreviations/acronyms:

OT:	Occupational therapy
OTs:	Occupational therapists
OTTs:	Occupational therapy technicians
ADL:	Activities of daily living
DASH:	Disability of the Arm, Shoulder and Hand (outcome measure)
DGMAH:	Dr George Mukhari Academic Hospital
TOHP:	Task-orientated home programme
TEHP:	Traditional exercise home programme
SA:	South Africa
EBP:	Evidence Based Practice

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Chapter 1: Introduction

1.1 Introduction

Stroke is painstakingly unusual from other chronic diseases in that it is an unexpected occurrence leaving the survivor disabled almost immediately. The survivor's life changes instantly and the most active and independent individual can become dependent in the most basic task. In stroke, the route to coming the terms of disability may be more closely attached with the rehabilitation procedure than is the case for survivors with other chronic conditions (1).

Stroke is becoming an important area of expertise in rehabilitation due to the increase number of stroke survivors worldwide. It is one of the most costly diseases of modern society (2) and has been recognized as a main cause of death and disability internationally. Morbidity is likely to raise as a result of the demographic shift which leads to an raise in factors that are linked with an acceleration in the risk factors of stroke, such as detrimental lifestyle choices, increase in stress levels, lack of appropriate nutrition, loss of caregiver/family and community support as well as the increased rate of neurological dysfunction manifestations in persons infected with the human immunodeficiency virus (HIV) (3). Thus, it is of upmost importance that therapists know what therapeutic interventions are most effective in rehabilitating stroke survivors, so that best results are achieved as early as possible.

Years of neuro-science research currently prove that stroke rehabilitation is vital for best possible recuperation post brain injury. The benefits come from assisting the brain to 'restructure' itself through rehabilitation, which in turn helps the stroke survivor to recover functions lost post brain injury (4). Occupational therapists (OTs) treat stroke patients more than any other diagnostic group, and due to the large patient load, it is essential to find ways in making therapy more effective. In order to recognize what types and intensities of rehabilitation strategies result in optimal and cost effective outcomes has been a motivating drive behind research for the past two decades (5). Assuring that patients receive adequate and cost-effective care has humanitarian, clinical, and policy motives but needs complicated structuring in order to distinguish the benefits of rehabilitation from natural recovery.

Due to the poor coordination between the multidisciplinary team (MDT), lack of planning consistently regarding the patient needs or abilities, and the breakdown of communication between professionals, patients, and caregivers has resulted in major criticism in the treatment of stroke in general wards (6). The discontentment with service delivery in general medical wards has resulted in the development of more specific interventions in stroke care during the past 10 years (6). In developing countries such as South Africa, particularly in rural areas, resources for stroke management and rehabilitation are underprovided (7). Survivors with acute stroke are frequently discharged from hospitals/clinics without an option of receiving sufficient rehabilitation by qualified and skilled health care professionals. Patients are also struggle to attend out-patient rehabilitation services owing to the lack of public transport for people with disabilities, as well as due to the poor socio-economic circumstances for people with disabilities; private transportation is frequently not a possibility within the South African context (3). A flexible, more cost-effective strategy to community-based stroke management is desperately required for stroke survivors after their discharge from government hospitals.

According to a study conducted by Western Cape Rehabilitation Centre, many patients are being discharged home prematurely due to pressure on acute beds in tertiary, secondary and district hospitals (8). The average length of stay for a stroke patient at these hospitals is only 3 - 3.5 days. The major responsibility for relieving the departments' long-term health care burden, therefore rests with rehabilitation services (8).The failure of other health services providers to promptly refer appropriate patients for rehabilitation, frequently results in disabled patients falling through the safety net. Complications which cause further disability frequently develop, resulting in rehabilitation that is both more costly, lengthier, and has poorer outcomes (8). Given the increasing demand on health care services in an aging population with having the challenge of patients not able to attend therapy regularly due to financial constraints; it is of dyer need that therapists, consumers and policy makers evaluate the most effective, competent and suitable methods of managing patients with stroke. Due to the constraints of in-patient rehabilitation, alternative options such as community rehabilitation and home programmes must be considered in order to help decrease the pressure on healthcare and focus more on the independence of the stroke survivor. Therefore this research study is focused on implementing therapy in the form of home programmes.

Evidence regarding the effectiveness of home programmes to improve upper limb function post stroke is rare and not related to a South African context. However, presently there's mounting support that intervention strategies providing context appropriate, meaningful engagement in tasks that are more beneficial for skill attainment than rote exercise or passive modalities (9). Thus OTs should consider this; using task-orientated intervention in all aspects of their rehabilitation, especially in home programmes. Patients are known not to be compliant with their home programmes, such as exercises in the long term (10), and therefore it is essential that a home programme contains more activities that they would do normally at home, which will ensure more compliancy.

This study aims at comparing the effectiveness of a task-orientated home programme (TOHP) (Appendix A) and traditional exercise home programme (TEHP) (Appendix B) on the improvement of upper limb function through the measurement of the Disability of the Arm, Shoulder and Hand questionnaire (DASH) (Appendix C). The results of this study will guide OTs in their future designs of home programmes.

1.2 Problem Statement

1.2.1 OTs have a high patient load and are also faced with many challenges, amongst others, one of which, patients being prematurely discharged from hospitals before being fully rehabilitated.

1.2.2 Recovery after stroke is hindered due to numerous constraints mentioned previously.

1.2.3 There is lack is evidence regarding which home programmes are most effective with regard to the functional recovery of the upper limb post stroke.

1.3 Research Question

Is a TOHP or a TEHP more effective in improving the functional recovery of the upper limb in stroke patients?

1.4 Purpose of the study

The purpose of the study is to find an effective way of implementing treatment at home, which will improve the functional recovery of the upper limb in a stroke patient.There is no current evidence that states that the one intervention is more superior to the other, or that either is effective. There is also limited information on the use of these programmes in South Africa and in occupational therapy (OT). Therefore this study aims to show whether one intervention is more effective than the other. If the results prove that one of the interventions has better outcomes, the study could be used to motivate therapists to use the more effective intervention in clinical practice.

1.5 Null Hypothesis

The TOHP is not more effective than the TEHP in treating stroke survivors as measured by upper limb recovery.

1.6 Aims and objectives

The aim of this study was to compare the effectiveness of a TOHP versus a TEHP on upper limb function in stroke survivors.

The objectives were to:

1.6.1 To assess the recovery upper limb function of stroke patients based on the DASH after implementing a TOHP (Appendix A).

1.6.2 To assess the recovery upper limb function of stroke patients based on the DASH after implementing a TEHP (Appendix B).

1.6.3 To determine if a TOHP versus a TEHP intervention is more effective than the other in the functional recovery of the upper limb in stroke survivors.

1.7 Justification of the study

OTs treat stroke patients more than any other diagnostic group and due to the increase number of stroke survivors worldwide, it is essential to find ways in making therapy more effective. The need to recognize specific types and intensities of rehabilitation therapies that result in optimal and cost effective outcomes needs to be established. In-patient rehabilitation has numerous constraints, particularly when working with stroke survivors in a government hospital setting, thus it is essential for therapists to identify most effective treatment strategies, allowing for better recovery.

Chapter 2: Literature Review

2.1 Introduction to the literature review

In the subsequent literature review, a brief overview on the recovery of stroke patients will be discussed, particularly focusing on the upper limb. The importance of neuroplasticity in how the central nervous system (CNS) responds to injury and how patients regain lost behaviours by training, which has resulted in potential for new therapies in the rehabilitation for patients with CNS dysfunction, will also be discussed. A special focus on TOHPs and TEHPs will also be reviewed as it could play a vital part in the overall recovery of stroke patients in South Africa, where in-patient rehabilitation is often left incomplete. As stroke carries with it intrinsic costs to the survivor, their families and caregivers, the community and, more generally, the health services and country (11); it is important to establish other means of treatment. Lastly, the use of the Brunnström stages of recovery in post stroke will be described followed by the use of the DASH (Appendix C) as an outcome measure.

2.2 Stroke background and rehabilitation

Many patients living with stroke frequently experience a profusion of obstacles that include a reduced functional capability, poor activity tolerance, muscle atrophy, incomplete paralysis, residual gait obstacles, associated symptomatology, anxiety, depression, job/economic stress, and, for some, an overpowering sense of insecurity (12). Mobility-challenged survivors are liable to idleness and frequently have an inactive way of life, which in turn results in a range of obstacles including societal segregation, feelings of hopelessness and fatigue, deteriorating gait patterns, eventually affecting their quality of life (13). Additionally, as a result of inactivity, results in reduced exercise tolerance, which in turn may result in secondary complications such as muscle atrophy, decreased cardio-respiratory fitness, impaired circulation in the lower limbs and osteoporosis (13).

Typically, neuroscientists, physicians, and therapists have categorized the motor characteristics of CNS dysfunction into positive and negative features (14). Positive features are exaggerations of normal phenomena due to release of spinal and brainstem reflexes from hierarchical inhibitory control. Positive features of stroke include spasticity and hyperreflexia. In the past medical professions had considered positive features to be the major challenge to improved clinical function, but no clinical or experimental evidence has supported this view (14). Currently there is increasing supporting research that state that negative features of brain dysfunction are more important than positive features causing motor disability. Negative features include: muscle weakness, myofascial tension, neural tension, muscle shortening, muscle stiffness, fatigability, slowness, and impaired dexterity and are due to the impairments in recruitment and firing rate modulation of motor neurons. According to a study conducted by de Jong et al (15), 54% of stroke survivors develop contractures in the hemiplegic upper limb five months post stroke. In addition some patients develop resistance to passive movement and spasticity. In 26% of acute hemiparetic survivors, spasticity was found to be present and in 28% three months post stroke. The development of hemiplegic shoulder pain, as a result of spasticity (or more specifically, hypertonus) was seen as a cofactor and was also associated to a reduction in joint passive range of motion and correlates to the limitations in activities of daily (ADL) and motor impairments (15).

Carr and Shepherd (16) introduced a third category of features associated with upper motor neuron dysfunction, known as adaptive features. The changes include shortening, stiffness, neural tension and myofascial tension, which are changes in the mechanics of the muscle. Changes can also develop in the structure and working of the muscles (physiology of muscle) and the functioning of the muscle, and other tissues. This is due to limitation in the movement of muscles, lack of use, and the patient moving with the remainder of muscles, but this is abnormal. When muscles are immobilised in their shortened position, physiological changes include the loss of sarcomeres and remodelling of connective tissue. Subsequently, muscles undergo mechanical changes of shortening and stiffening. Carr and Shepherd advocate early therapeutic intervention after stroke to prevent or minimize the adaptive features of CNS dysfunction. It is particularly essential to prevent muscle stiffness and shortening through early passive and active mobilization (14), so that once strength has gradually regained, therapy can be directed towards dexterity as well as strength because both are essential for optimal function.

However, keeping this in mind, one must also remember that stroke does not occur in isolation. Many stroke patients with cerebral infarction or cerebral hemorrhage also have hypertension, diabetes mellitus, hyperlipidemia, or risk factors for atherosclerosis due to aging (17). These patients often show motor disorders due to hemiplegia with a consequential decrease in physical activities. On the other hand, compare to developed countries, stroke affects the younger population in developing countries, and in Africa, possibly 10-15 years earlier than in countries that are developed (18). The trouble of stroke does not only lie in the elevated death rate but the high morbidity leaving up to 50% of its survivors disabled (19). In sub- Saharan Africa, the years of possible life lost as a result of stroke is therefore large, and has significant socioeconomic costs attached to it (18). Thus, it is of paramount importance to find cost-effective strategies in neurorehabilitation to assist in overcoming these obstacles.

Disorders of muscle tone, posture and the selective control of movement are as a result of stroke causing an interruption of sensory and motor pathways and their integration. The loss of upper limb control is frequent post stroke, with up to 88% of the patients having various degrees of upper limb limitations (20). Amongst the surviving stroke patients, neurological deficits such as, communication disorder, disorders in visual-spatial perception and hemiparesis may result in a number of disabilities (21). Most of the affected upper limb improvement occurs in the preliminary three months after stroke, and the extent of initial severity, accompanied by the ability to generate grip strength or shoulder shrug are excellent indicators for good functional recovery (22). The location of the lesion, constant shoulder pain and perceptual inattention also affect upper limb movement and functional recovery (22).

There is no acceptable method for treating stroke patients, despite the fact that stroke is an imperative root to disability (23). In stroke patients with hemiplegia, a decrease in the quantity of daily physical activities is considered to be a factor of deterioration of physical fitness (17). Therefore it is essential to maintain and promote the remaining motor functions through rehabilitation. Stroke rehabilitation can be defined as a goal-directed process by which the patient works with a multi-disciplinary team through the goal of salvaging as much of the function as possible post stroke, as a result of a combination of cognitive, physical, and language disabilities (4)(11). Neurorehabilitation is a means for learning a previously known task in a different manner, via the option of two methods: adaptively recruiting alternative pathways or by compensatory strategies (22). Stroke patients can capitalize on their chances of recovery by attending a comprehensive rehabilitation programme immediately after being discharged from the hospital, and in the majority of cases they will be able to regain a significant part of lost functions a result of the stroke (4). Keeping this in mind, there are also a number of factors that add to the difficulties in assessing the effectiveness of stroke rehabilitation units (6).

The measurement of differences in stroke rehabilitation is complex and challenging due to the heterogeneity of patient individuality, the multiplicity of settings in which stroke survivors are treated, failure to stratify for severity of stroke (which determines the level of resources needed in addition to the prognosis of the survivors), differences in quality and quantity of treatment received by patients, variation in resources allocated to stroke management and the organization of services, as well as challenges in disentangling the effects of differing service organizations (6).

Brain damage affects the entire life situation of stroke patients as well as that of their families. A stroke often gives rise to stress and crisis therapy is often needed (24). Sometimes a stroke patient can be need of more help than their actual functional impairment indicates. Thus, it is important that both the patient and their families to take an active part in the rehabilitation programme (24). Improved independence in mobility and ADL can boost quality of life and lessen the burden on health care (25).

According to studies reviewed by Kwakkel et al(21), “comprehensive functional therapy incorporating elements of task-specific along with intensive strategies is most likely to result in therapeutic effects” (21, pg377). Stroke survivors can have improved function in ADL for three months post stroke rehabilitation. Spontaneous recovery post stroke will occur within six weeks (26). Thus the patient needs to be treated for longer than six weeks so that one can conclude on effectiveness of therapy rather than commenting on spontaneous recovery of patients. Initial management of stroke will aim at finding the cause and localising the lesion, as well as the prevention of deterioration of the lesion, reducing cerebral oedema, and the prevention of complications due to the neurological and medical injury (26). Rehabilitation including OT, is designed to promote maximum possible functional recovery from stroke, by improving and facilitating control over movement and hand function in the affected upper limb, to help the patient manage cognitive, perceptual and behavioural challenges, maximizing the their ability to perform occupational performance activities, as well as to prepare the patient for their home and work settings (27). OTs seek to aid task performance by improving performance skills and body functions or by teaching compensatory methods in order to prevail over the functional skills lost post stroke (28). The burden of care in stroke patients is furthermore placed on family members and caregivers. Thus, lessening the burden of care and improving quality of life in stroke patients and their caregivers is a vital role to be fulfilled by OTs (28). Stroke rehabilitation starts the moment the stroke is diagnosed and life threatening problems are being managed (26). Admission in acute hospital beds is generally only sufficient for the most essential diagnostic tests, for initiation of appropriate medical treatment, and for making referrals and taking clinical decisions for the continuation of the patient’s rehabilitation. The early introduction of basic ADL such as rolling in bed, sitting over the side of the bed, transferring to a wheelchair, feeding oneself, basic hygiene, and dressing helps the patient reestablish some control over the environment and begin to improve occupational functioning and component abilities and capacities (26).

After stroke, OT is aimed at maximizing the patient’s ability to take on his or her own ADL and domestic tasks, to cope the psychosocial deficits and changes in sensory perception and behaviour connected with stroke and to prepare the home and work setting for the patient's return, as well as at improving the patient's hand function and motor control in the affected side (27). OTs work in conjunction with the patient to establish the impact of stroke on developing the necessary skills needed for participation in everyday living and performance of daily tasks (27).

2.3 The recovery of the upper limb post stroke

As the use of one's arms and hands is essential for the performance of ADL tasks, the lack of improvement may be overwhelming to an individual's health-related quality of life, especially as more stroke patients are returning home (29). The treatment of the affected upper limb and hand remains a great stride for health care professionals.

A number of studies have been done, to study the recovery of the affected upper limb in post stroke survivors. 85% of survivors show untimely deficits in the affected upper limb. Problems associated with the affected upper limb remain in 55% to 75% of patients, three to six months post stroke. So far, most studies indicate that the localization and type of stroke and initial severity of paralysis of the upper limb are just a few of the greatest predictors for outcome at 6 months (30). In addition, Kwakkel and his team (30) found that in most studies, the most favorable prediction of outcome can be made within 4-5 weeks post stroke and that the lack of a quantifiable grip function at one month after stroke can be an found to be indicative of a poor functional recovery of the affected upper limb, while early return of voluntary motion of the affected upper limb in the 1-2 weeks post stroke is thought to be an excellent prognostic indication. The duration of time through which one finds a lack of progress reflects the intrinsic damage to the cerebral cortex and should be viewed as a significant forecaster of reduced outcomes (30).

While the recovery of the upper limb is poor in many stroke patients, lower limb functioning has been demonstrated to be less of a challenge. This discrepancy might be due to several reasons, one being that 75% of infarcts or haemorrhages take place in the area supplied by the middle cerebral artery and as a result, the upper limb will be more affected in many of the patients (31). The functional recovery of the hand and upper limb includes holding, grasping and manipulating objects, which needs the recruitment and complex integration of muscle activity from the shoulder joint to the fingers. On the contrary a minimum amount of recovery of the affected lower limb is possibly needed for adequate functional walking (31). Additionally, secondary complications such as shoulder-hand syndrome, inferior subluxation of the glenohumeral joint, painful shoulder and soft tissue lesions, often delay the rehabilitation of the affected upper limb. An additional contributor which may reduce the chance of return of upper limb function is the need of spontaneous stimulation during functional tasks. During every transfer, transition of movement and each effort to stand or walk will entail bilateral activity of the lower limbs, however, when it comes to engaging in upper limb tasks, the patient could use the “non-affected” upper limb solely (31).

The impairment of upper limb functioning has a major impact on functional and social independence of stroke patients and such difficulties represent a major public health problem (32). The loss of upper limb functioning is a primary problem in managing everyday ADL. The dominant focus for individuals with hemiparesis is their impairment and the possibility of difficulty in performing everyday activities may cause psychosocial repercussions such as frustration which can affect self-esteem in the long term. Low self-esteem in turn can significantly affect functional independence in a vicious cycle (32). Many patients post stroke, with upper limb paresis regain strength, but often fail to achieve independence in daily functional tasks. This phenomenon is referred to as learned non-use, and it has been reported that the longer the time reinforcing the non-use of the affected hand, the slower the recovery of function (32). In previous studies reviewed by Park et al. (32), have demonstrated the effectiveness of forced use on upper limb functioning and ADL performance, however, they proposed the need for additional research on the effects of home therapy, schedule adherence, and voluntary use of the affected hand. Forced use home programmes involve a restraint that results in unstructured practice whenever an activity is performed needing the use of the affected upper limb and hand. Despite improving upper limb functioning during such a home programme, it has been noted that individuals frequently report difficulty in adhering to a practice schedule that requires a restraining device at home and in voluntary use of the affected hand (32).

The primary impairment, most frequently treated by therapists with regard to stroked-induced disability, is upper limb hemiparesis/hemiplegia (33). There are several therapeutic interventions are presently available. Nonetheless, substantial debates exist about each one’s efficiency (31). Controlled studies intended to compare neuro-physiological treatment interventions, such as the neuro-developmental theory (NDT), proprioceptive neuromuscular facilitation and the Brunnström theory with conventional therapy, were not successful in detecting any major changes overall in upper limb functioning (31). The expansion of new rehabilitation strategies such as “constraint-induced movement therapy” (CIMT), “robotic training”, electromyographic feedback, and other intensive activity tasks (22), like bilateral arm training with rhythmic cueing, to enhance functional motor recovery have resulted due to the persistence of weakness in the upper limb post stroke. These strategies often force the use of the affected upper limb and have generated optimistic improvements in motor functioning in the affected upper limb (22); however, most are not realistic and practical within a South African context.

2.4 Neuroplasticity

Cortical maps and neuronal connections are continuously being remodeled by one's experience, even in 'normal' individuals (34). The comprehension of the possible capability of the brain to compensate for lesions is a precondition for the best possible stroke rehabilitation strategies. Even in daily life, when one performs an extremely skillful motor activity, the cortical presentation of the muscles associated will stay enlarged as demonstrated in blind people who do finger Braille reading.

"Experimental focal cortical lesions induce changes in adjacent cortex" (34, pg 223) and in the contra-lateral hemisphere. Neuro-imaging research studies in stroke survivors have indicated changed post stroke activation patterns, which propose functional reorganization (34). A number of mechanisms are to be implicated in brain plasticity and reorganization may be the key process responsible for recovery of function post stroke. The reorganization of adult cortical areas and activity-dependent adaptation of synaptic connections are thought to be involved in long-term potentiation as well as long-term depression mechanisms by which information is kept in the CNS (34). The changes in additional cortical areas in the cerebrum have been recognized at various points after the lesion, from as soon as the first minutes to longer periods extending up to several months. Post lesion events could be as a result of deafferentation, changes in membrane excitability, removal of inhibitory mechanisms, task-dependent synaptic changes, unmasking of preexisting pathways or growth of new pathways. When weaker neuronal pathways have been unmasked, it has commonly been seen as responsible for the fast cortical and synaptic plasticity (34). In a study conducted by Johansson in primates (34), the cortical mapping by intracellular recordings confirmed that "the tissue surrounding a minute lesion in the hand-representation area of primary motor cortex in adults undergoes additional territorial loss in the functional representation of the affected body part" (34, pg 224), via the disturbance of local intrinsic cortical circuitry or nonuse. "This additional tissue loss can be prevented and functional reorganization in the undamaged surrounding motor cortex stimulated by retraining of hand use" (34, pg 224), beginning 5 days post injury.

Following a lesion to the CNS, both the body and the brain need to relearn how to function. Harnessing this intrinsic capability for neuronal circuit change in the brain can be crucial to optimize the benefits of therapy (35). It has been well recognized that early mobilization can decrease secondary thrombo-embolic incidents, pneumonia, and mortality in acute stroke. Improvement in recovery by environmental stimulation is not a latest concept; however, it is important to indicate that it can improve the efficacy of additional interventions, as shown with neocortical grafting (34). Functional outcomes are not only dependent on the amount of neurons remaining, but also on how they function and what associations they can make. Motor-learning research in non-disabled individuals and in patients with CNS dysfunction has recommended that numerous repetitions of task-specific activity could be essential to encourage neuroplastic changes (35). Therefore actual functional tasks rather than just pure exercises may be more beneficial in encouraging neuroplasticity and could be the key to effective stroke rehabilitation.

The means by which the brain acquires novel responses to therapy and encodes experiences can be defined as neuroplasticity. It is furthermore the means by which the injured brain relearns lost behaviours in response to therapy (36). It is through physical rehabilitation that both relearning in the damaged brain and learning in the intact brain is believed to occur. In order to understand and recognise the essential principles that may direct the optimization of therapy, neuroscience research has made important strides and these findings are starting “to be integrated with research on the degenerative and regenerative effects of CNS damage” (36, pg S226).

Recent evidence strongly suggests that amongst other brain cells; neurons have the capacity to change their make-up and function in response to a range of internal and external pressures, together with behavioural training. Therefore, by taking into consideration the fundamental principles of neuroplasticity that direct learning in the unharmed and damaged brain, identifying neurobiological signals and behaviours that steer recovery can commence.

Task-orientated intervention is imperative. This makes innate sense as the paramount means to relearn a given task is to train exclusively for that task. In order to generate enlarged motor cortical representations exercise in a repetitive manner alone, neglecting the meaningfulness and value of the task, is not sufficient (37). Cortical plasticity paired with meaningful and purposeful task improvement can be produced, by a smaller amount of intensity but should be specific in task training to successfully recover movement in a paralyzed limb.

The approaches to recovering function post CNS damage are divided into two main categories: "(a) efforts to limit the severity of the initial injury to reduce loss of function and (b) efforts to reorganize the brain to reinstate and compensate for function that has already been compromised or lost (36, pg S226)". The first approach is evidently vital, though, many will go on to have severe lasting disabilities even in those benefiting from early intervention (36). Therefore, the "need to understand how brain function and structure can be driven to adapt in the days, months, and years" (36, pg S226) post CNS dysfunction. "Neuroscience research has set important strides in understanding the brain; however, we are far from understanding the brain circuitry at the level necessary to lay for new neurons and neural connections in just the correct places to reinstate a lost function" (36, pg S226). Luckily, there are other ways to generate suitable functional neural connections capitalizing on the manner in which the brain generally does this, is through learning. Vast evidence has suggested that the brain constantly remodels its neural circuitry so as to encode behavioural changes and new experiences. This is indeed neuroplasticity, as it is determined by changes in cognitive, sensory and behavioural experiences (36). For promoting the reorganization of remaining tissue in the injured brain, "the endogenous process of functionally appropriate reorganization in healthy brains" (36, pg S226), is also essential. To encourage adaptive neuroplasticity is a growing point of research and is prone to be improved the by taking the principles of experience dependent neuroplasticity into consideration, as this approach uses the practice of learning, alone and in combination with other therapeutic interventions (36). Even when there are no evident rehabilitation efforts learning is a critical part of brain adaptation to CNS damage. Due to the loss of function on the affected side, stroke patients tend to develop compensatory behavioural strategies in order to perform their ADL tasks, and this is one of the most dependable behavioural consequences of CNS damage. Dependence on the less-affected limb post stroke is linked with significant reformation and neuronal growth in the contra lateral hemisphere (36). Therefore, a brain that one can endeavour to reorganize with rehabilitation is one that is already steered to restructure via compensatory behavioural changes. Such self-taught behavioural changes can be adaptive and fundamental contributors to efficient outcomes (36).

"Changes in genes, neurons, synapses and neuronal networks within the specific brain areas can alter learning processes" (36, pg S226), when CNS injury causes several changes in non-neuronal brain cells and neurons. Furthermore, brain damage causes key neuroplastic and neurodegenerative changes to the connected areas (36). When a section of the cerebrum becomes dysfunctional in its associations, it results in a number of changes associated "with the clearance of degenerating debris, the remodelling of neuronal processes, and the production of new neural synapses" (36, pg S227). Time dependent disruption of function and permanent functional changes, such as the altered cortical excitability post stroke can also result in CNS damage (36). Therefore, it is not unexpected that learning would be considerably transformed when it involves the very same neural connections and neurons that are undergoing regenerative and "degenerative responses to the injury or that have been persistently transformed in excitability" (36, pg S227). Thus, when applying these principles of learning to patients with cortical damage, the results of CNS injury could be associated limitations and advances should be considered in learning (36).

Amongst many of the journal articles reviewed, a study conducted by Kleim et al. (36), describes essential and fundamental principles of experience dependent neuroplasticity that have been determined from years of neuroscience research that are likely to be significant to rehabilitative interventions post CNS damage. These principles have been described in detail below:

Principle 1: Use it or lose it - When neural circuits not actively occupied in task performance for an extensive period of time begin to degrade. Therefore by encouraging purposeful use of the affected extremity and behavioural experiences, will encourage better movement associated activation in the remaining cortex of the damaged brain which would otherwise be lost after the injury. Therefore rehabilitation must focus on the use of both upper limbs and should be steered away from encouraging patients to use one handed techniques, as failure to perform explicit brain functions could result in functional degradation.

Principle 2: Use it and improve it – Neuroplasticity within the cerebral cortex, is brought about by improvements in skill training. "It is hypothesized that related neural changes occur to mediate functional improvements in response to neurorehabilitation" (36, pg S228). Thus a behavioural experience can boost performance and maximize restorative brain neuroplasticity post CNS damage, as motor skill training has been found to restore neural plasticity in addition to improving motor function in the remaining cortical regions. Therefore, if one practices a specific skill on a daily basis which drives a definite brain function that will result in an improvement of that function.

Principle 3: Specificity – "The changes in gene expression, synapse addition, neuronal activity" (36, pg S229) and dendritic growth in the cerebellum and motor cortex re associated with motor skill attainment. Skill acquisition or learning, rather than sheer use, appear to be needed in order to create major changes in patterns of neural connectivity. Thus, learning-induced brain changes too, display regional specificity. In order to have an impact on the ability to obtain behaviours in non-trained modalities, training in that specific modality can change a limited subset of the neural circuitry concerned with more general functions, when related behavioural changes and specific forms of neuroplasticity are reliant on definite kinds of experience and the implications for rehabilitative interventions. In addition there is likely to be key "differences in learning effects compared with healthy brains, when learning involves a brain region that is undergoing damage-induced remodelling of neuronal circuitry" (36, pg S229). As recommended the cortical tissue surrounding a lesion and in regions distant from, but connected to, the location of injury, may offer a unique opportunity to direct the restructuring of this brain region with suitable behaviours. Hence, the form of the training experience will dictate the type of the neuroplasticity.

Principle 4: Repetition matters – By just participating in a neural circuit during task performance is not adequate to steer neuroplasticity. To induce lasting neural changes, repetition of new learned (or relearned) behaviours is necessary. Thus, some types of neuroplasticity want not only the acquirement of a skill but in addition the continued performance of that skill over a period of time. "It is hypothesized that the neuroplasticity brought about via repetition represents the instantiation of proficiency within the neural circuitry, making the acquired behaviour challenging to perish in the lack of training" (36, pg S229).   The role of concomitant learning and repetition in driving neuroplasticity could be vital for therapy. Neuroplasticity can represent a substitute indicator of functional recovery indicative of behavioural change which is challenging to perish. It has been suggested that a sufficient level of rehabilitation is necessary to get the patient 'over the hump'—that is, repetition may be required to attain a degree of improvement and brain reorganization adequate enough for the patient to carry on using the affected function outside of therapy as well as to preserve and make added functional gains. For this reason, repetition of a newly learned (or relearned) task on a regular basis is necessary to induce permanent neural changes to the brain.

Principle 5: Intensity matters –"The induction of neuroplasticity is also affected by the intensity of stimulation or training" (36, pg S230) in addition to the repetition. High intensity stimulation will facilitate long-term potentiation and low-intensity stimulation will induce a weakening of synaptic responses (long-term depression).However, there is a possibility that overuse of the affected limbs in an extent that worsens function is one possible negative side effect of intensity training. This appears to require both an overuse of the affected limbs during the early vulnerable time as well as an extreme amount of use, post injury. The nature of the injury depends upon the sensitivity to overuse. Hence, the more one practices a skill, whether new or old, the better one will become is engaging in that skill.

Principle 6: Time matters – Instead of a single measurable occurrence, neuroplasticity underlying learning can be best thought of as a process. Even though, "it is an intricate cascade of physiological, molecular, structural and cellular events, certain forms of neuroplasticity appear to precede and even depend upon others" (36, pg S230). Therefore, when one looks at the brain, the nature of neuroplasticity observed is dependent on its behavioural relevance. Such an example is when gene expression precedes synapse formation, which in turn precedes motor map reorganization during motor skill training. Additionally, the time post training may depend on the stability of the neuroplastic changes. During the early phase of stimulation, synaptic responses are more vulnerable to degradation when stimulation experiments are enhanced, rather than at a later stage.

The stable consolidation of memories has been well known to require time. The time factor may be even more crucial post CNS injury given the dynamics of the environment that are taking place independent of any therapy. As stated earlier, there are critical cascades of neuronal reactions to CNS damage that happen over time. For rehabilitation it has been proposed that the timing of behavioural treatments, whether therapy/treatment is primarily neuro protective in nature, where loss of neural connections and sparing of neuron death or whether the treatment works mainly by facilitating the reorganisation of residual connections should always be considered. "These are not independent processes as neurons that are steered to form new synaptic, that are likely to vary, gain additional signals promoting survival" (36, pg S230), temporally, in their sensitivity to behavioural experience effects.

Many studies (36) have also established that a 5-6week period of therapy initiated 30 days post stroke was by far less effective in promoting growth of cortical dendrites and improving functional outcomes than the same routine initiated 5 days post CNS damage. An improved "understanding of the neural processes responsible for this time dependent sensitivity could lead to ways of reintegrating this sensitivity at later time periods" (36, pg S230). Time delays can additionally permit for the “better establishment of self-taught compensatory” (36, pg S231) behaviours, of which could impede therapy efforts. And as stated previously, there are “additional time-dependent vulnerabilities in user-dependent exaggeration of excitotoxicity” (36, pg S231). Challenges in translating this research, needs more fundamental “information on time-dependent interactions between learning and brain adaptation to CNS damage and the need to better understand how time windows” (36, pg S231) may translate to those recovering from CNS injury. Hence, we know that different forms of neuroplasticity that occur at various times during training, and for that reason it is essential for therapists to understand the crucial recovery periods post stroke in order to obtain maximal recovery from their stroke patients.

Principle 7: Salience matters – In numerous neurological impairments, including aphasia and motor speech disorders, saliency is already an essential consideration. In order to optimize treatment, a “better understanding of the neural processes underlying the modulation of recovery processes by saliency” (36, pg S231) is needed. The strength of memory consolidation has long been known to be modulated by emotions. Thus having enough attention and motivation are indeed fundamental in promoting engagement in the task. In order to promote task performance, providing stimulations of a gratifying circuit in the brain (the ventral tegmental area) has been established to be significantly effective. Therefore, the training experience needs to be suitably relevant and important for the patient, in order to induce neuroplasticity.

Principle 8: Age matters – In an aged brain, it is obvious that neuroplastic responses are altered. With aging, experience-dependent synaptic potentiation, synaptogenesis and cortical map reorganization are all reduced. Normal aging is linked with widespread synaptic and neuronal degeneration and physiological degradation. Therefore, aging could be comparable to an insidious brain insult, and that neuroplasticity is the method by which the brain compensates for aging. For age-related impairments, cognitive decline may reflect the progressive failure of neuroplasticity processes by compensation. Yet, the aging brain is furthermore reactive to experience, even if the brain changes could be “less profound and/or slower to occur than those observed in younger brains” (36, pg S232). Training-induced neuroplasticity occurs more eagerly in the young brains and this should be kept in mind by therapists, especially when working with aged stroke patients.

Principle 9: Transference – This is the ability of neuroplasticity contained by one set of neural circuits to encourage subsequent or concurrent neuroplasticity. This trend has been confirmed in the individual motor cortex by means of TMS (Transcranial Magnetic Stimulation) and skill learning. When training in a fine motor task, an enhancement in the corticospinal excitability along with an extension of the hand muscles representation in the primary motor cortex is induced. Even though "learning may be needed to support the formation of functionally appropriate synaptic connections post CNS damage, exercise may be more suitable for promoting a productive environment to maintain these changes" (36, pg S232). Exercise results in "angiogenesis in the motor cortex and cerebellum and in expression of factors that promote neuronal growth and survival of vulnerable neurons" (36, pg S232) in the CNS. Consequently, neuroplasticity in response to one's training experience will enhance the attainment of related behaviours, for example, training a patient to eat using a knife and fork will also benefit the patient in other hand function tasks such as cutting food items on a chopping board when cooking, etc.

Principle 10: Interference – This "refers to the ability of neuroplasticity" (36, pg S233) contained by a "given neural circuitry to hinder the induction of new, or expression of existing, neuroplasticity within that same circuitry, which this in turn, can impair learning" (36, pg S233). Even though some forms of non-invasive cortical stimulation applied shortly before or during skill training can improve motor learning, other forms can also disrupt learning. During stimulation, synchronizing training with stimulation improves performance as a result of behavioural signals encouraging neuroplasticity. "When stimulation is provided outside of the training experience, along with the potential of disturbing the memory consolidation process, it may encourage neuroplasticity that is not shaped by behavioural signals and is unfavourable to performance" (36, pg S233). This has obvious "implications for how adjuvant stimulation" may be applied to boost recovery post CNS damage. Furthermore it is likely for behavioural experiences to encourage neuroplasticity within residual brain areas in a manner that will hinder optimal behavioural recovery. Patients with CNS dysfunction may also develop compensatory strategies ("bad habits") that are simpler to carry out than more challenging but ultimately more efficient strategies acquired during neurorehabilitation. "These strategies may be adopted earlier and used with much greater frequency than those guided in rehabilitation" (36, pg S233). The effortlessness of learning definite compensatory behaviours may also be facilitated post CNS damage.

Neuroscience research has contributed a considerable amount of knowledge regarding the mode of experience-dependent neuroplasticity, and there is rationale for optimism that our understanding of this can be capitalized upon to enhance functional outcomes post CNS damage (36). This effort robustly supports the use of rehabilitation as means to enhance functional outcome and brain reorganization. Although, countless aspects that are likely to be vital for optimizing rehabilitation continue to be vaguely understood and need better consideration in neuro science research. An improved understanding is required on "how training experiences interact with neural reactions to the damaged brain, with self-taught compensatory behavioural changes, and with age, in addition to how to combine rehabilitation with other treatment interventions" (36, pg S233). More importantly, the call to understand the time windows in which training can be optimally and safely applied in required. The conversion of these findings to rehabilitation will also in general need transitional steps, together with experimental research using computational models as well as human subjects. With anticipation, the translational relevance of further research will be enhanced when better interactions between clinical researchers and neuroscientists can focus on the problems faced by those in hospitals or clinics that are administering and receiving rehabilitation.

2.5 Stroke in South Africa

Stroke is a one of the leading causes of disability and morality in South Africa (SA) (11). Public hospitals in SA are under great pressure as a result of staff shortages, unmanageable workloads and management failures (38). Stroke patients in SA are being prematurely discharged from hospital leaving patients with a poor functional status, especially with regard to mobility (39). The premature discharge of stroke patients to a wheelchair-bound lifestyle results in less physical challenges which are essential to promote neuroplastic responses which can lead to better mobility i.e. apart from placing further pressure on the family/caregivers, the patient misses out on the opportunity for functional recovery (39). Much of the stroke population of SA is undergoing a fast epidemiological transition with greater than before exposure to stroke risk factors; together with an ageing population this will certainly cause a rise in the burden of stroke (11). Exposure to stroke risk factors is already at alarming rates and is likely to increase, adding further to the burden of stroke. The obvious solution from a health care perspective is to reduce risk at a population and high-risk individual level. However, for the individual presenting with an acute stroke the best possible care is needed to optimize their outcome and own personal long-term burden of disease (40). OTs' patient load is being affected by the increase in incidence of stroke in SA and it is imperative that we find alternative strategies to manage stroke patients effectively in order to convene the strain of practice in this country. The ideal setting for the management of stroke is a stroke unit, and the Cochrane Library meta-analysis found that stroke units significantly protects against premature death, need for institutionalization and long-term dependency from the onset compared with other methods of organized care (40). However, key to a stroke unit is multidisciplinary team (MDT) that is guided by correct procedures and outcomes. Not all of these are available to every unit though a core team of stroke nurses and a clinician, all interested in stroke, are essential (40).

The South African National Department of Health has endorsed the necessity for stroke rehabilitation units and suggests that every provincial government should consider the development of at least one stroke unit per province (40). Despite evidence showing that stroke units work, and government backing for the establishment of units, there are only three state stroke units in SA. Two are in Cape Town with only one in Gauteng, and a handful more are scattered around private hospitals across the rest of the country (40). A skeptic may wonder whether the lack of stroke units in the private sector is related to the fact that they are seldom big income generators; but that cannot explain the absence of units in the state sector. Part of the explanation may lie with the current concept of who should manage stroke in SA (40). Hence, until this battle is won, therapists treating stroke patients need to think of other effective methods in order to treat stroke patients in their home environment and reduce the amount of dysfunction that may result as a consequence of stroke. Additionally treating a patient within their home environment will be more cost-effective overall, patients and caregivers are encouraged to take ownership of the patient's rehabilitation, limited trained staff members are needed, family and caregivers are more involved in the patient's rehabilitation programme and "therapy" is indirectly done within the patient's own environment.

South African health care resources and services and patient's ability to access to these services and resources differ extensively within our health care system, subject to locality and S.A's past history (11). The representation of care in South African stroke management units has not been extensively fulfilled in spite of having robust evidence of its effectiveness (11). At most times, the stroke patient is managed as being part of the 'normal' medical services where there are no devoted services or specialized beds assigned exclusively to stroke patients. It is also not unusual, not to have minimum requirements for set stroke management and protocols for stroke management care have not been established in many clinics/hospitals as stroke is not viewed as a premeditated concern due to the lack of funding and shortage of trained health care professionals. The shortage and stress for hospital beds recurrently results in stroke patients being prematurely discharged from hospitals/clinics (11). For the rehabilitation phase of stroke care, stroke management units are in significantly limited throughout the country. In addition, they often deal with other patients diagnosed with spinal cord and head injuries together in addition to stroke, and the distribution to these beds consistently beats supply. The infrastructure for home-based management is distorted and varies throughout the country (11). Hence, therapists need to look at alternative methods of carrying over 'therapy' within a home environment, in order to facilitate home-based care more efficiently.

The access and availability of rehabilitation, whether for inpatients or outpatients varies significantly in SA, and so does the intensity and duration of the therapy. This not only depends on the severity of the stroke, but in addition to numerous factors pertinent to developing counties such as "whether or not the stroke patient has private health insurance (a minority of the country's stroke patients have), their residential location, and availability of trained rehabilitation therapists and public or private rehabilitation facilities in the area (most are located in the larger metropolitan areas)" (11 pg 761).

Despite many authors having demonstrated that delaying rehabilitation treatment elevates medical care costs (25), it is for this reason, emphasizing the importance to promptly arrange rehabilitation services for post stroke patients to treat potentially disabling conditions. Programmes that meet these needs can reduce the number of severely disabled persons, or at least delay their entering a critically disabled condition (25). Therefore home-based care, in the form of caregiver training and home programmes should be considered as an alternative to assist in combating this battle.

2.6 Home programmes

Current interventions to stroke rehabilitation are characterized by multiple, conflicting, and unsubstantiated treatment philosophies and an affinity to invest efforts in those with severe strokes and in goals limited to self-care (41).There is emerging evidence that suggests that intensive remedial therapy may be beneficial for stroke patients. A home programme that is well-organized, with specific schedules that clearly define the specific time of practice, tasks, content, and sequence apparently increases participants' sense of responsibility and consistency by providing them with a clear plan from which they can organize assigned tasks or schedule over time (32).

Keeping this in mind as well as all the challenges faced by South African therapists that have already been mentioned previously, it is no doubt that the focus on home programmes for stroke survivors need more of our attention and more efforts need to be made into establishing effective programmes that will be of great benefit to our South African stroke survivors. Considering that home programmes are an additional form of rehabilitation in the absence of a therapist, therapists particularly in a government setting need to advocate for the use of these programmes more regularly.

2.7 Task-orientated home programmes

Improving muscle strength and coordination in addition to training mobility and personal care activities, continues to form the fundamental area of focus in most rehabilitation programmes. Several diverse task-orientated practice interventions have revealed notably better benefits from more intensive therapies or more added hours of therapy that “involve training in specific skills, as compared with only several additional hours a week of general rehabilitation spread among many activities “ (42, pg 1678). Early interventions for the hemiplegic upper limb are designed at “eliciting small voluntary or reflexive involuntary movements” (42, pg 1678). Training the upper limb for functional tasks can begin when the arm and hand move to overcome gravity (42), as seen in patients with a stage 3 Brunnström level of recovery. Further details on Brunnström will be mentioned later.

As the physical improvement of stroke patients is not considered to be the ‘main’ goal of OT, the focus on the improving of performance components can result in some pressure in relation to the core of OT (1). The CAOT (Canadian Association of Occupational Therapy) mentions that allowing patients to make decisions with regard to the goals of treatment and perform tasks they find meaningful or practical in their settings must be at the center of OT (1). Other factors that have an impact on the patient’s level of activity limitations include flexibility and coping skills, essential motivation and mood, cognition learning and capability, severity and type of preexistent and acquired co-existing medical conditions, their health stability, the consequences of acute treatment regimes, their physical endurance levels and the degree and nature of rehabilitation training (12). Even though many ideas presented as part of the OT Task-Orientated Approach are as old as OT itself, recent motor behaviour literature offers a stronger theoretical basis for the use of meaningful and purposeful tasks as the main focus of treatment (9). However, the development of this intervention is still evolving (9) but, it is founded on attainment of motor skills as a product of repetitive practice and the recognition that the drive of motor control is to govern the movement needed in order to perform a particular task (43) and suggests that the patient has an active involvement in treatment. This intervention, in which real objects is used in probable natural environment may give a new idea about motor behaviour problems in stroke rehabilitation and aims at restoring skills of the patient by using various neuro-physiological techniques and utilising the neuroplasticity of the brain e.g. to encourage bilateral hand use during activity participation and facilitate normal movement patterns using task-orientated activities (9).

Modern views on motor control principles suggest that the enhancement in functional tasks would benefit from task-orientated biofeedback therapy (44). Feedback, together with practice, is thought to be a compelling factor influencing motor skill learning (45). During task performance, there are 2 forms of performance-related information, or feedback. One type of feedback is known as “task-intrinsic feedback”, which is the sensory perceptual information that is a normal part of performing a skill (e.g. when one notices that she/he has inaccurately judged the picking up a glass with their hands). The second type of feedback is known as “augmented” feedback, which refers to enhancing task-intrinsic feedback with an outside source” which may be a clinician or a tool such as a timer or biofeedback system (45). Literature states that there are numerous fundamentals of training that contribute to motor relearning, these include active, repetitive training of functional tasks in a meaningful setting, which is recognized to enhance functional recovery, motor control and muscle strength in upper limb during therapy (46). The use of suitable feedback to improve motor learning and the motivation of the patient is a vital component of the training. Feedback refers to one’s sensory-perceptual awareness concerning their interaction with the environment. This awareness may be presented as sensation, resonance, or visualization, during or after the motion is carried out (46). Given that intrinsic feedback mechanisms are at most times impaired post stroke, allowing for augmented feedback is considered to be favorable. This can be in the form of or touch, sound, or vision, to enhance task performance or goal attainment. Past studies have verified the efficiency of forced use on upper limb functioning and ADL performance, and they proposed the need for additional research on the effects of home therapy, schedule adherence, and voluntary use of the affected hand (32).

Bearing in mind that any form of personal hygiene task evidently needs the interaction between the environment and neuromuscular system, successful motor retraining must include motor components and a setting that resembles the directed task in the appropriate functional and meaningful environment (44). Therefore, in order to learn a task, it must be related to an evidently distinct purposeful goal. For effective task-orientated training the patient must be encouraged to solve specific movement problems and explore the environment. Hence, successful rehabilitation for stroke patients with movement impairments must be able to re-educate the motor-cortex system during active movements that are meaningful, purposeful and orientated instead of solely depending on the control of a single or muscle action (44).

A hindrance in neurorehabilitation is to grade the finest methods in providing repetitive therapy for task training and this must entail multimodal processes to aid functional recovery in the motor systems. Task-orientated biofeedback therapy may be more broadly useful if the biofeedback cues were: “(1) multimodal, so insightful and cognitive functions are involved in the physical rehabilitation; (2) attractive and motivating, to keep the patient interested; and (3) easy-to-understand, to evade the information overloading problem” (44 pg 6). Hence, commendable task-orientated biofeedback system needs coordinated feedback of many factors that portray the task performance without overriding a patient's cognitive and perceptual capability.

Regrettably, there is no definite description of a task-orientated approach that exists in text. In a task-orientated approach, movement develops as a collaboration of multiple brain systems and is arranged around an aim/goal and is bound by the environment (23). Task-orientated training includes a variety of tasks such as gait training on the ground, treadmill training, bicycling programmes, circuit training as well as endurance training, sit-to-stand exercises, and reaching activities for improving balance etc. (23). The key solution to functional motor recovery is the intensity of task training and the patient's active participation throughout rehabilitation.

Recent evidence indicates that there is mounting evidence that repetitive and intensive task-orientated practice promotes upper limb recovery in patients with CNS dysfunction (47). Repetition is known to play a vital function in enhancing and sustaining brain changes.

Yet, the repetition of task performance in the lack of new essential and purposeful skill learning will not likely facilitate changes within the cortex that are of importance (37). Less intense together with task-specific training using the more affected limb can create cortical reorganization and functional improvements that are more likely to be meaningful and purposeful. This has been established with regard to specific motor control retraining (37). Personal ADL are necessary for survival and include “those tasks which all of us undertake every day of our lives in order to maintain our level of care” such as, dressing, toileting, feeding, grooming, mobilizing and transferring (48).

According to Carr & Shepherd, “the recovery of motor performance components is based on reorganization of neural mechanisms and that specific motor learning approaches should still be applied post spontaneous recovery” (16, pg 101). In addition, interest and motivation are important goals for successful rehabilitation as interests are likely to increase energy levels, and this is important for stroke patients who might suffer from fatigue due to brain damage (14). It can be argued that at home, in familiar surroundings and with family present, it is often much easier to do what you are interested in (24). In stroke rehabilitation the use of various task related training which involves neurophysiology are well recognized with their limitations. Task–specific training is aimed at improving component skills of selected tasks such as using hand muscles to practice gripping a fork (9). In a study conducted by Legg et al. (49), found that stroke patients who attend OT focused on personal ADL, as opposed to no routine OT, are thought to be more independent in these tasks (48). In natural science it is well believed that purposeful practice for the principle of attaining and maintaining expert achievements in sports, academics, chess playing, and learning to drive etc. follows a dose-response relationship (50). Therefore, the more time spent learning a precise skill is related with improved performance in that skill/task (50). Recognizing that therapy may be fundamentally viewed as the manner in which patients learn to achieve challenging motor tasks such as dressing, walking and bathing oneself, one can assume that intensive training by stroke patients should follow similar 'natural' rules (50). Presently, there are strong indicators that functional recovery is more than the restoration of impairments only, but to great degree due to the strategies of incorporating the compensation of present impairments.

2.8 Traditional exercise home programmes

When considering 'exercise therapy', many literature reviews do not present separate results for the lower and upper limb (51). Nonetheless, most reviews do conclude that exercises and in particular extensive practice thereof, is favourable (51). The relationship between exercising and enhanced cardiovascular health and fitness has been well recognized in the general population. Whether the training-induced fitness and health benefits can be extrapolated to stroke survivors remained unclear until recently (12). 'Exercise therapy' is defined as "physical activity that is usually regular and done with the intention of improving or maintaining physical fitness or health" (12, pg 2033), and included both physical therapy and OT. Evidence currently suggests that the exercise training in stroke patients can be similar, in many ways, to that of their age matched healthy counterparts (12). Additionally exercises 'indirectly', address the negative features that are associated with CNS dysfunction that have been mentioned previously. Muscle strengthening has also been found to have advantageous effects in stroke patients. As increased levels of physical activity are linked with a reduced risk for cardiovascular disease and stroke and improved physical and psychosocial performance, such interventions performed in a stroke rehabilitation programme may have a positive outcome on the prevention of recurrent strokes and cardiovascular incidents (12). Physical activity remains to be the basis in the current management of risk-reduction therapies for the treatment and prevention of stroke. The importance of the therapist's recommendations appears to one of the greatest influential predictors of patient involvement in any exercise programme and has displayed the main reason as to be the main reason behind why stroke patients would exercise. This ‘economical’ intervention, which is now robustly, reinforced by research studies, but the challenge lies for healthcare professionals to bring this promise to reality (12).

Therefore the TEHP intervention aims at enhancing the patients’ task performance by teaching the patient physical exercises such as bridging, trunk rotation, and bilateral upper limb exercises etc. There is no current evidence that states that the one intervention is superior to the other, or that either is effective. There is also inadequate information on the use of these programmes in South Africa and in OT. Therefore this study aims to show whether one intervention is more effective than the other. If the results prove that one of the interventions has better outcomes, the study could be used to motivate therapists to use the more effective intervention in clinical practice.

In one identified randomized, controlled pilot study of a home-based exercise programme for patients with mild to moderate stroke, the controlled clinical trial of a post stroke exercise programme proved to be feasible. The measures of neurological impairments and lower limb function displayed that home exercise programmes benefitted the patients in terms of their endurance, strength, and balance and they were encouraged to use their hemiplegic limbs (41). Effects of the intervention on upper limb dexterity and functional health status were equivocal; however, the exercise programme was designed to improve endurance strength, and balance, and to promote more use of the affected limbs (41).

In another study conducted by JH van der Lee et al. (51), which looked at literature reviews relating to the various types of treatment for the upper limb in stroke survivors concluded that more intensive exercising is favourable (51). Although, these reviews were not authority based and not based on replicable, transparent methods (51). The findings of these reviews did not allow a definite conclusion to be drawn about the effectiveness of exercising to improve the upper limb motor function in stroke patients. Trials comparing different types of exercises for the upper limb in stroke survivors have shown no difference in efficiency (51). The minute amount of positive results calculated by means of ADL questionnaires could be due to insufficient understanding of these questionnaires to changes in upper limb function (51). However, the difference in results between studies with and without contrast in the amount or duration of exercising between groups suggested that more intensive exercising was more favourable (51).

In a another study conducted by Ada et al. (52), regarding the physical activity undertaken taken by patients post stroke, it was identified that two-thirds of stroke patients spend most of their time outside therapy being on your own and inactive while for the most part physical activity occurred in the treatment area with a therapist, which is also only where patients spend only a small proportion of their entire day (52). This advocates that it is mainly the therapist, rather than the structure of the treatment area, which steers the way in which physical tasks are performed (52). These results entail that the amount of physical activity in treatment would be increased if the amount of time spent with a therapist was increased. But, in the current economic setting this is not a practical suggestion. Hence, the need to re-emphasize the finding of other interventions which will guarantee that practice under one-on-one supervision by a therapist maximizes the number of repetitions undertaken; in addition to interventions which will increase physical activity without relying on one-on-one supervision by a therapist is vital (52). The predicament is to find intervention strategies that maximize the quantity of training without improvising on the quality of training.

In another systematic review, by van der Lee et al. (51) “it was found that there is insufficient evidence for the effectiveness of exercise therapy on upper limb function” (51, pg 28). In less severe stroke patients, upper limb function improved more after functional training than after muscle strength training and standard care. “A functional training programme aimed at improving arm participation proved ineffective: the control group, who received a walking programme combined with ADL tasks such as carrying groceries, performed even better on upper limb tests” (51, pg29). Progress was only noted in participants who entered the study with better upper limb performance. Usually, exercise tasks need to be specific, and should be practiced as meaningful activities. Between the improvement of physical fitness and functional task performance, a positive connection has been noted. Fitness and exercise training should be a significant component of stroke rehabilitation, as endurance post stroke is known to be compromised to a degree that places limitations the basic functioning of daily life (51).

2.9: Challenges of home programmes

A patient’s collaboration and satisfaction with a home exercise programme is imperative for positive outcomes of intervention (53). Home programmes are an additional form of rehabilitation that patients can carry out independently, at most times, within their home environment as most public sector patients struggle to come for follow up appointments due to a lack of finances or transportation problems. Compliancy to OT treatment regimes has not been the focus of many research studies, yet compliance has been included as a variable in numerous studies (53). Patients known to have strictly followed their treatment recommendations have been noted to experience improved treatment outcomes (53). Although compliance with OT treatment recommendations is thought to be high, more research is required to consider a number of variables that can have an impact on compliance and strategies that could aid compliancy (53).

Nonetheless, as we would like for home programmes to be implemented more often, we also need to keep in mind the challenges that are associated with home programmes. Apart from having the challenges of patients not always being compliant with their home programmes, therapists need to remember, that a home programme needs to be comprehensive and that it does not replace the therapist, additionally current interventions need to consider better integration of home programmes and the therapist. Also, it is essential, for therapists to measure the effectiveness of their therapeutic interventions and to make use of outcome measures, as to prove effective ‘evidence-based practice’. Therefore in this research study the DASH (Appendix C) has been used as outcome measure and will now be discussed in further detail.

2.10 The DASH (Disability of the Arm, Shoulder and Hand)

The DASH Outcome Measure (Appendix C) is a 30-item disability/symptom scale; self-report questionnaire designed to measure physical function and symptoms in people with musculoskeletal disorders of the upper limb. The tool is a single, reliable instrument that can be used to assess any or all joints in the upper extremity (54). The DASH (Appendix C) includes 21 physical function items, six symptom items, and three social/role function items”. “The items explore the degree of difficulty in performing different physical activities because of the arm, shoulder, or hand problem (21 items), the severity of each of the symptoms of pain, activity-related pain, tingling, weakness and stiffness (5 items), as well as the problem's impact on social activities, work, sleep, and self-image (4 items). Each item has five response options. The scores for all items are then used to calculate a scale score ranging from 0 (no disability) to 100 (most severe disability). The score for the disability/symptom scale is called the DASH score (54).

At least 27 of the 30 items must be completed for a score to be calculated (54).The assigned values for all completed responses are simply summed and averaged, producing a score out of five. This value is then transformed to a score out of 100 by subtracting one and multiplying by 25. The transformation is done to make the scores easier to compare to other measures scaled on a 0-100 scale. A higher score indicates greater disability (54).

The DASH (Appendix C) disability/symptom score = $\frac{[(sum\ of\ n\ of\ responses) - 1]}{n} \times 25$, where n is equal to the number of completed responses.

According to a study by, Gummesson et al. (2003), titled “The longitudinal construct validity and measuring self-rated health change after surgery using the DASH” (55, pg1), it was established that the DASH was able to detect and distinguish large as well as small changes in disability over time post-surgery in patients with upper limb musculoskeletal disorders. The DASH showed self-rated treatment effectiveness post-surgery for subacromial impingement and carpal tunnel syndrome. A 10-point difference in mean the DASH score may be considered as a minimal significant change. The standardized response and effect size mean (commonly used indices of the magnitude of health change measured by questionnaires) may yield substantially differing results (55). It was also established in the study that “to enhance the use of the DASH in prospective studies such as assessment of effectiveness of different treatment strategies, further studies of the instrument's ability to detect changes over time would be useful both for interpretation of score changes and for sample size calculations (55).”To aid research, longitudinal studies of the instrument's ability to detect changes and identify larger and smaller changes in health status as perceived by the patient are required (55).

2.11 The Brunnström Assessment

Brunnström was a physical therapist who developed the theory and published the principles of this movement therapy in 1962 (56). The assumptions underlying this theory are that purposeful movement becomes modified with the development of higher centres. She believed that after CNS damage, patients revert to reflexive and primitive movement patterns, and that reflexes and primitive movements must be used in a developmental sequence in rehabilitation to facilitate the return of normal voluntary movement. She developed a sequence which she found that stroke patients move through as they recover.

This sequence typically occurs from mass stereotyped flexor and extensor movement patterns, to movements that combine the features of two patterns, and the finally near normal movement that presents as discreet voluntary movements of each joint. Brunnström developed guidelines for the treatment of the upper limb, hand and wrist and lower limb. This theory is also presented in a hierarchical organization, which has been outdated since the development of the dynamical systems theory (56). The theory also does not consider the needs and motivation of the patient, and activities are selected according to the movement required, and these are not always the activities the patient chose to perform. It would therefore not conform to treatment found to be effective Brunnström Movement Therapy is one of the many approaches used by OTs in the evaluation and treatment procedures of stroke patients.

The level of motor recovery is evaluated using sequences motor performance after stroke from reflex to full voluntary control (56). This approach is based on six stages of recovery of the proximal upper limb, hand and lower limb. Although, on average, stroke patients proceed through these, recovery may stop at any stage (56). Brunnström stages I to VI are useful to designate summarily the status of voluntary control present in that particular patients upper limb or hand. The patient is reported to be in the stage at which he or she can accomplish all motions specified for that stage. Recovery of movement is gradual, and sometimes the patient is in transition between stages (56).A patient is able to move voluntarily when they reach stage three, although movement are in mass stereotyped patterns. A patient will be able to start moving independently once in this stage and it is therefore recommended that they start a home programme when they reach this stage of movement.

2.12 Conclusion to the literature reviewed

It is clear in this literature review that rehabilitation of stroke patients in SA is met by many challenges. This is further impacted on by the lack of OTs working in the public sector, and particularly in the field of physical rehabilitation. This in turn places a large work load on current therapists working in the public health sector, where therapy may not be as efficient as they would like it to be. The shortage of education programmes, negative perceptions about research and the therapists' role in evidence-based practice (EBP), and low self-efficacy to execute EBP tasks signify challenges in implementing EBP in stroke patients that can be addressed through continuing-education programmes. Organizational provision of access to web-based resources is likely to be lacking to improve research use by therapists (57). Rehabilitation is also further limited by financial constraints that most patients are faced with as well as transportation problems for people with disabilities. Thus it is essential to develop other means of treatment such as successful home programmes that can be implemented in a home environment in an absence of a therapist.

Chapter 3: Methodology

3.1 Introductionto the methodology

The methodology of the study will now be described. To begin with, the details on the study design, study population, and study sample will be described. In the study sample the selection of subjects and research procedure will be mentioned. Thereafter the measurement techniques used will then be discussed in depth as well as how the data was collected, analyzed and managed. Lastly the ethical considerations and budget for the research study will be reviewed.

3.2 Study design

Two programmes (Appendix A and B) were set up using the two different home programme interventions, these programmes were used to treat two groups of patients presenting with hemiparesis as a consequence of a stroke. The TEHP (Appendix B) was based on conventional exercises that have been used many a times in stroke rehabilitation by therapists across the country. The TOHP (Appendix A) was designed after the researcher had studied the task-orientated approach in-depth and had also consulted expert therapists that specialise in adult neurorehabilitation within the University of the Witwatersrand. The DASH (Appendix C) was used as an assessment scale to measure the patient's level of upper limb recovery upon discharge as well as upon outpatient follow up. A clinical trial was conducted to compare the functional recovery of the upper limb in stroke patients following a TOHP versus a TEHP.

A longitudinal, randomised control test with a pre-test /post-test design was used where participants were randomly assigned to an experimental or a control group i.e. the TEHP group and the TOHP group. Both groups were measured using the DASH (Appendix C) prior to discharge, at the beginning of the study in a pre-test. Both groups received intervention; the home programmes were different, according to each of their allocations to the controlled and experimental groups. After implementation of the different home programmes, both groups were measured again, using the DASH (Appendix C) during their routine out-patient rehabilitation appointments. Thereafter, the pre-test and post-test scores of both groups were compared, in order to evaluate the effectiveness of both home programme interventions (58). Follow-up out patients appointments were kept within 4 weeks post discharge.

3.3Study population

The study population included any stroke patient, who was above the age of 18 years, whom had been admitted or referred to Dr. George Mukhari Academic Hospital (DGMAH) during the time period from May 2013 to January 2014. The patient had to live in one of the following catchment areas: Soshanguve, Mabopane, Ga-Rankuwa, Hebron, Klipgaat or Brits as these areas are considered to be the direct catchment areas of the hospital (sample of convenience). The target population was any stroke survivor admitted to wards 33, 37 as well as 34 and 38 (neurology and internal medicine wards) and wards 9-13 (neurosurgery) who are medically stable and had been referred to rehabilitation during this time frame. Stable outpatients, who have been referred by Neurology Outpatient Department for rehabilitation and had suffered a stroke in the previous 2-4 weeks, were also to be included in the study. The sample population was any patient that met the inclusion criteria, admitted into the above mentioned wards during the time frame mentioned. Randomisation was used to assign each patient to a specific group to ensure that groups stay as similar as possible so as to make comparisons possible.

There were 44 participants that were identified whom matched the inclusion criteria for the research study. These participants were randomly selected to the controlled and experimental groups. Each trial group consisted on 22 participants each.

3.4 Study sample

3.4.1 Selection of subjects

Inclusion Criteria	Exclusion Criteria
Subjects had to be diagnosed with stroke by a physician/neurologist.	Subjects that presented will a global or receptive aphasia as diagnosed by a MDT (multi-disciplinary team) member.
Adult stroke survivors of both sexes	Unstable medical condition like severe hypertension or convulsions, as subjects would be unstable to attend active rehabilitation.
First stroke resulting in hemiplegia at least 2-4 weeks ago and without having received any previous rehabilitation post stroke.	Subjects that had total or severe sensory deficits or pain syndromes of the upper limb, as assessed by the occupational therapist.
Patient had to present with some voluntary movement in the affected upper limb	Subjects that presented with a shoulder dislocation, fixed deformities of the hand or

(stage 3 and above of Brunnström)	shoulder hand syndrome, as diagnosed by the MDT member.
	Patients who are visually impaired as they will have difficulty reading the home programmes.
	Patients with behavioural problems as a pre-morbid problem or due to the stroke, as compliancy and implementation of the home programme could have been impacted on. . This should be confirmed by an MDT member.

3.4.2 Research Procedure

- After an ethical clearance certificate (Appendix D) was granted by the Ethics Committee of the University of the Witwatersrand, a letter of permission (Appendix E) was written to the clinical director at DGMAH to conduct the research study at DGMAH.
- After permission was granted (Appendix F), the following procedures were carried out.
- All patients who met the inclusion criteria were invited to participate in the research study and thereafter were be given an information sheet (Appendix G) outlining the purpose of the research study and were required to sign the informed consent forms (Appendix H) in order to be part of the research study.
- Participants were randomly selected into the controlled TEHP and experimental TOHP groups using a computer programme, using a minimisation technique.
- Demographics of the sample group were collected via the patient's OT green card as well as by the researcher's own demographic sheet (Appendix I).
- Prior to the participants being discharged the researcher issued the home programmes to each of the participants and educated them on how the home programmes should be carried out. Compliancy to the home programmes was reinforced by providing the participants with home programme journals (Appendix A and B), so that caregivers/family members can sign to state that the participants carried out the home programmes as required. This was followed up via weekly phone calls by the researcher to the participants, and evaluation of their knowledge of the home programmes during their out-patient rehabilitation sessions.
- Prior to the discharge of the patients, an OTT (Occupational Therapy Technician) working alongside the researcher in the field of neurology rehabilitation assisted the participants in carrying out the DASH questionnaire (Appendix C), so as to ensure

that the participants fully understood how to complete the questionnaire and assisted them in translation of the questionnaire where necessary.

- The DASH questionnaire (Appendix C) (pre-test) was carried out by each of the participants, who were accompanied by an OTT so assist in translation where necessary and to ensure blinding of the researcher. The questionnaires were then coded by the OTT on a participant code sheet (Appendix J), so that the researcher was not aware of which participant had filled in which questionnaire. Additionally, the researcher had prepared an 'assessment kit', consisting of a glass jar, pen and paper, a lock with a key, a therapy block (30cmx30cmx30cm), and a tool box brief case etc. which was used by the participants after they had carried out the questionnaire. This assessment kit was used by the OTTs to ensure more accuracy of the self-report questionnaires, as participants were requested to use these items in order to determine the accuracy of some the questions used in the DASH. Thereafter, the questionnaires were scored and analysed by the researcher and only at the end of data collection, after all questionnaires had been collected did the OTT reveal to researcher which codes applied to which patients, so that the researcher can conclude on the research findings.
- For participants who were unable to read or write (due to illiteracy or language barriers), the home programmes and questionnaires were explained & translated to them verbally by an OTT. This was further reinforced by educating the caregiver/family member on the home programme. Pictures/drawings were included in both home programmes (Appendix A and B), with specific instructions regarding how many repetitions etc. needed to be done so as to make it easier to follow.
- During hospital admission each patient was treated by the researcher daily for 30-45 minutes according to the usual treatment protocol, until they were discharged.
- To standardise the study, the two specific treatment home programmes (Appendix A and B) included pictures/drawings and each was printed separately for each participant upon their discharge.
- The participants were given an outpatient appointment, 2-4weeks after having been discharged, where the post-test using the DASH questionnaire (Appendix C) was carried out again by the participant themselves and were also be accompanied by the OTT, which was then be coded and scored the same way as mentioned above.
- The participants did not receive any other form of rehabilitation services when they were discharged. They were requested to attend out-patient rehabilitation on their follow-up appointments and were seen by all rehabilitation members (including physiotherapists and speech therapists) on the same day where necessary, so as to

make it affordable and feasible for the participants to come for all therapies on the same day.

- To limit inter-rater reliability bias, the DASH (Appendix C) was carried out by the same OTTs at baseline (prior to being discharged) and after intervention (2-4 weeks after discharge).

3.5 Measurement techniques

3.5.1 Brunnström Assessment

The Brunnström assessment was used to determine if the patient had voluntary movement of a stage three or above in the upper limb. This forms part of the usual documentation completed upon assessment of a stroke patient in the DGMAH department.

3.5.2 Demographic information

The researcher completed the demographic information of the each participant in each of their OT patient green cards as well as on a Microsoft excel spread sheet document (Appendix I). This consisted of the participants' brief background and medical history, and was be used in order to note necessary variables such as the date of admission/stroke, pre and post-tests dates of the DASH etc.

3.5.3 DASH assessment

The DASH (Appendix C) was used as an outcome measure to assess the recovery of the upper limb of patients post stroke (upon discharge and then on outpatient follow up). Each participant was also be given a home programme journal (Appendix A and B) in which they needed to record that the date each time they carried out the selected home programme and this was be co-signed by a family member or caregiver, so as to reinforce compliancy of the home programme. This will also be followed up by the researcher calling each participant weekly as well asevaluating the patient's knowledge of the home programmes during their out-patient rehabilitation sessions.

3.6 Data collection

The pre and post tests of the DASH questionnaire (Appendix C) was carried out by each participant, under the guidance and supervision of an OTT. The scores of the DASH (Appendix C) was calculated and analysed by the researcher. The researcher then evaluated these scores appropriately and drew a conclusion from the results.

For each participant the sum of the scores for each of the two sub themes (total DASH score) was obtained. Overall the total sum of the sub themes was the main outcome measure. Each score from the DASH (Appendix C) pre-test and post-test questionnaires were transferred to a Microsoft excel sheet, which organised data for ease at analysis.

3.7 Control of variables

One hospital was used throughout the study so as to ensure that all patients received the same protocol of treatment throughout the study.

Other forms rehabilitation such as physiotherapy and speech therapy was also continued as normal during the patient's hospital stay, and once the patients was discharged they were given an appointment on the same day for follow-up with all relevant rehabilitation members where necessary so as to avoid additional financial costs.

A home programme was an additional form of rehabilitation in addition to the normal treatment the patient was receiving during their hospital stay and when attending out-patient rehabilitation.

Each participant was given a home programme journal (Appendix A and B) in which they needed to record the date each time they carried out the selected home programme and this had to be co-signed by a family member or caregiver daily to reinforce compliancy. This was further reinforced by the researcher who called each participant on a weekly basis to record their compliancy to the home programme, as well as evaluating their knowledge of the home programmes during out-patient rehabilitation sessions. This aided the researcher in investigating stroke patients' compliancy to the each of the home programmes.

3.8 Data analysis and management

The data was collected in the presence of the participant, alongside an OTT, using a paper based DASH questionnaire form (Appendix C). Each completed DASH questionnaire was issued a coded number so as to maintain the anonymity of the participant.

The variables and demographic information collected on the assessment form was transferred to an excel spread sheet (Appendix I), which was stored with a password to protect the information. The data collection information and demographics of the participants will be stored in the OT department at DGMAH for 15 years. In order for the researcher to ascertain whether there is a statistically significant difference between the improvement of the controlled TEHP group and the experimental TOHP group, a Mann Whitney U test, which is a non-parametric statistical hypothesis test, was used. This tests for differences between means on two-independent groups and is equivalent to the to the independent groups *t* test (59)**.** The Wilcoxon rank sum test will be used to measure statistical differences between the two different home programme groups, as this test is equivalent to the *t* test for independent groups for use on nonparametric data. For this test, ranks are assigned to scores for all subjects in the study, and the ranks for all subjects in each group are summed. The test determines the degree of differences between group total scores (59).

3.9 Ethical considerations

- The protocol was sent to the University of Witwatersrand Ethics Committee for approval and ethical clearance (Appendix D).
- Legal consent/permission from the Department of Health Gauteng, clinical director of DGMAH and the Head of Department of the OT department was obtained (Appendix F), so the research study could be conducted at the institution.
- An information sheet (Appendix G) was given to each participant to ensure that each participant was aware of the purpose of the study, and informed consent (Appendix H) was obtained from all participants.
- It was made clear to participants that they are welcome to withdraw the invitation to participate in the study and by doing this there will be no negative consequences. All information was kept confidential and participants will have access to the results of the study once completed, with the information regarding the effectiveness of the programmes summarised on in a table format.
- The researcher's contact details were made available for consultation regarding the findings of the study.
- The participants were free to leave the study at any point with no repercussions as they are participating at free will and their treatment would continue as usual.
- Results will stay anonymous and no data will be shared using individual names. This is in relation to names collected by signing informed consent forms. During the study, names were not be used at any other stage of the study.

Chapter 4: Results

4.1 Introduction to the results

The results of the current study will now be presented. Firstly the details on the demographics of the sample will be described. Thereafter the improvement in UL function in the task-orientated group will be presented followed by the improvement in UL function in the traditional exercise home programme group. Finally the differences in improvement between the controlled and experimental groups will be presented.

4.2 Sample demographics

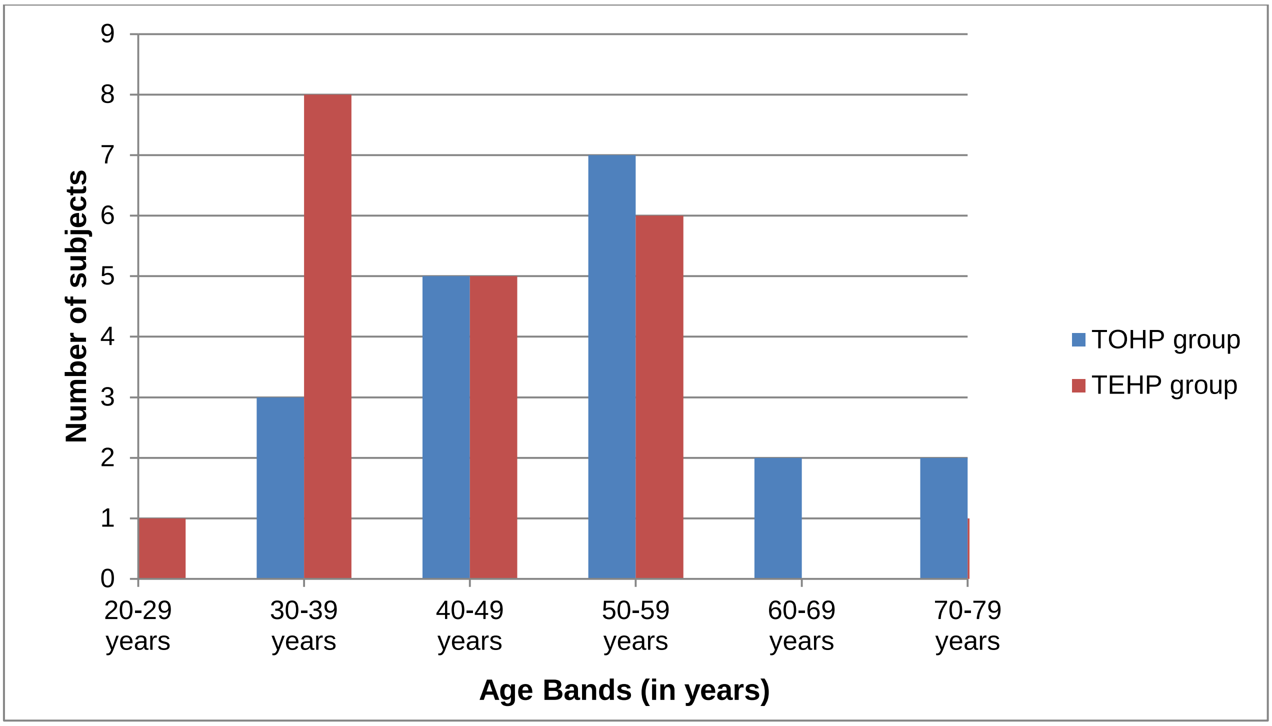
The trial was conducted over a period of thirteen months; January 2013 to January 2014. During that time 44 participants were identified who met the inclusion criteria. 100% of the research sample was of the Black African ethnic group. 21 participants were male and 23 participants were female in total. The diagnosis distribution of the patients included 27participants with right hemiplegia and 17 participants with left hemiplegia. As discussed in the methodology the participants were allocated to a treatment group using the process of stratification. Each treatment group (TOHP and TEHP) had 22 participants each. 26 participants in total had their dominant side affected during the stroke.

The table and the graph below indicate the participants' demographics between the TOHP group and the TEHP group. There was no statistical significant difference between the two groups.

Table 1: Indicates the participants' demographics between the TOHP group and the TEHP group (n=44).

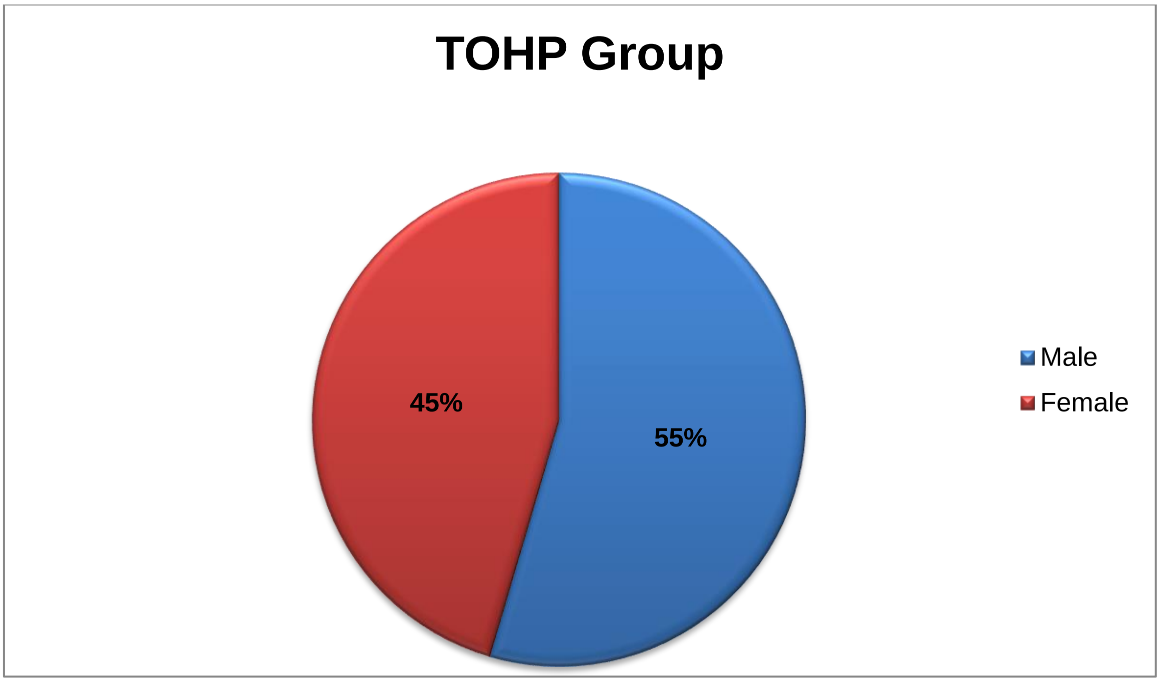
Criteria	TOHP Group (Mean)	TEHP Group (Mean)	Total group Mean	p-values
Average age (in years)	49.86	46.27	48.07	0.03
Number of females	10	9	-	0.38
Number of males	12	13	-	
Number of patients with right hemiplegia	14	13	-	0.77
Number of patients with left hemiplegia	8	9	--	
Number of participants who are right hand dominant	22	21	-	
Number of participants who are left hand dominant	0	1	-	
Number of participants in which dominant side was affected	14	12	-	
Average length of stay (in days)	10.41	11.64	11.03	
Average difference between the date of discharge and the date of follow up (in days)	23.86	23.91		

The age band with the largest number of subjects in the TOHP group was 50-59 years and in the TEHP group it was 30-39 years. Majority of subjects overall were between 30-59 years. The p-value regarding the subjects age and sex was of no significant difference.

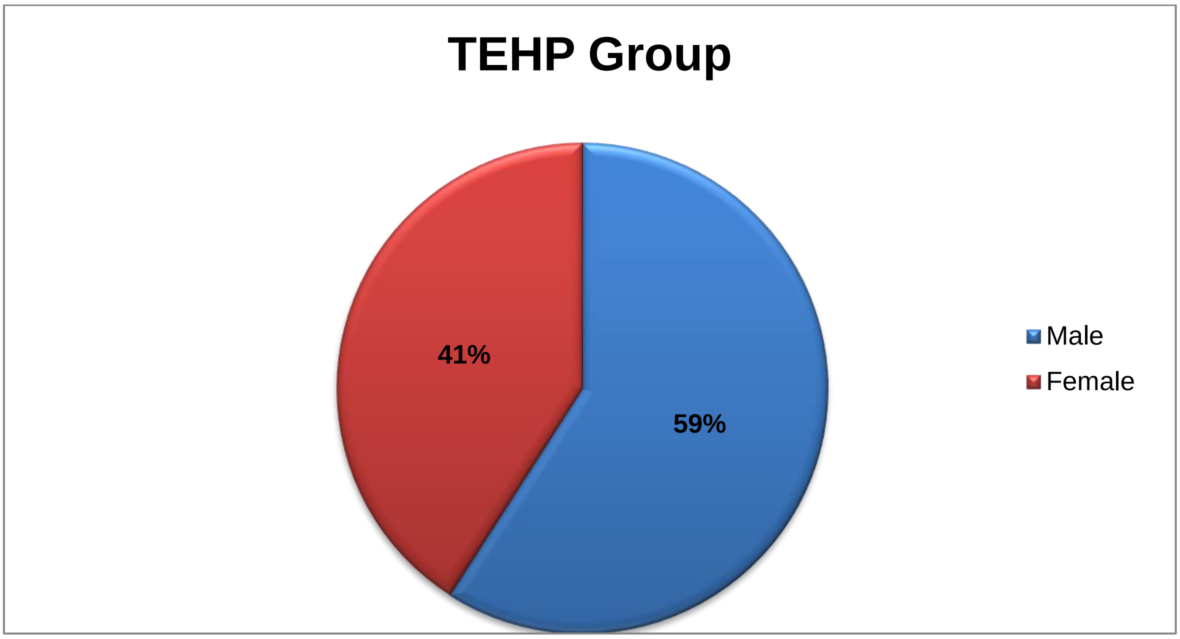


<u>Figure 1:</u> The above graph indicates the various age bands between the TOHP group and the TEHP group (n=22 per group).

The pie graphs below highlights that there were more male subjects in both the TOHP group as well as the TEHP. However, the TEHP had the most male subjects.



<u>Figure 2:</u> The above pie chart indicates the gender ratio between male and female in the TOHP group (n=22).



<u>Figure 3:</u> The above pie chart indicates the gender ratio between male and female in the TEHP group (n=22).

The pie graphs below highlights that there were more subjects with right hemiparesis than left hemiparesis in both the TOHP group as well as the TEHP. However, the TOHP had the most subjects with right hemiparesis.

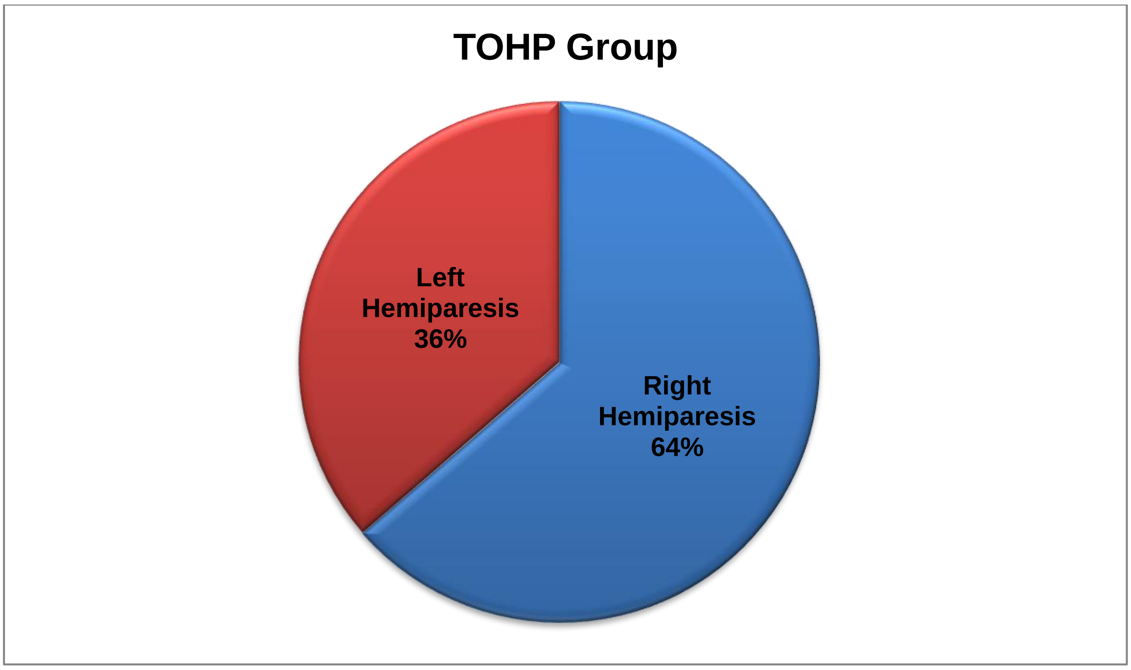


Figure 4: The above pie chart indicates the affected side hemiplegia distribution in the TOHP group (n=22).

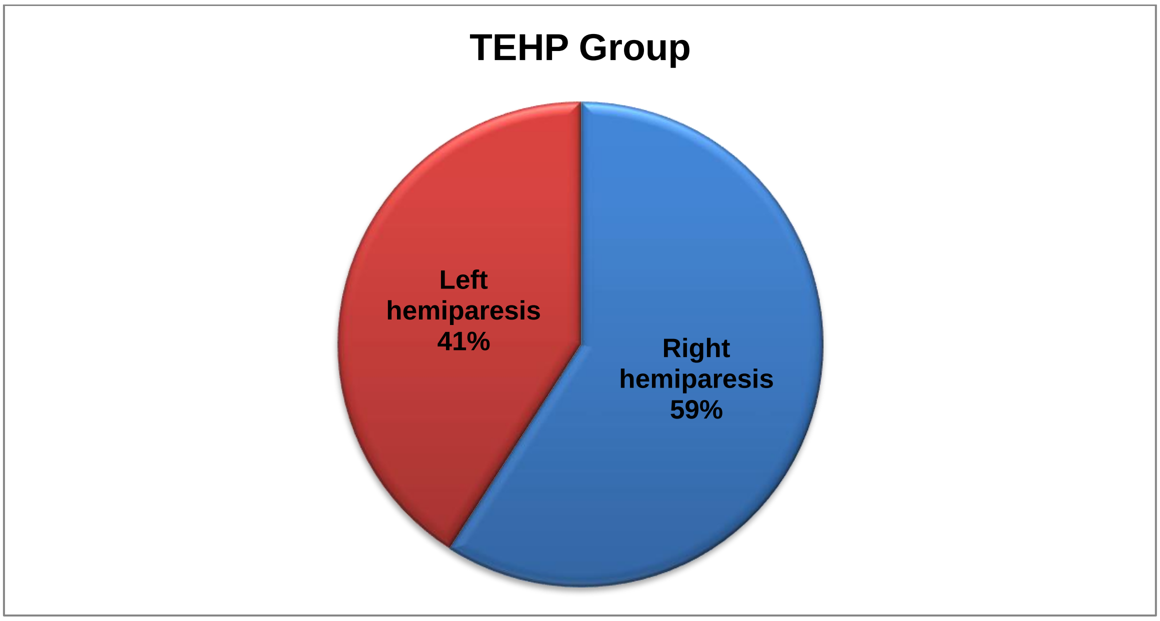


Figure 5: The above pie chart indicates the affected side hemiplegia distribution in the TEHP group (n=22).

The figures below highlight that the TEHP groups' average length of stay was slightly longer than that of the TOHP group. However, the average difference between the date of discharge and the date of follow up between the two groups were very similar.

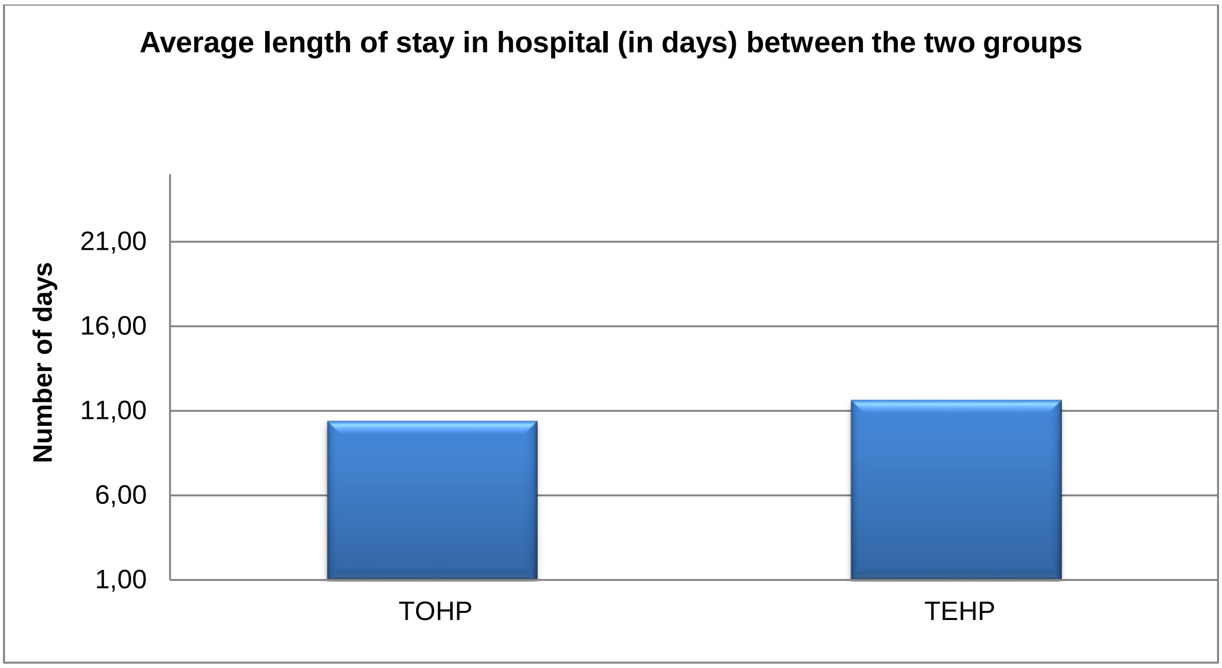


Figure 6: The bar graph above indicates the average length of stay in hospital between the TOHP group and the TEHP group (n=22 per group).

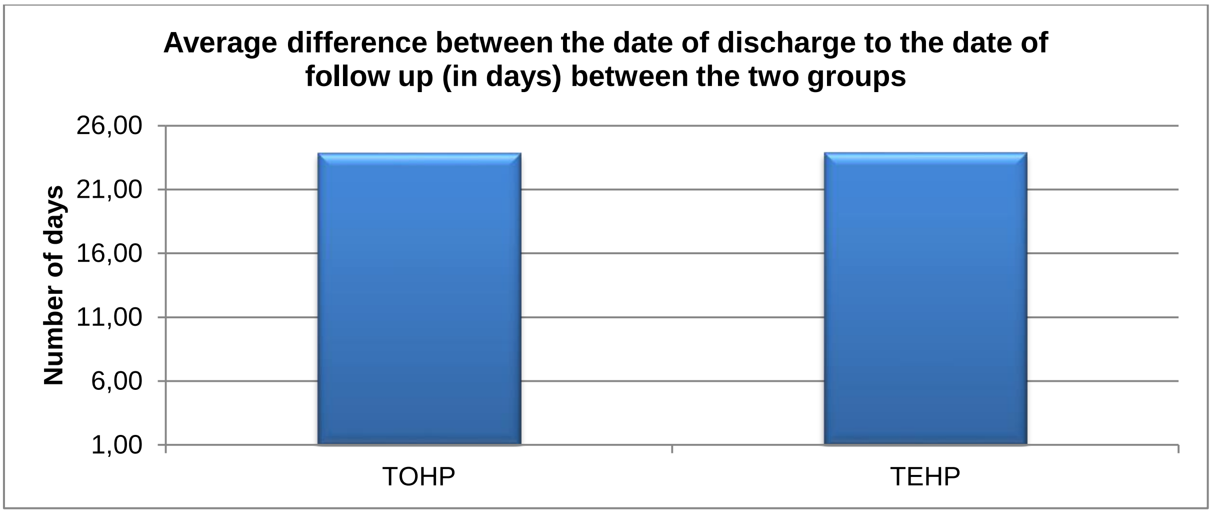


Figure 7: The bar graph above indicates the average difference between the date of discharge to the date of follow up as an outpatient between the TOHP group and the TEHP group (n=22 per group).

4.3 Improvement in upper limb function in the TOHP group

Table 2: below highlights the difference in the mean and standard deviation between the pre-test and the post-test of the TOHP group. The mean score for the pre-test dash score was 43.35 and was reduced to 25.66 in the post-test. The standard deviation of the pre-test scores is 10.83 with a standard error of 2.3 and in the post-test the standard deviation is 10.72 with a standard error of 2.28. The p-value of 0.0000 which is less than 0.05, indicating that there is a significant difference, between the pre-test DASH scores and the post-test DASH scores. Therefore it can be concluded that TOHP did improve upper limb function in the sample stroke population. Even so, there was a statistical significant difference in majority of the DASH questions as well as the overall DASH scores, the following questions mentioned below: did not display a statistical significant difference.

- **23**: “During the past week, were you limited in your work or other regular daily activities as a result of your arm, shoulder or hand problem”,
- **27**: “Weakness in your arm, shoulder or hand”
- **30**: “I feel less capable, less confident or less useful because my arm, shoulder or hand problem”

Table 2: Results of the TOHP scores: The difference in pre-test and post-test DASH scores using the Paired T-test (n=22)

	Variable	Pre -test		Post-test		
		Mean	Std.Dev.	Mean	Std.Dev.	p-value
1	Open a tight or new bottle	3.00	0.76	1.73	0.77	0.00*
2	Write	3.00	1.27	2.05	1.13	0.00*
3	Turn a key	2.45	0.67	1.59	0.50	0.00*
4	Prepare a meal	3.32	0.57	2.36	0.79	0.00*
5	Push open a heavy door	2.64	0.85	1.68	0.57	0.00*
6	Place an object on a shelf above your head	2.91	0.75	2.05	0.79	0.00*
7	Do heavy household chores	3.45	0.67	2.55	0.60	0.00*
8	Garden or do yard work	3.14	1.21	2.32	1.04	0.00*
9	Make a bed	2.32	0.57	1.41	0.59	0.00*
10	Carry a shopping bag or briefcase	2.68	0.89	1.86	0.77	0.00*
11	Carry a heavy object (over 5 Kg)	3.41	0.73	2.55	0.74	0.00*
12	Change a light bulb overhead	4.09	0.92	3.23	0.92	0.00*
13	Wash or blow-dry your hair	1.55	0.51	1.05	0.21	0.00*
14	Wash your back	2.14	0.77	1.14	0.35	0.00*
15	Put on a pull over jersey	1.68	0.48	1.09	0.29	0.00*
16	Use a knife to cut food	3.00	0.62	2.23	0.69	0.00*
17	Recreational activities which require little effort	3.41	0.80	2.27	0.77	0.00*
18	Recreational activities in which you take some force or impact through your arm, shoulder or hand	1.59	1.87	1.32	1.59	0.03*
19	Recreational activities in which you move your arm freely	1.68	1.99	1.32	1.67	0.04*
20	Manage transportation needs	2.23	0.75	1.50	0.91	0.00*
21	Sexual activities	2.36	1.09	1.64	0.73	0.00*
22	During the past week, to what extent has your arm, shoulder or hand problem interfered with your normal social activities with family, friends, neighbours or groups?	2.68	0.89	2.18	0.85	0.00*
23	During the past week, were you limited in your work or other regular daily activities as a result of your arm, shoulder or hand problem?	2.45	0.60	2.09	0.53	0.14
24	Arm, shoulder or hand pain	2.91	0.68	2.55	0.60	0.01*
25	Arm, shoulder or hand pain when you performed any specific activity	2.68	0.65	2.32	0.57	0.01*
26	Tingling (pins and needles) in your arm, shoulder, or hand	1.27	0.63	1.18	0.39	0.01*
27	Weakness in your arm, shoulder or hand	2.95	0.58	2.32	0.65	0.18
28	Stiffness in your arm, shoulder or hand	2.91	0.61	2.41	0.73	0.00*
29	During the past week how much difficulty has you had sleeping because of the pain in your arm, shoulder or hand?	1.68	0.78	1.45	0.74	0.01*
30	I feel less capable, less confident or less useful because my arm, shoulder or hand problem.	3.32	0.99	3.14	1.04	0.16
	Total number of responses	28.77	1.11	28.77	1.11	0.00*
	DASH Score	43.35	10.83	25.66	10.72	0.00*

4.4 Improvement in upper limb function in the TEHP group

Table 3 below highlights the difference in the mean and standard deviation between the pre-test and the post-test of the TEHP group. The mean score for the pre-test dash score was 41.96and was reduced to 31.60 in the post-test. The standard deviation of the pre-test scores is 13.37 with a standard error of 2.85 and in the post-test the standard deviation is 10.95 with a standard error of 2.33. The p-value of 0.0000 which is less than 0.05, indicating that there is a significant difference, between the pre-test DASH scores and the post-test DASH scores. Therefore it can be concluded that TEHP did improve upper limb function in sample stroke population. Even so, there was a statistical significant difference in majority of the DASH questions as well as the overall DASH scores, the following questions mentioned below: did not display a statistical significant difference.

- **16:**"Use a knife to cut food"
- **18**: "Recreational activities in which you take some force or impact through your arm, shoulder or hand"
- **19:**"Recreational activities in which you move your arm freely"
- **23:**"During the past week, were you limited in your work or other regular daily activities as a result of your arm, shoulder or hand problem"
- **24:**"Arm, shoulder or hand pain"
- **25:**"Arm, shoulder or hand pain when you performed any specific activity"

Table 3: Results of the TEHP scores: The difference in pre-test and post-test DASH scores using the Paired T-test (n=22)

	Variable	Pre -test		Post-test		
		Mean	Std.Dev.	Mean	Std.Dev.	p-value
1	Open a tight or new bottle	2.86	0.71	1.86	0.64	0.00*
2	Write	2.68	1.04	2.05	1.00	0.00*
3	Turn a key	2.18	0.66	1.73	0.70	0.01*
4	Prepare a meal	3.14	0.71	2.45	0.80	0.00*
5	Push open a heavy door	2.64	0.73	2.14	0.56	0.00*
6	Place an object on a shelf above your head	2.91	0.75	2.36	0.85	0.01*
7	Do heavy household chores	3.50	0.80	3.05	0.95	0.01*
8	Garden or do yard work	3.45	0.86	2.95	0.84	0.01*
9	Make a bed	2.05	0.84	1.73	0.83	0.04*
10	Carry a shopping bag or briefcase	2.45	0.86	2.09	0.68	0.04*
11	Carry a heavy object (over 5 Kg)	3.14	0.71	2.82	0.66	0.03*
12	Change a light bulb overhead	4.00	0.93	3.45	0.96	0.01*
13	Wash or blow-dry your hair	1.82	0.73	1.23	0.53	0.01*
14	Wash your back	2.36	1.09	1.59	0.96	0.00*
15	Put on a pull over jersey	1.77	0.75	1.32	0.89	0.04*
16	Use a knife to cut food	2.86	0.64	2.55	0.67	0.08
17	Recreational activities which require little effort	3.05	1.00	2.77	0.87	0.03*
18	Recreational activities in which you take some force or impact through your arm, shoulder or hand	1.27	1.80	1.23	1.74	0.18
19	Recreational activities in which you move your arm freely	1.27	1.80	1.18	1.74	0.18
20	Manage transportation needs	2.18	0.91	1.55	0.67	0.00*
21	Sexual activities	2.09	1.60	1.64	1.26	0.02*
22	During the past week, to what extent has your arm, shoulder or hand problem interfered with your normal social activities with family, friends, neighbours or groups?	2.73	0.77	2.27	0.70	0.01*
23	During the past week, were you limited in your work or other regular daily activities as a result of your arm, shoulder or hand problem?	2.45	0.67	2.23	0.53	0.09
24	Arm, shoulder or hand pain	2.55	0.51	2.41	0.50	0.11
25	Arm, shoulder or hand pain when you performed any specific activity	2.59	0.59	2.45	0.60	0.11
26	Tingling (pins and needles) in your arm, shoulder, or hand	1.32	0.72	1.32	0.72	0.01*
27	Weakness in your arm, shoulder or hand	3.00	0.53	2.77	0.61	0.04*
28	Stiffness in your arm, shoulder or hand	2.68	0.48	2.36	0.66	0.03*
29	During the past week how much difficulty has you had sleeping because of the pain in your arm, shoulder or hand?	1.86	0.83	1.64	0.85	0.04*
30	I feel less capable, less confident or less useful because my arm, shoulder or hand problem.	3.23	1.02	3.18	0.96	0.01*
	Total sum of responses	76.09	15.01	64.36	12.52	0.00*
	DASH Score	41.96	13.37	31.60	10.95	0.00*

4.5 Determining the most effective home programme

Table 4 highlights the mean difference within the two groups as well as indicates the p-values of the difference in DASH scores between the two groups. The TOHP group mean difference was -17.69 and the TEHP group mean difference was -10.36, thus indicating a difference of 7.33 between the two groups. Because the p value = 0.00 which is less than 0.05 there is significant difference between the TOHP group and the TEHP group. The TOHP showed a statistically more significant difference between the pre-test and the post-test, indicating greater improvement (change) in function than those whom followed the TEHP. The table below has also highlights that there was a significant difference for question 12 of the DASH (change a light bulb overhead) between the groups in particular.

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Table 4: Comparison of amount of improvement in each home programme in order to determine which group is most effective (n=22 per group). P-values have been ranked from smallest to largest p-value difference

	Variable	Mean Difference (TOHP)	Mean Difference (TEHP)	p-value
18	Recreational activities in which you take some force or impact through your arm, shoulder or hand	-0.27	-0.05	1
26	Tingling (pins and needles) in your arm, shoulder, or hand	-0.09	0	1
29	During the past week how much difficulty has you had sleeping because of the pain in your arm, shoulder or hand?	-0.23	-0.23	1
30	I feel less capable, less confident or less useful because my arm, shoulder or hand problem.	-0.18	-0.05	1
25	Arm, shoulder or hand pain when you performed any specific activity	-0.36	-0.14	0.96
11	Carry a heavy object (over 5 Kg)	-0.86	-0.32	0.74
22	During the past week, to what extent has your arm, shoulder or hand problem interfered with your normal social activities with family, friends, neighbours or groups?	-0.5	-0.45	0.74
20	Manage transportation needs	-0.73	-0.64	0.7
19	Recreational activities in which you move your arm freely	-0.36	-0.09	0.61
9	Make a bed	-0.91	-0.32	0.59
2	Write	-0.95	-0.64	0.55
8	Garden or do yard work	-0.82	-0.5	0.55
16	Use a knife to cut food	-0.77	-0.32	0.51
1	Open a tight or new bottle	-1.27	-1	0.49
27	Weakness in your arm, shoulder or hand	-0.64	-0.23	0.46
4	Prepare a meal	-0.95	-0.68	0.45
28	Stiffness in your arm, shoulder or hand	-0.5	-0.32	0.43
3	Turn a key	-0.86	-0.45	0.4
6	Place an object on a shelf above your head	-0.86	-0.55	0.37
14	Wash your back	-1	-0.77	0.35
7	Do heavy household chores	-0.91	-0.45	0.34
23	During the past week, were you limited in your work or other regular daily activities as a result of your arm, shoulder or hand problem?	-0.36	-0.23	0.31
17	Recreational activities which require little effort	-1.14	-0.27	0.29
21	Sexual activities	-0.73	-0.45	0.29
24	Arm, shoulder or hand pain	-0.36	-0.14	0.27
5	Push open a heavy door	-0.95	-0.5	0.26
15	Put on a pull over jersey	-0.59	-0.45	0.23
13	Wash or blow-dry your hair	-0.5	-0.59	0.19
10	Carry a shopping bag or briefcase	-0.82	-0.36	0.11
12	Change a light bulb overhead	-0.86	-0.55	0.03*
	DASH SCORE	-17.69	-10.36	0.00*

As one can see in Table 5, in majority of the DASH questionnaire the TOHP group displayed greater results than the TEHP group, apart from questions 13 (wash or blow-dry your hair) and 29 (during the past week how much difficulty have you had sleeping because of the pain in your arm, shoulder or hand?), where the TEHP group performed better than the TOHP group.

Questions, 17 (recreational activities which require little effort), 9 (make a bed) and 19 (recreational activities in which you move your arm freely) showed the greatest percentage improvement overall and questions 13 (wash or blow-dry your hair), 29 (during the past week how much difficulty have you had sleeping because of the pain in your arm, shoulder or hand?), 20(manage transportation needs), 22 (during the past week, to what extent has your arm, shoulder or hand problem interfered with your normal social activities with family, friends, neighbours or groups?), 23 (during the past week, were you limited in your work or other regular daily activities as a result of your arm, shoulder or hand problem?), 28 (stiffness in your arm, shoulder or hand), 30 (I feel less capable, less confident or less useful because my arm, shoulder or hand problem) displayed the least percentage improvement, where improvement was less than 5 % in general.

In the TOHP group patients displayed the most improvement in questions 1 (open a tight or new bottle) and 14 (wash your back), where improvement was noted to be greater than 40%, where as in the TEHP displayed the most improvements in questions 1 (open a tight or new bottle) and 13 (wash or blow-dry your hair), where improvement was noted to be greater than 30%.

Table 5: Summary of % improvement between each DASH question in TOHP group and the TEHP group as well as the % difference between the two groups

Variable		Overall % improvement between pre-test & post-test scores per question between the two groups		
		TOHP group	TEHP group	% Difference between the two groups
13	Wash or blow-dry your hair	32.35%	35.00%	-2.65%
29	During the past week how much difficulty have you had sleeping because of the pain in your arm, shoulder or hand?	13.51%	14.63%	-1.12%
20	Manage transportation needs	28.57%	27.08%	1.49%
22	During the past week, to what extent has your arm, shoulder or hand problem interfered with your normal social activities with family, friends, neighbours or groups?	18.64%	16.67%	1.97%
23	During the past week, were you limited in your work or other regular daily activities as a result of your arm, shoulder or hand problem?	13.21%	10.91%	2.30%
30	I feel less capable, less confident or less useful because my arm, shoulder or hand problem.	4.11%	1.41%	2.70%
28	Stiffness in your arm, shoulder or hand	15.63%	11.86%	3.77%
2	Write	30.30%	23.73%	6.57%
4	Prepare a meal	28.77%	21.74%	7.03%
24	Arm, shoulder or hand pain	12.50%	5.36%	7.14%
26	Tingling (pins and needles) in your arm, shoulder, or hand	7.14%	0.00%	7.14%
12	Change a light bulb overhead	21.11%	13.64%	7.47%
25	Arm, shoulder or hand pain when you performed any specific activity	13.56%	5.26%	8.30%
21	Sexual activities	30.77%	21.95%	8.82%
1	Open a tight or new bottle	42.42%	33.33%	9.09%
15	Put on a pull over jersey	35.14%	25.64%	9.50%
6	Place an object on a shelf above your head	29.69%	18.75%	10.94%
8	Garden or do yard work	26.09%	14.47%	11.62%
27	Weakness in your arm, shoulder or hand	20.00%	7.58%	12.42%
16	Use a knife to cut food	25.76%	12.90%	12.86%
7	Do heavy household chores	26.32%	12.99%	13.33%
18	Recreational activities in which you take some force or impact through your arm, shoulder or hand	17.14%	3.57%	13.57%
11	Carry a heavy object (over 5 Kg)	24.00%	10.14%	13.86%
3	Turn a key	35.19%	20.83%	14.36%
10	Carry a shopping bag or briefcase	28.81%	13.21%	15.60%
14	Wash your back	46.81%	30.77%	16.04%
5	Push open a heavy door	36.21%	18.97%	17.24%
19	Recreational activities in which you move your arm freely	23.68%	3.57%	20.11%
9	Make a bed	39.22%	17.39%	21.83%
17	Recreational activities which require little effort	33.33%	5.97%	27.36%
	DASH Score	42.42%	33.33%	9.09%

Figure 8 below demonstrates the greatest % improvement in the question 17 and the least for question 20 for the TOHP group, where as in questions 13 and 29, the TEHP group performed better than the TOHP group.

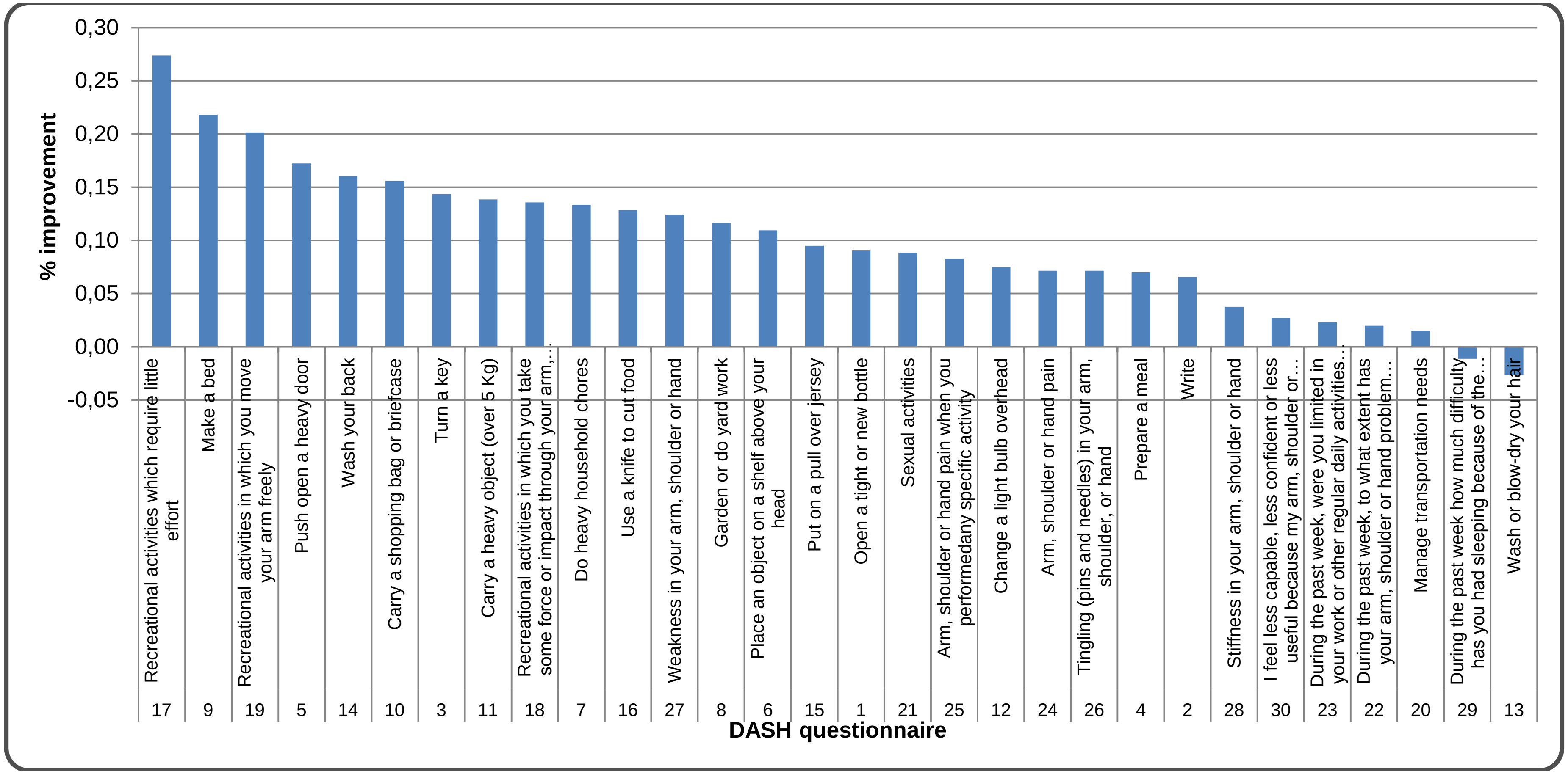


Figure 8:% Improvement between each DASH question in TOHP vs. the TEHP from the most to the least (n=22 per group).

4.6 Conclusion to the results

The results from this study were presented in this chapter. A significant statistically difference in the pre-test and post-test DASH scores were noted in both the controlled and experimental groups. However, the experimental group performed significantly better than the controlled group. A discussion of these results will be presented in the next chapter.

Chapter 5: Discussion

5.1 Introduction to the discussion

The first aim of this study was to determine if a TEHP intervention is effective in improving the functional recovery of the upper limb in post stroke survivors, using a pre-test, post-test research design. The second aim of this study was to determine TOHP intervention is effective in improving the functional recovery of the upper limb in post stroke survivors, using a pre-test, post-test research design. Lastly, the purpose of the study was to explore if the either of the above mentioned interventions was more effective than the other, in improving the functional recovery of the upper limb is post stroke survivors.

The initial reason for choosing to research this topic was the fact that the researcher was concerned about the rapid discharge rate of acute stroke patients within a government hospital setting, often leaving patients with incomplete stroke rehabilitation by trained health care professionals. According to the patient government statistics, OTs' treat stroke patients more than any other diagnostic group. In-patient rehabilitation has too many constraints and therefore we should be looking at alternative and effective options. Thus, a great need was seen in investigating cost-effective interventions in stroke management to optimize their outcome and limit their personal long-term burden of disease.

The relatively short hospital stay in government hospitals may be due to hospitals focusing on acute care, and patients are discharged once they are medically stable and not necessarily when they are independent in functional tasks. It may be challenging to meet the international standards due to the small OT to patient ratio in SA as wells due to the rapid discharge rate due to pressure on hospital beds and the lack of access to out-patient facilities (3)As a result of short hospitalizations, it becomes vitally important for OTs to have other systems in place for rehabilitating stroke survivors, and one such solution is the reinforcement of home programmes post discharge.

Two home programmes were set up using the two different intervention strategies; these programmes were used to treat two groups of stroke survivors. The DASH was used as an assessment scale to measure the patient's level of upper limb recovery. A clinical trial was conducted to compare the functional recovery of the upper limb in stroke patients following a TEHP versus a TOHP. Both groups were measured using the DASH on discharge in a pre-test. After implementation of the different home programmes, both groups were measured again, using the DASH in a post-test during their routine out-patient rehabilitation appointments. Follow-up out patients appointments were kept within 4 weeks post discharge.

From the overall results one can see that both home programmes were effective in the functional recovery of the upper limb post stroke as both groups presented with a significant difference between their pre-test and post-test scores. However, when comparing the difference between the two groups, it was found that the TOHP achieved greater results than the TEHP, as a significant difference was noted between the two groups. The fact that the TOHP group displayed a greater improvement in the DASH may suggest that the patients benefited more from this intervention than those who followed the TEHP. The following reasons below have been postulated as to why the TOHP group fared better than the TEHP group.

5.2 Demographics of the research study

As displayed in Table 1, one can conclude that TOHP and TEHP groups were the similar and comparable at the beginning of the trial. There were no significant differences noted in the p-values between the two groups considering age, gender, and the affected side of hemiparesis post stroke. Therefore, it can conclude that the results of this study are of reasonable conclusion, as both trial groups were the same from the start of the research project.

5.3 Both trial groups displayed improvement

The fact that both groups displayed a significant difference between their pre-test and post-test DASH scores can be associated with the initial degree and time course of recovery from stroke. The early initial improvement or spontaneous recovery occurs because pathologic processes in the brain resolve and neurotransmission resumes near and remote from area of injury within the brain (26). Later, ongoing improvement occurs with structural and functional reorganization within the brain by means of neuroplasticity. The recovery of the brain post stroke includes both intrinsic and adaptive recovery.

Intrinsic recovery is associated with the remediation of neurological impairments such as the return of movement to a paralysed limb and adaptive recovery entails regaining the ability to perform meaningful tasks without full restoration of neurological function, such as using the unaffected hand for dressing or walking with an assistive device. Most patients post stroke gain some degree of both intrinsic (neurological) and adaptive (functional) recovery (26). Another contributing reason why participants demonstrated such significant recovery of their affected upper limb may be due to the fact that the majority of the participants' affected upper limb was also their dominant side. It instinctively seems that the affected hand is an important factor in determining the effects of functional recovery, with participants having possibly higher motivation to regain the use of their dominant hand than their non-dominant hand. The participant's voluntary participation in the research study, their degree of motivation for continued improvement over time can be a contributing factor to the positive results of this study as it possibly had to be primarily through self-management and reinforcement and with support from family members/caregivers that patient's were compliant with the home programmes. In extensive home programmes where participants are required to use their affected limb during their exercises or when participating in functional tasks, often requires assistance from a family member/caregiver for emotional and physical support.

It is said that with differing degrees (32) of support available within a family environment, individual functioning may display different rates of progress. Another reason for such positive results may be linked to increased patients' satisfaction with their performance, increased motivation to work towards improving the functional use of the affected hand, and family support. In addition, such factors, which may have fostered their compliance as well as clarifying the beneficial effects of functional improvement in the affected hand, may be a reflection of the participants' desire to perform tasks of which they had a latent ability prior to the start of the study. In other words, such factors may have ultimately contributed to increased motivation, consequently creating a positive feedback loop. The most likely cause for the high compliance rate in the present study may be as follows. First, the researcher telephoned each participant on a weekly basis to find out about their participation regarding the home programme and secondly, their caregivers' encouragement and help may have further assisted them in carrying out the home programmes for efficiently.

The results of this present study, overall, indicate that encouraged use of the affected upper limb in exercises or task orientated activities combined with individualized scheduled home programmes had a positive effect on improving upper limb functioning and ADL in persons with post-stroke hemiparesis in their home setting. The present study promoted the actual facilitation of active patient involvement with opportunities for self-direction and self-assessment of performance, which may have promoted participants' motivation, confidence, empowerment, and self-management skills. Also, its emphasis and promotion of ADL task performance had the advantage of keeping participants focused and motivated so that a number of exercises can be maintained throughout the intervention.

5.4 Traditional Exercise Home Programme

Agreed the vast evidence, it seems obvious that everyone should all be physically active. It is important if one wants to live a healthy and satisfying life into old age. The link between exercising and enhanced cardiovascular health and fitness has been well recognized in the general population (12). Individuals who do regular exercises already have a reduced the risk of chronic illnesses such as coronary heart disease, raised cholesterol levels, stroke, type 2 diabetes etc. Additionally it is well thought-of that physical activity can also enhance mood self-esteem, sleep quality and energy levels in addition to reducing ones risk of anxiety and stress, feelings of depression and dementia.

The positive results achieved in the TEHP group can be associated with the same principles as mentioned above, that all exercise is beneficial for one’s wellbeing and recovery. In addition, the participants may have perceived the greater benefits of rehabilitation and the advice given to them by the treating therapist, along with having perceived the severity of the illness as greater. Furthermore, the exercises in the TEHP were aimed at addressing the negative features and reducing the adaptive features as described by Carr and Shepherd post CNS dysfunction. The exercise prescribed in the TEHP proposed to improve muscle strength, prevent muscle stiffness, muscle shortening, myofascial tension and neural tension. Therefore addressing these features in early therapeutic intervention demonstrated a positive outcome in the functional recovery in the upper limb post stroke.Despite that there was a statistical significant difference in majority of the DASH questions as well as the overall DASH scores, the following questions in the DASH questionnaire mentioned below: did not display a statistical significant difference.

- **16:”** Use a knife to cut food”
- **18**: “Recreational activities in which you take some force or impact through your arm, shoulder or hand”
- **19:**“Recreational activities in which you move your arm freely”
- **23:**“During the past week, were you limited in your work or other regular daily activities as a result of your arm, shoulder or hand problem”
- **24:”** Arm, shoulder or hand pain”
- **25:**“Arm, shoulder or hand pain when you performed any specific activity”

Participants having limited improvement in these questions can be attributed to the general impairment of the upper limb associated with stroke, as these survivors have been through a traumatic event and since upper limb function is essential for many tasks of daily living, impairment contributes to reduced quality of life and increases dependence, especially considering challenging tasks such as using a knife etc. In addition to this, stroke survivors are more vulnerable to pain, as a result of the negative and adaptive features associated with CNS dysfunction, which have been mentioned previously and will always want to compare the level of functioning and independence to that of their pre-morbid status. Additionally the participants who followed the TEHP, may have had limited improvements in 'certain' sections of the DASH, which can be contributed to the fact that they were not required to perform specific tasks, whereas the TOHP group had clearer requirements for task participation.

In a previous study (53), it was hypothesized that perceived physical capability would negatively relate to compliance and contributed significantly to predicting the level of compliance. Therefore, encouraging the participants to become actively involved in their treatment and increasing their confidence in performing recommendations appears to have been a fundamental for both programmes effectiveness as participants in both groups demonstrated significant improvement between their pre-test and post-test DASH scores. Also, patients with higher expectations regarding improved outcomes tend to be more actively engaged in their treatment.

Furthermore each participant's sense of control was enhanced by the therapist's endeavour to decrease the probable challenges to compliance, such as the patients' fears from lack of knowledge or the family members/caregivers' lack of understanding for the importance of their support. In addition, the therapist facilitated more precise and consistent follow-through by providing the patients with the opportunity for further feedback and encouragement when requesting them to demonstrate their home programmes upon follow-up, as well as using weekly phone calls to record their compliancy to the home programme.

However, the differences between perceived and actual compliancy to the home programmes are noteworthy as there were differences noted between participants whom thought they were 100% compliant versus their home programme journal reviews were different. However, these differences were not assessed and documented formally as this was not the aim of the research study.

5.5 Task Orientated Home Programme

Regrettably there is no definite explanation of a task-orientated approach which exists in current literature (23). Additionally, the content and optimal amount of the therapy, needed for patients post stroke is not precisely known (23).The TOHP intervention was brought about by the motor-relearning theory, together with the task-orientated approach. It has been well established that the motor-relearning approach promotes the regaining of normal motor skills through task-orientated practice with appropriate feedback and the active participation of the patient (52). There is also proof that increased practice leads to better outcomes. With keeping this in mind it is believed that "movement emerges as an interaction between many systems in the brain and is organized around a goal and constrained by the environment" (23, pg 738). As this approach makes use of real objects and natural environments, focus on meaningful tasks and functional goals, which have been included in the TOHP, it is assumed that it helps organise motor behaviour and occupational performance, as there is a interaction of multiple systems that contribute to the unique characteristics of the person and the environment and that practice and active experimentation with varied strategies and contexts are needed to find the optimal solution for a motor problem and develop skill in performance (9).

Therefore keeping the above mentioned theories in mind, it can be proposed that the TOHP group displayed better results in their DASH scores, as these participants' were given a set functional goal in the home programme, a target was always involved, and where possible the natural objects were used and the task itself was more purposeful and meaningful to the patients. The tasks included in the home programme also included attention and focus in addition to providing the patients' with feedback in the form of tactile and visual feedback as well as knowledge of results. The use and presence of natural objects in a known and familiar environment could possibly have enhanced the performance of reaching etc. in the participants. The TOHP included specific tasks which were resolute to the participants, thus helped to motivate and instruct them as well as enhance more compliancy to the programme. With regard to the TEHP, the exercises may have been attached to a goal, but was not a "functional goal" that was purposeful and meaningful to the patient. Patients would perceive this home programme to be '"good", for them, as it has been recommended by the therapist to benefit them in the long-term, thus were compliant to the programme. However, this home programme does not use make use 'real' objects in a natural environment and also does enhanced a carryover effect in the 'real' world.

Another large contributing factor as to why the TOHP group achieved better results than that of the TEHP group, apart from what has been mentioned above is that of neural plasticity. From the literature review, we understand that functional outcomes are not only dependent on the amount of neurons left, but also on how they function and what connections they can make. Therefore high numbers of repetitions of task-specific activities, such as those that were included in the TOHP, are known to promote neuroplastic change. This statement makes instinctive sense as the best way to relearn a given task is to train specifically for that task and that repetition alone, without usefulness or meaning in terms of function, is not enough to produce increased motor cortical representations. Another way to generate functionally appropriate neural connections, capitalizing upon the way the brain generally does this, is through learning. Learning is a critical part of brain adaptation to brain damage even when there are no evident rehabilitation efforts. Reliance on the less-affected limb after stroke is associated with major restructuring and neuronal growth in the contra-lateral hemisphere (36). Therefore, "a brain that one may attempt to reorganize with rehabilitative training is one that is being steered to reorganize by compensatory behavioural changes and such self-taught behavioural changes can be adaptive and major contributors to functional recovery" (36, pg S225). Additionally there is also vast evidence that indicates that "the brain continuously remodels its neural circuitry in order to encode new experiences and enable behavioural changes." Thus, this neuroplasticity is, itself, steered by changes in behavioural, sensory, and cognitive experiences, which can be achieved via the TOHP which the participants had received. The "endogenous process of functionally appropriate reorganisation in healthy brains" (36, pg S226), is also important in promoting reorganization of remaining tissue in the damaged brain.

However, even so, there was a statistical significant difference in majority of the DASH questions as well as the overall DASH scores, it must be noted that the following questions mentioned below: did not display a statistical significant difference.

- **23**: "During the past week, were you limited in your work or other regular daily activities as a result of your arm, shoulder or hand problem"
- **27**: "Weakness in your arm, shoulder or hand"
- **30**: "I feel less capable, less confident or less useful because my arm, shoulder or hand problem"

The possible reasons for this can attributed to the fact that participants will always associate their general and overall impairment of the upper limb to stroke, as they will always compare the level of functioning to that of their pre-morbid status. Additionally, stroke survivors are more vulnerable to pain, as a result of the negative and adaptive features associated with CNS dysfunction, which have been mentioned previously, hence they will always find their upper limb to be weaker, more pain and less competent than their non- affected side.

Last but not the least, the principles of experience dependent neuroplasticity that can be associated and linked to that of the task-orientated approach and that are likely to be relevant to rehabilitation after CNS damage include:

- **Principle 1: Use it or lose it –**If neural circuits not actively occupied in task performance for extensive periods of time, they start to degrade. Therefore by encouraging purposeful use of the affected upper limb and hand through task-orientated activities, which include behavioural experiences, encourage better movement associated activation in the remaining cortex of the injured brain which would otherwise be lost after the injury. In addition it prevents one handed use and learned non-use of the affected upper limb. This principle can be associated with the both home programmes, as both the programmes needed bilateral upper limb involvement through exercises as well as during activity participation, thus contributing to improved functional recovery on the affected upper limb. However, when coming to the TOHP, all the tasks within the programme required bilateral integration thus "forcing" the patient to use the affected upper limb during activity participation.

- **Principle 2: Use it and improve it** - The improvements brought concerning skill training are accompanied by profound neuroplasticity within the cerebral cortex as it is hypothesized that similar neural changes occur in response to neurorehabilitation and mediate functional improvement. Thus by doing tasks and exercises that involve bilateral use of the upper limbs/hand in a either of the home programme created a behavioural experience via the participation in a exercise or purposeful task thus enhancing performance and optimizing restorative brain plasticity post CNS damage, as motor skill training has been found to improve motor function and to restore neuroplasticity in remaining cortical regions. This is further reinforced by regular practice of the task/exercise as a result of daily practice, which in turn leads to the enhancement of that skill. Additionally, seeing that rehabilitation cannot be carried out daily in a South African context, the only way to fulfil principle 2 will be the use of home programmes. As seen with the total DASH scores, both groups did improve in their function, which shows that home programmes are effective.

- **Principle 3: Specificity** -Learning or skill acquisition, rather than mere use, is required to produce major changes in patterns of neural connectivity. Therefore learning-induced brain changes also show regional specificity. "Specific forms of neuroplasticity and related behavioural changes are dependent upon specific kinds of experience and the implication for rehabilitation is that training in a specific modality, can change a limited subset of the neural circuitry involved in the more general function and hence can manipulate the capacity to acquire behaviours in non-trained modalities" (36, pg S229). Therefore when one uses the TOHP versus the TEHP, it facilitates behavioural changes as it is dependent on specific kinds of experience that can be associated more with tasks rather than mere exercises, which can influence the neural circuitry and influence the capacity to acquire behaviours in non-trained modalities. This provides a "special opportunity to guide the restructuring of the brain region with appropriate behaviours, as suggested both in the cortical tissue bordering a lesion and in regions distant from, but connected to, the site of injury" (36, pg S229).

- **Principle 4: Repetition matters –** Repetition is also needed to attain a level of improvement and brain reorganization sufficient for the patient to continue to use the affected function outside of therapy and to maintain and make further functional gains. Therefore bysimply just engaging a neural circuit in task performance is not sufficient to drive neuroplasticity. Repetition of a newly learned (or relearned) behaviour may be required to induce lasting neural changes. Since participants in both home programme groups were required to repeat their exercises/tasks on a daily basis, this principle of neuroplasticity was fulfilled by both the controlled and experimental groups."It has also been hypothesized that the neuroplasticity brought about through repetition represents the instantiation of skill within neural circuitry, making the acquired behaviour resistant to perish in the absence of training" 36, pg S229). Hence, this is further reinforced with the TOHP group as it uses practical tasks which naturally repeat in a day/on daily basis.

- **Principle 5: Intensity matters** - With repetition, the intensity of stimulation or training can also influence the induction of neuroplasticity. Higher intensity stimulation will induce long-term potentiation, whereas low-intensity stimulation may induce a weakening of synaptic responses (long-term depression). One harmful side effect of training intensity after brain injury is the possible overuse of impaired limbs that results in more impaired function. This seems to require both an extreme amount of use and that the overuse occurs during an early vulnerable period. The sensitivity to overuse effects also depends upon the nature of the injury. Therefore family members/caregivers were to monitor the participants during their exercise routine and task performance so to ensure that overuse or strain to the affected limb does not occur. However, the degree of intensity within both home programmes cannot be quantified, as many patients and their caregivers reported that patients often did more than their expected tasks/ exercises as they were motivated to achieve better outcomes as quick as possible. Intensity is greater because patients are more compliant and again repeated tasks are reinforced as they do it every day.

- **Principle 6: Time matters** - It has been known that the stable consolidation of memories needs time. The time aspect may be more crucial post brain injury given the dynamic changes in the neural environment that are taking place independent of any rehabilitation. For rehabilitation it has been proposed that the timing of behavioural treatments, whether therapy/treatment is primarily neuro protective in nature, where loss of neural connections and sparing of neuron death or whether the treatment works mainly by facilitating the reorganisation of residual connections should always be considered. These are not independent processes as neurons that are steered to form synaptic connections, which are likely to vary and gain additional signals temporally, in their sensitivity to behavioural experience effects. It already has established that a 5-6 week period of therapy initiated 30 days post stroke is by far less effective in promoting growth of cortical dendrites and improving functional outcomes than the same routine initiated 5 days post CNS damage Time delays also allow for the greater establishment of self-taught compensatory behaviours, some of which may interfere with the rehabilitation process. Hence the patients started receiving immediate therapy the moment they were referred for rehabilitation and compliancy to home programmes was reinforced on discharge. Consequently this prevented patients from developing self-taught compensatory behaviours, such as one-handed techniques, that could have interfered with therapy and compliancy to the home programmes. Hence, this principle was fulfilled by both home programme groups, as a therapeutic approach to treatment was used in the rehabilitation of these participants. One-handed techniques are often only taught to patients when therapy has been directed using a rehabilitative approach, where patient's level of recovery has often plateaued and no further improvements in terms of selective control of movement can be achieved. Therefore this approach of treatment was not used in this research study, as the overall aim of this study was to improve the selective control of movement in both the controlled and experimental groups, thus using a therapeutic approach to treatment.

- **Principle 7: Salience matters** - As we already know that saliency is an essence of attention given in the treatment of many CNS disorders. Yet, treatment can be optimized an improved understanding of the neural processes that underlie the modulation of the recovery process by saliency. It has also been established that the strength of memory consolidation are modulated by emotions. Thus sufficient attention and motivation are also fundamental in promoting task engagement. Additionally by providing stimulation of a gratifying circuit in the brain has also been found to be very effective in encouraging performance. Therefore, the participant's voluntary participation in the research study, their degree of motivation for continued improvement over time can be a contributing factor to the positive results of this study for both home programme groups as it possibly had to be primarily through self-management and reinforcement and with support from family members/caregivers that patient's were compliant with the home programmes, as displayed by the overall DASH scores for both groups.

- **Principle 8: Age matters –** We know that neuroplastic responses are altered in the brain as it ages, as experience-dependent synaptic potentiation, synaptogenesis and cortical map reorganization are all reduced with aging. Extensive neuronal and synaptic atrophy is associated with aging and physiological degradation. Therefore, aging may be equivalent to a brain insult, and that neuroplasticity is the method by which the brain balances the effects of aging. Yet, the aging brain is also evidently responsive to experience, as demonstrated in both the TOHP and TEHP groups where both groups' participants fell within the younger than expected age bands for stroke incidence. Therefore, training-induced plasticity could occur more readily in these participants', as there were younger than the common stroke population, even though the brain changes may be less profound and/or slower to occur than those expected in younger brains.

- **Principle 9: Transference** – "This phenomenon of the ability of neuroplasticity within one set of neural circuits to promote concurrent or subsequent neuroplasticity has been demonstrated in the human motor cortex with skill learning and TMS (Transcranial Magnetic Stimulation)" (36, pg S232). Hence, when training a fine motor skill, results in an increase in corticospinal excitability and to expand the representation of the hand muscle in primary motor cortex. A portion of the TOHP, did involve participants to carry out fine motor tasks, such as doing up ones buttons when putting on a shirt or when picking up coins from the table and placing it into a plastic container, hence this re-learning may have promoted the a prolific environment to support these changes, compared to those participants in the TEHP group, who had limited fine motor skills exercise training.

- **Principle 10: Interference -** Even though some types of non-invasive cortical stimulation that are applied shortly before or during skill training appear to enhance motor learning, other forms have been shown to be disruptive of learning. Supposedly, the synchronization of training and stimulation improves performance because of the behavioural signals steering neuroplasticity during stimulation. Therefore, when stimulation is applied outside of training, it may disrupt the memory consolidation process and induce neuroplasticity unshaped by behavioural signals which can be harmful to performance. The implications for the application of stimulation when enhancing recovery post brain injury must take this into account. It is also possible for behavioural experiences to steer neuroplasticity in areas of the brain with residual function in a direction that will hinder optimal behavioural recovery. Therefore in it essential that early therapeutic intervention is initiated as soon as possible in brain injured patients, so as to prevent the development of compensatory strategies, such as one-handed techniques or mass movement patterns, and ultimately promote more effective strategies as those guided in therapy. Hence therapy was initiated the moment participants were referred to OT for treatment, whether they met the inclusion criteria or not, so as to prevent compensatory strategies from developing. This form of intervention as been recommended for acute stroke patients in order to optimize the functional recovery of the patient, thus early intervention focusing on appropriate positioning of the hemiplegic patient and attempts at early mobilization and mobility together with the recommencement of daily activities such as grooming, toileting, washing, shaving, dressing and eating improves recovery from stroke (11).

On the whole the results suggest that the TOHP group yielded better results overall than the TEHP group in improving the functional recovery of the upper limb in stroke survivors. This finding is further supported by the fact that only one therapist (i.e. the researcher) was involved in the rehabilitation of the participants as well as in the issuing of the home programmes, thus keeping the intervention standard amongst the participants. A fair number in sample size was used, where significant difference was noted, thus further supporting the effectiveness of a TOHP. However, other factors such as the length of stay in hospital, the affected side of the stroke, as well as the type of stroke, the degree and duration of obstruction or haemorrhage, and the extent of brain tissue death could have impacted on the research findings, however, these variables were uncontrollable by the researcher.Compliancy to the home programmes were no assessed and documented formally as this was not the aim of the research study. However, it can be assumed that the TOHP group may also have been more compliant to their home programmes as to the TEHP group as “actual” tasks are more specifically goal directed versus just doing tedious, monotonous, tiresome and uninteresting exercises without having an ultimate goal to link it to in the end.

5.6 Recommendations for future studies

The study has yielded conclusive results and indicated that a task-orientated intervention to home programmes is better in improving the functional recovery of the upper limb in stroke survivors than merely doing a TEHP. A few recommendations will now be discussed which may yield a more definitive answer.

A research study of this nature; where the patient’s length of hospital stay and treatment received in terms of medical care differed amongst patients; thus resulting in some patients receiving more individual therapy than others due to their increase length of stay in the hospital, could have better been controlled by using a collaborative interdisciplinary research approach to ensure that treatment for all patients remain consistent. Also the outcome measure used in this study, the DASH, is mainly based on the patient's subjective perception of each question, rather than a therapist's formal assessment for each question. Although, the researcher did attempt to control this variable, by having an assessment kit which consisted on some items (e.g. bottle, jar, pen, paper, knife, spoon, cloth, bucket etc.) which were assessed by the questionnaire available to the OTTs for ensuring reliable results, some questions in the questionnaire remain to be subjective. These questions included the subject's view regarding their pain levels, sleep patterns etc. Thus future studies should have an additional blind therapist to formally assess recovery and to also possibly use a motor behaviour recovery scale etc. Also when looking at the individual question scores of the DASH, one can see that it is not a sensitive test, as p-value differences was mostly only picked up in the total DASH scores rather than each question.

Future studies should ensure that they have more time and manpower to involve more patients over an extended period of time, so as to increase the sample size and length of therapy. Initial statistical calculations required at least 46 patients per group in order to deliver significant results. Furthermore the reliability of these results can be reinforced if subjects were re-tested on a 6 monthly to yearly basis over a three year span to determine if their conditions improved further or regressed. Additionally further research should include other intensive intervention for longer time periods that include more meaningful bilateral tasks that involve both the upper and lower limbs. Therapy should emphasize the performance of ADL and be based on tasks that are integrated and require the simultaneous use of both upper and lower limbs, including the use of materials meaningful to the patient as this has been shown to have a favourable effects on task performance.

The participants in this study were patients with mild upper limb impairment, and it is clear that repetitive, intensive, and task-specific training is more beneficial to contributing to the functional recovery of the upper limb, post stroke. However, it is unclear as to whether this strategy is effective in patients with more severe motor impairments. Therefore, it is necessary to confirm the effects of task-orientated training in patients with different degrees of impairment. One of the main challenges still remaining is the treatment of those patients whose upper limb is severely affected (Brunnström stage 1 and 2 level of recovery) and cannot part engage in task-orientated activities. The development of a different treatment strategies may be needed and interventions for these patients who have very little or no movement in their affected side and the restriction of task-orientated programmes to individuals who have some arm movement and dexterity at baseline. In addition the development of more outcome measures that are more sensitive is needed so small changes in the arm and hand can be detected.

Finally research further research is required to show the effectiveness of the commonly used neurological rehabilitation interventions within the OT and South African contexts. Research and development of newer neurological rehabilitation approaches should be boosted in the case where current theories are not meeting the needs of the stroke patients in these contexts.

Chapter 6: Conclusion

The aim of the study was to assess the recovery of upper limb function of stroke survivors using two different home programmes. It was noted that both home programmes (TEHP and TOHP) displayed significant improvement in the recovery of upper limb function in stroke survivors. However, the TOHP was more effective than the TEHP in the functional recovery of the upper limb in stroke survivors, as a significant difference was noted between the two independent groups. Thus the aims and objectives of this research study have been achieved. While the task orientated approach is still evolving, these results can help motivate and guide other therapists in the designs of their home programmes and implementation of therapy in the future treatment of stroke survivors. Although many thoughts; in terms of occupational performance, person, environment etc; presented as part of the task-orientated approach are as old as OT itself, recent motor behaviour literature combined with understanding the principles of neuroplasticity provides a stronger theoretical basis for using purposeful and meaningful tasks as the primary treatment modality (9). Thus this intervention to treatment offers the field of OT new thoughts about the remediation of motor control problems in patients with CNS dysfunction. Compliancy rate in this research study is thought to be high; however; more research is needed to consider a wide range of variables that may influence compliance and strategies that may better compliancy. This research study further highlights that home programmes and recommendations by the therapists are important in achieving therapy goals, thus further research should be done with regard to the factors that influence patient’s engagement in their treatment. Upper limb dysfunction is believed to be the primary impairment underlying disability induced by stroke, and is most commonly addressed by OTs. Motor practice frequently used in commonly used in rehabilitation protocols to improve motor skill learning have been shown to be ineffective. Very little has been written about motor therapies for patients with minimal movement in their affected upper limb, and no home-based therapies have been shown to be effective for these patients.

Neurological rehabilitation faces many challenges within a South African context. There is limited financial support for the care of stroke patients in SA, given the limited stroke units available throughout the country. The South African stroke patient is different to that of a developed country’s’ patient, as South Africa faces challenges of extreme poverty, lack of basic resources such as running water and electricity and the effect of HIV/AIDS on the patient’s presentation and prognosis are to be considered, apart from the typical presentation of stroke. Functional activities such as going to a toilet 10-20 meters away from the South African patient’s house, presents a challenge that is very different to that of a British/American patient learning to drive a car again.

Patients in South Africa often rely on public transport to attend out-patient therapy due to their low socio-economic status and there is the lack of this type of transport for disabled persons.

Currently there is a lack of research to show the effectiveness of the commonly used neurological rehabilitation approaches in SA. The effectiveness of neurological rehabilitation can be questionable within a South African context, as this country brings about its distinctive challenges within the public health care system. A neurological rehabilitation intervention suitable in the South African context would need to consider the challenges of stroke patients attending therapy, the lack of resources in the OT departments, especially in government and rural institutions, and in the stroke patients' environments and should also take into consideration the co-morbid illnesses and disabilities brought on by poverty. If research finds the current treatment approaches unsuitable, new theories should be investigated.

As a final point, OTs should use the modern evidence in neurological rehabilitation more frequently, and higher levels of evidence are recommended for use, if available. Evidence will only be available if more research is done on the effectiveness of the current neurological rehabilitation interventions, especially within the OT and South African contexts. OTs should be made aware of cost effective and time efficient sources of EBP, which may boost the use of EBP.

6.1Limitations of the study

The small sample size limits the researcher from generalising the data to a greater population. A larger sample size may also have resulted in a more significant finding.

If the compliance had been measured over a longer period more accurate estimates of compliance than those assessed at e one-time could have been obtained. To deal these limitations, research in the future should use larger sample sizes and set inclusion criteria with a similar range since time of onset. The participant's active involvement in the rehabilitation process could be more accurately measured should be measured more than once at set times. Additionally implementation of home programmes should be done at a national level, in government settings as well as in private settings, to tests its true effectiveness within a South African context. Furthermore future research should also compare the implementation of home programmes with no home programmes just to ensure that it is not just merely natural recovery that occurred in the stroke survivors.

Another point to consider is that participants who were part of the TOHP group may have performed the tasks in the DASH better than the participants in the TEHP group, whom might not have attempted such tasks as all, thus making the DASH more bias towards the TOHP. Therefore future studies should include more than one outcome measure to ensure more reliable and valid results as well as to determine gains beyond those attributable to spontaneous recovery.

Although this research study has provided some form of guidance to therapists in their future approach to treatment and home programme, it is also difficult to imitate natural environments or vocational and recreational activities in clinical settings. Therefore this limitation suggests that therapy should take place in the patient’s home, work or leisure setting whenever possible.

The pressure to reduce the length of hospital stays and the increased development in community-based rehabilitation programmes can be seen as supporting this trend (9).

References:

1. Daniels R, Winding K, Borell L. Experiences of Occupational Therapists in Stroke Rehabilitation: Dilemmas Some Occupational Therapists in Inpatient Stroke Rehabilitation. Scandinavian Journal of Occupational Therapy. 2002; IX.

2. Vestling M, Tufvesson B, Iwarsson S. Indicators for Return to Work After Stroke and the Importance of Work for Subjective Well-Being and Life Satisfaction. Journal of Rehabilitation Medicine. 2003; XXXV.

3. Freeme J, Casteleijn D. A proposal for an undergraduate stroke rehabilitation curriculum appropriate for South African occupational therapy. South African Journal of Occupational therapy. 2014 April; XLIV(1).

4. Jose Vega MD. Stroke Rehabilitation is a Critical Part Stroke Recovery. Health's Disease and Condition. 2009 September.

5. Bode RK, Heinemann AW, Semik P, Mallinson T. Relative Importance of Rehabilitation Therapy Characteristics on Functional Outcomes for Persons With Stroke. Journal of the American Heart Association. 2004 October; XXXV.

6. Kalra L, Dale P, Crome P. Improving Stroke Rehabilitation, A Controlled Study. Journal of the American Heart Association. 1993; XXIV.

7. Wasserman S, de Villiers L, Bryer A. Community-based care of stroke patients in a rural African setting. South African Medical Journal. 2009 August; XCIX(8).

8. Unknown. http://www.westerncape.gov.za/eng/directories/projects/15020/76162. [Online].; 2003 [cited 2011 October 13.

9. Bass-Haugen J, Mathiowetz V, Flinn N. Optimising Motor Behaviour Using the Occupational Therapy Task-Orientated Approach. In Radomski MV, Trombly Latham CA, editors. Occupational Therapy for Physical Dysfunction. Sixth Edition ed. Philladelphia: Wolters Kluwer, Lippincott Williams & Wilkins; 2008. p. 598-617.

10. Touillet A, Guesdon H, Bosser G, Beis J, and Paysant J. Assessment of Compliance with Prescribed Activity by Hemiplegic Stroke Patients After an Exercise Programme and Physical

Activity Education. Annals of Physican and Rehabilitation Medicine. 2010 May; 4.

11. Bryer A, Connor MD, Haug P, Cheyip B, Staub H, B T, et al. South African guideline for management of ischaemic stroke and transient ischaemic attack 2010: A guideline from the South African Stroke Society (SASS) and the SASS Writing Committee. South African Medical Journal. 2010 November; C(11).

12. Gordon NF, Gulanick M, Costa F, Fletcher G, Franklin BA, Roth EJ, et al. Physical Activity and Exercise Recommendations for Stroke Survivors. Circulation - Journal of the American Heart Association. 2004 April; CIX.

13. van der Port IG, Wevers L, Roelse H, van Kats L, Lindeman E, Kwakkel G. Cost-effectiveness of a structured progressive task-oriented circuit class training programme to enhance walking competency after stroke: The protocol of the FIT-Stroke trial. BMC Neurology. 2009 August; IX(43).

14. Sabari JS. Optimizing Motor Skill Using Task-Related Training. In Radomski MV, Trombly Latham CA, editors. Occupational Therapy for Physical Dysfunction. Sixth Edition ed. Philadelphia: Wolters Kluwer - Lippincott Williams & Wilkins,; 2008. p. 618-641.

15. de Jong L, Nieuwboer A, Aufdemkampe G. Contracture Preventive Positioning of the Hemiplegic Arm in Subacute Stroke Patients: A Pilot Randomized Controlled Trial. Clinical Rehabilitation. 2006 January; XX.

16. Carr J SR. Stroke Rehabilitation: guidelines for exercise and training to optimise motor skill. London: Butterworth-Heineman; 2003.

17. Murakami M, Kato J, Maeda N, Takahashi K, Furukawa , Hiroshi. Influences of Physical Activity in Stroke Patients with Hemiplegia on Pulse Wave Velocity. Isokinetics and Exercise Science. 2005; XIII.

18. Lemogoum D, Degaute JP, Bovet P. Stroke Prevention, Treatment, and Rehabilitation in Sub-Saharan Africa. American Journal of Preventive Medicine. 2005; XXIX.

19. Connor M, Bryer A. Stroke in South Africa. Chronic Diseases of Lifestyle in South Africa. 2005.

20. Mandal AK, Mokashi SP. Effect of Occupational Therapy Task Orientated Approach on the

Recovery of Upper Extremity Motor Function and Activities of Daily Living in Stroke Patients. The Indian Journal of Occupational Therapy. 2009 May; XLI(2).

21. Kwakkel G, Kollen BJ, Wagenaar RC. Therapy Impact on Functional Recovery in Stroke Rehabilitation. A critical review of the literature. Physiotherapy. 1999; LXXXV(7): p. p. 377 - 391.

22. Rabadi M, Galgano M, Lynch D, Akerman M, Lesser M, Volpe B. A pilot study of activity-based therapy in the arm motor recovery post stroke: a randomized controlled trial. Clinical Rehabilitation. 2008 June; XXII.

23. Rensink M, Schuurmans M, Hafsteindottir T. Task-oriented Training in Rehabilitation After Stroke: Systemic Review. Journal of Advance Nursing. 2009; LXV(4).

24. Ljungberg C, Hanson E, Lovgren M. A Home Rehabilitation Program for Stroke Patients. Scandinavian Journal of Caring Sciences. 2003 January; XV(1).

25. Landi F, Cesari M, Onder G, Tafani A, Zamboni V, Cocchi A. Effects of an Occupational Therapy Program on Functional Outcomes in Older Stroke Patients. Gerontology. 2006; LII.

26. Woodson AM. Stroke. In Radomski MV, Trombly Latham CA, editors. Occupational Therapy for Physical Dysfunction. Philadelphia: Wolters Kluwer- Lippincott Williams & Wilkins; 2008. p. 1001- -1041.

27. Rowland TJ, Cooke DM, Gustafsson LA. Role of Occpuational Therapy After Stoke. Annals of Indian Academy of Neurology. 2008.

28. Steultjens EMJ, Dekker J, Bouter LM, van de Nes JCM, Cup EHC, van den Ende CHM. Occupational Therapy for Stroke Patients: A Systematic Review. Journal of the American Heart Association. 2003 February; XXXIV.

29. Higgins J, Salbach NM, Wood-Dauphinee S, Richards CL, Cote R, Mayo NE. The Effect of aTask-Oriented Intervention on Arm Function in People with Stroke: A Randomized Controlled Trial. Clinical Rehabilitation. 2005 September; XX.

30. Kwakkel G, Kollen BJ, van der Grond J, Prevo AJH. Probability of Regaining Dexterity in the Flaccid Upper Limb: Impact of Severity of Paresis and Time Since Onset in Acute Stroke.

Journal of the American Heart Association. 2003 August; XXXIV.

31. Feys HM, De Weerdt WJ, Selz BE, Cox Steck GA, Spichiger R, Vereeck LE, et al. Effect of a Therapeutic Intervention for the Hemiplegic Upper Limb in the Acute Phase After Stroke - A Single-Blind, Randomized, Controlled Multicenter Trial. Journal of the American Heart Association. 1998 April; XXIX.

32. Park HY, Yoo EY, Park JH, Kang DH, Chung BI, Jung MY. Effects of Forced Use Combined with Scheduled Home Exercise Program on Upper Extremity Functioning in Individuals with Hemiparesis. Journal of Neuro Rehabilitation. 2012; XXXi.

33. Hara Y, Ogawa S, Tsujiuchi K, Muraoka Y. A Home-Based Rehabilitation Program for the Hemiplegic Upper Extremity by Power-assisted Functional Electrical Stimulation. Disability and Rehabilitation. 2008; XXX(4).

34. Johansson BB. Brain Plasticity and Stroke Rehabilitation: The Willis Lecture. Journal of the American Heart Association. 2000; XXXI.

35. Kimberley TJ, Samargia S, Moore LG, Shakya JK, Lang CE. Comparison of amounts and types of practice during rehabilitation for traumatic brain injury and stroke. Journal of Rehabilitation Research & Development. 2010; XLVII(9).

36. Kleim JA, Jones TA. Principles of Experince-Dependent Neural Plasticity: Implications for Rehabilitation After Brain Damage. Journal of Speech, Language, and Hearing Research. 2008 February; LI.

37. Bayona NA, Bitensky J, Salter K, Teasell R. The Role of Task-Specific Training in Rehabilitation Therapies. Top Stroke Rehabilitation. 2005; XII(3).

38. von Holdt K, Murphy M. Public Hospitals in South Africa: Stressed Institutions, Disempowered Management. Management of public hospitals in South Africa. 2006 April.

39. Mamabolo MV, Mudzi W, Stewart AS, Olorunju S, Singh A. A Study to Determine Post Discharge Functional Improvements in Patients with Stroke. South African Journal of Occupational Therapy. 2009 May; XXXIX(1).

40. Connor M. Stroke Management in South Africa. South African Psychiatry Review. 2005

November; VIII.

41. Duncan P, Richards L, Wallace D, Stoker J, Pohl P, Luchies C, et al. A Randomized, Controlled Pilot Study of a Home Based Exercise Program for Individuals with Milld and Moderate Stroke. Journal of the American Heart Association. 1998 July; XXIX.

42. Dobkin BH. Rehabilitation After Stroke. The New England Journal of Medicine. 2005 April;(352).

43. Jang SH, Kim YH, Cho SH, Lee JH, Park JW, Kwon YH. Cortical Reorganization Induced by Task-Oriented Training in Chronic Hemiplegic Stroke Patients. Motor Systems Neuro Report. 2002 November; XIV(1).

44. Huang H, Wolf SL, He J. Recent developments in biofeedback for neuromotor rehabilitation. Journal of NeuroEngineering and Rehabilitation. 2006 June; III(11).

45. van Dijk H, Jannink MJA, Hermens HJ. Effect of Augmented Feedback on Motor Function of the Affected Upper Extremity in Rehabilitation Paatients: A Systematic Review of Randomized Controlled Trials. Journal of Rehabilitation and Medicine. 2005;(37).

46. Molier BI, Prange GB, Krabben T, Stienen AHA, van der Kooij H, Buurke JH, et al. Effect of Position Feedback During Task-Oriented Upper-Limb Training After Stroke: Five-Case Pilot Study. Journal of Rehabilitation Research and Development. 2011; XLVIII(9).

47. Barker RN, Brauer SG, Carson RG. Training of Reaching in Stroke Survivors With Severe and Chronic Upper Limb Paresis Using a Novel Nonrobotic Device. A Ranandomized Clinical Trial. Journal of the American Heart Association. 2008 April; XXXIX.

48. Legg L, Drummond A, Leonardi-Bee J, Gladman JRF, Corr S, Donkervoort M, et al. Occupational therapy for patients with problems in personal activities of daily living after stroke: systemic review of randomised trials. British Medical Journal. 2007 November; CCCXXXV.

49. Legg L DALBJCSDMEJea. Occupational Therapy for patients in personal activites of daily living after stroke: systematic review of randomised trials. British Medical Journal. 2007; 335: p. 922-925.

50. Kwakkel G. Impact of intensity of practice after stroke: Issues for consideration. Disability and

Rehabilitation. 2006 July; XXVIII(13).

51. van der Lee J, AK SI, Beckerman H, Lankhorst Gj, Wagenaar RC, Bouter LM. Exercise Therapy for Arm Function in Stroke Patients: A Systematic Review of Ranndomized Controlled Trials. Clinical Rehabilitation. 2001; XV.

52. Ada L, Dean CM, Mackey FH. Increasing the Amount of Physical Activity Undertaken after Stroke. Physical Therapy Reviews. 2006; XI.

53. Chen CY, Strecker Neufeld P, Feely CA, Sugg Skinner C. Factors Influencing Compliance With Home Exercise Programs Among Patients With Upper-Extremity Impairment. The American Journal of Occupational Therapy. 1999 March/April; LIII(2).

54. Solway S, Beaton DE, McConnel S, Bombardier C. The DASH Outcome Measure User's Manual. 2nd ed. Toronto, Ontario: Institute for Work and Health; 2002.

55. Gummesson C, Atroshi I, and Ekdahl C. The Disabilities of the Arm, Shoulder and Hand (DASH) Outcome Questionnaire: Longitudinal Construct Validity and Measuring Self-Rated Health Change After Surgery. BMC Musculoskeletal Disorders. 2003 June; IV(11).

56. Trombly Lathan CA. Optimizing Motor Behaviour Using the Brunnstrom Movement Therapy Approach. In Radomski MV, Trombly Latham CA, editors. Occupational Therapy for Physical Dysfunction. Philadelphia: Wolters Kluwer - Lippincott Williams & Wilkins; 2008. p. 667-689.

57. Salbach NM, Jaglal SB, Komer-Bitensky N, Rappolt S, Davis D. Practitioner and Organizational Barriers to Evidence-based Practice of Physical Therapists for People With Stroke. Physical Therapy. 2007 October; LXXXVII.

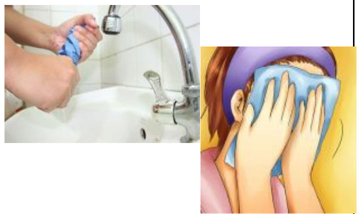
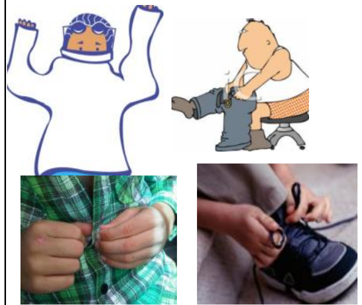
58. Brink H. Fundamentals of research methodology for health care professionals. 2nd ed. Ristic D, editor. Cape Town: Juta & Co. (Pty) Ltd; 2006.

59. Bailey DM. Research for the Health Professional - A Practical Guide. 2nd ed. Philladelphia: F.A. Davis Company; 1997.

Appendix A: Task-Orientated Home Programme

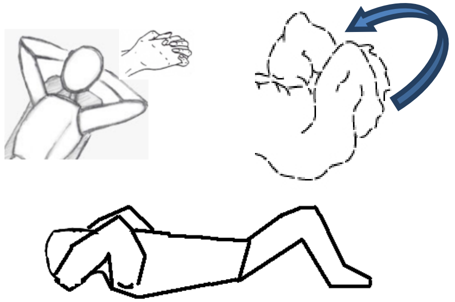
Task-Oriented Home Programme - Using the affected hand during task performance as much as possible!						
Task:	**Description of task:**	**What you are expected to do?**	**Date/s:**	**Signed by patient:**	**Signed by caregiver/ family member:**	**Comments:**
1) Making a sandwich 	Make a sandwich of your choice: E.g. cheese & tomato, pap & sauce, or a peanut butter & jam, ham & egg etc. Try doing this at least twice a week.	Take the bread out of its bag, spread butter on each slice, using a butter knife. Cut/grate/spread ingredients of your sandwich and place them on the bread. Sprinkle some salt and pepper by pinching your fingers.				
2) Unpack groceries from shopping bags 	Unpack the daily groceries from the plastic bags onto a table.	You are expected to take out the groceries from the shopping bags, using the different grasps of your hand. Lift items up from the bag and place on top of table.				
3) Wipe the table clean 	Wipe the table clean after each meal using the affected hand. This should be done as often as possible	While carrying out the task of wiping, try to use as much arm and hand movement as possible, try not to cheat by using bending your abdomen.				

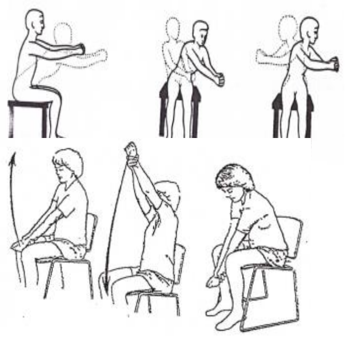
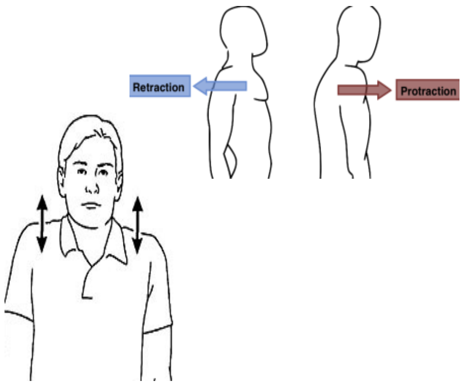
Task:	**Description of task:**	**What you are expected to do?**	**Date/s:**	**Signed by patient:**	**Signed by caregiver/ family member:**	**Comments:**
4) Collect transport money   	Try to collect and count the leftover change in your wallet as well as the rest of your family members.	The main aim of this task is to practice picking up various sizes of coins from the table, without sliding it to the edge of the table, using the tips of your fingers. Then try to stack them up as high as possible, use the various denominations of coins for each stack.				
5) Hanging up the washing 	Hang up the washing as often as u can during the week.	The aim of this task is the make your shoulders stronger by reaching up high in order to hang the washing. Use washing pegs to secure the washing on the washing line, thus practicing and strengthening your pinches.				
6) Make an elastic ball by stretching them over socks/dishcloths  	Making an elastic band ball. Use 5 elastic bands each day. Practice this everyday in order to make BIG elastic ball.	The purpose of this task is to strengthen your finger muscles. This will be done by stretching each elastic band by pulling your fingers apart and placing it over a ball of socks/dishcloths.				

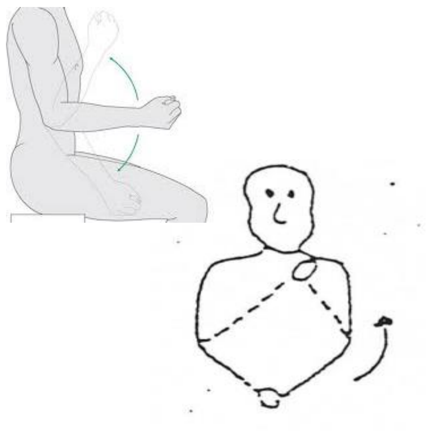
Task:	**Description of task:**	**What you are expected to do?**	**Date/s:**	**Signed by patient:**	**Signed by caregiver/ family member:**	**Comments:**
7) Brushing your own hair 	Brush your hair every day after you get ready in the morning.	When carrying out this task, try holding the comb using your affected hand and let you good arm help if needed. Remember to also comb the back of your head as well as both the sides.				
8) Wash yourself daily using a facecloth 	When washing oneself daily, practice using the affected hand. This should include wetting the facecloth, applying the soap to the cloth, squeezing and wiping the whole body etc.	The aim of this task is to strengthen the muscles of you arm, hand and fingers. The task can to be continued by applying lotion, roll-on, vaseline etc.				
9) Dress yourself daily 	After bathing and before going to bed, practice dressing. This should include putting on and taking off your clothes as well as putting on shoes, shoelaces, buttons and zips.	The aim of this is work on your balance in various positions, as well as to strength different aspects of your arm and hand. This will also help improve you bilateral co-ordination and in-hand manipulation of objects.				

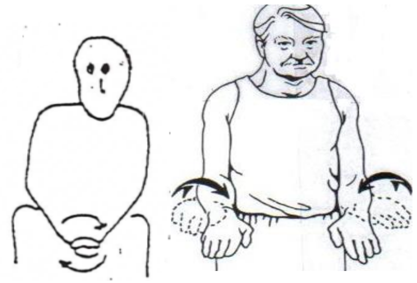
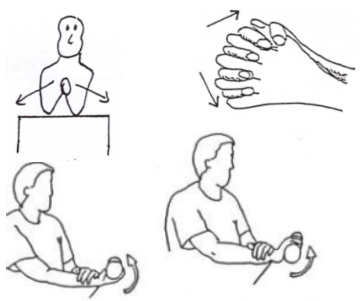
Task:	**Description of task:**	**What you are expected to do?**	**Date/s:**	**Signed by patient:**	**Signed by caregiver/ family member:**	**Comments:**
10) Wash the windows  	This can be done once week. This task should include squeezing the sponge, applying polish etc.	The aim of this task is to make your shoulders movements stronger by reaching up and down etc. This will also improve you balance.				
11) Watering the garden  	This can be done once week and should involve fetching and pouring the water. Use an empty 2Lt milk bottle, if a watering can is unavailable.	This task will make you arms stronger by carrying the amount and accurately trying you water the plants in your home or garden.				
12) Make your bed 	This must be done daily, after waking up and before going to bed.	The task will help you with improving your balance as well as aspects of hand functioning.				

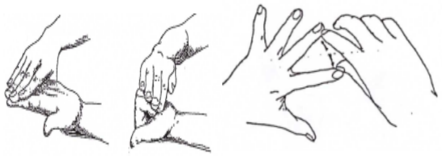
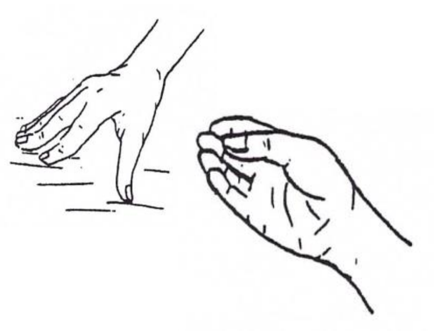
Appendix B: Traditional Exercise Home Programme

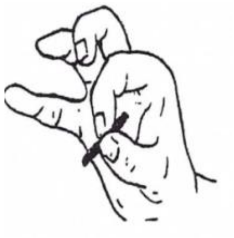
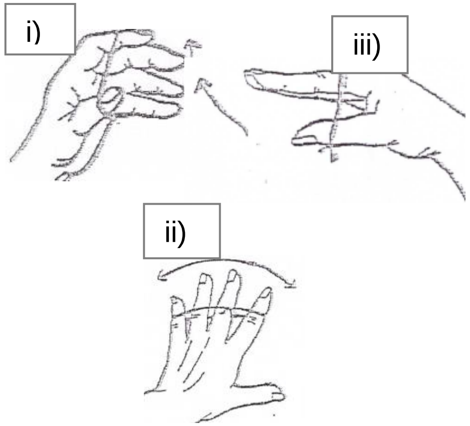
Traditional Exercise Home Programme - Using the affected hand during task performance as much as possible!						
Type of exercise:	**What you are expected to do?**	**Description of exercise:**	**Date/s:**	**Signed by patient:**	**Signed by caregiver/ family member:**	**Comments:**
Supine exercises: Lying on your back						
1) Shoulder flexion & extension 	Repeat 30 times, but rest between each 10. Do these exercises slowly.	Hold your hands together. Lift the arms up & down (to the back of your head & back to your abdomen).Straighten the elbow of the affected side & try to improve this every day. Try not to bend your elbows while doing the exercise. You can lie in bed or sit in a chair while doing this exercise.				
2) Opening and closing axilla (armpit) area with hands behind the head 	Repeat 20 times, but rest between each 10. Do these exercises slowly.	Hold your hands together and place them behind your head. Squeeze your face by bringing your arms up &then relax them by touching the pillow/bed again with your elbows.				

Type of exercise:	**What you are expected to do?**	**Description of exercise:**	**Date/s:**	**Signed by patient:**	**Signed by caregiver/ family member:**	**Comments:**
Exercises in a sitting position:						
3) Shoulder & trunk extension and flexion 	Repeat each 15 times, but rest in-between each different position 10. Do these exercises slowly.	Clasp your hands together as described above and raise your arms with the elbows straight. Move your arms slowly from side to side (right to left), & up & down. Also holding your arms straight, turn and bend your waist to touch the floor, in-between your legs.				
4) Shoulder elevation & depression, protraction & retraction 	Repeat each exercise position 20 times. Rest in -between each different exercise position	Place your arms down on either side, raise your shoulders up to your ears & back down. Hold up on each tenth count for 10 seconds. Thereafter keep your arms down, but bring your shoulders towards the chest & go back.				

Type of exercise:	What you are expected to do?	Description of exercise:	Date/s:	Signed by patient:	Signed by caregiver/ family member:	Comments:
5) Shoulder abduction, adduction, trunk rotation & weight shift 	Repeat 20 times, but rest between each 10.	Resting the affected arm on top of the strong arm, rock from side to side (like rocking a baby in your arms). Lift buttocks off the chair/bed, while shifting weight from side to side & rotating the waist.				
6) Elbow extension & flexion 	Repeat 10 times, in each direction. Rest between each 10.	With the hands clasped together, straighten elbows and allow the back of right hand to touch your right knee, then twist wrists and forearms, and raise arms to the left shoulder. Repeat with the left hand to right knee and right shoulder.				

Type of exercise:	**What you are expected to do?**	**Description of exercise:**	**Date/s:**	**Signed by patient:**	**Signed by caregiver/ family member:**	**Comments:**
7) Forearm pronation & supination 	Repeat 20 times, but rest between each 10.	Lean forward and rest forearms on knees or a table, while keeping weight over the weaker side. Clasp hands together & alternate rotating wrists. This exercise can also be done separately with each arm if possible.				
Exercises of the hand at a table:						
8) Wrist extension & flexion 	Repeat 10 times, in each direction. Rest between each 10.	Place elbows on a table in front of you and clasps your hands together. Move the wrists by pushing the hands from side to side as well as pushing your hands away & towards you. You can also strengthen the weak wrist, by placing a soft object like a sponge inside your hand, place your hand over the edge of the table & lift object up & down (first facing you & then facing the floor).				

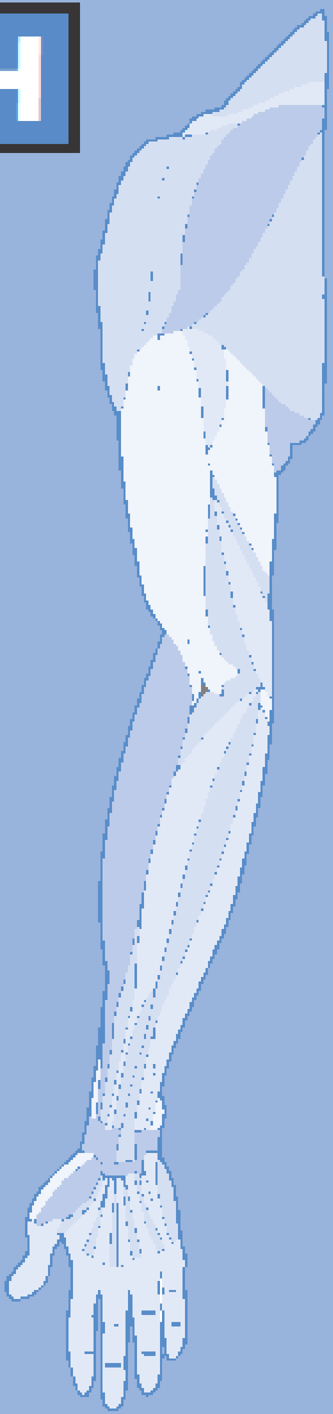
Type of exercise:	**What you are expected to do?**	**Description of exercise:**	**Date/s:**	**Signed by patient:**	**Signed by caregiver/ family member:**	**Comments:**
9) Finger flexion & extension. Finger abduction& adduction 	Repeat 10 times, in each direction. Rest between each 10.	Place the affected hand on top of a table, with the palm facing up. Bend your fingers to make a fist. Then, straighten the finger. First try to let your weak hand do it by itself, if you struggle, allow the other hand to help. Thereafter spread the fingers apart, and then bring them back into its normal position.				
10) MP (knuckles) extension & flexion & opposition of the thumb 	Repeat each exercise 10 times.	Place hand on table and lift finger ups until they are all together in a group & then straighten them up again until the palm is flat against the table again. Thereafter allow each finger to touch the thumb.				

Type of exercise:	**What you are expected to do?**	**Description of exercise:**	**Date/s:**	**Signed by patient:**	**Signed by caregiver/ family member:**	**Comments:**
11) Isolated finger movements & strengthening of pinches 	Repeat 10 times with each finger	Roll a pen between each finger & thumb. Repeat this with each finger.				
12) Elastic band finger strengthening exercises 	Repeat each of these elastic band exercises 10 times with the affected hand	Put the elastic band around the tips of all fingers & thumb of the affected hand. Straighten & spread the fingers & thumb, then relax the hand. Place the elastic band around the four fingers & pull the fingers wide apart, then relax the hand. Put the elastic band around all four of the fingers &thumb. Straighten the fingers (keeping them together) & then move them away from the thumb, then relax the hand.				

Appendix C: The DASH

DISABILITIES OF THE ARM, SHOULDER AND HAND

THE DASH



INSTRUCTIONS

This questionnaire asks about your symptoms as well as your ability to perform certain activities.

Please answer *every question*, based on your condition in the last week, by circling the appropriate number.

If you did not have the opportunity to perform an activity in the past week, please make your *best estimate* on which response would be the most accurate.

It doesn't matter which hand or arm you use to perform the activity; please answer based on your ability regardless of how you perform the task.

Disabilities of the Arm, Shoulder and Hand

Please rate your ability to do the following activities in the last week by circling the number below the appropriate response.

	NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	UNABLE
1. Open a tight or new jar.	1	2	3	4	5
2. Write.	1	2	3	4	5
3. Turn a key.	1	2	3	4	5
4. Prepare a meal.	1	2	3	4	5
5. Push open a heavy door.	1	2	3	4	5
6. Place an object on a shelf above your head.	1	2	3	4	5
7. Do heavy household chores (e.g., wash walls, wash floors).	1	2	3	4	5
8. Garden or do yard work.	1	2	3	4	5
9. Make a bed.	1	2	3	4	5
10. Carry a shopping bag or briefcase.	1	2	3	4	5
11. Carry a heavy object (over 10 lbs).	1	2	3	4	5
12. Change a lightbulb overhead.	1	2	3	4	5
13. Wash or blow dry your hair.	1	2	3	4	5
14. Wash your back.	1	2	3	4	5
15. Put on a pullover sweater.	1	2	3	4	5
16. Use a knife to cut food.	1	2	3	4	5
17. Recreational activities which require little effort (e.g., cardplaying, knitting, etc.).	1	2	3	4	5
18. Recreational activities in which you take some force or impact through your arm, shoulder or hand (e.g., golf, hammering, tennis, etc.).	1	2	3	4	5
19. Recreational activities in which you move your arm freely (e.g., playing frisbee, badminton, etc.).	1	2	3	4	5
20. Manage transportation needs (getting from one place to another).	1	2	3	4	5
21. Sexual activities.	1	2	3	4	5

Disabilities of the Arm, Shoulder and Hand

	NOT AT ALL	SLIGHTLY	MODERATELY	QUITE A BIT	EXTREMELY
22. During the past week, *to what extent* has your arm, shoulder or hand problem interfered with your normal social activities with family, friends, neighbours or groups? *(circle number)*	1	2	3	4	5

	NOT LIMITED AT ALL	SLIGHTLY LIMITED	MODERATELY LIMITED	VERY LIMITED	UNABLE
23. During the past week, were you limited in your work or other regular daily activities as a result of your arm, shoulder or hand problem? *(circle number)*	1	2	3	4	5

Please rate the severity of the following symptoms in the last week. *(circle number)*

	NONE	MILD	MODERATE	SEVERE	EXTREME
24. Arm, shoulder or hand pain.	1	2	3	4	5
25. Arm, shoulder or hand pain when you performed any specific activity.	1	2	3	4	5
26. Tingling (pins and needles) in your arm, shoulder or hand.	1	2	3	4	5
27. Weakness in your arm, shoulder or hand.	1	2	3	4	5
28. Stiffness in your arm, shoulder or hand.	1	2	3	4	5

	NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	SO MUCH DIFFICULTY THAT I CAN'T SLEEP
29. During the past week, how much difficulty have you had sleeping because of the pain in your arm, shoulder or hand? *(circle number)*	1	2	3	4	5

	STRONGLY DISAGREE	DISAGREE	NEITHER AGREE NOR DISAGREE	AGREE	STRONGLY AGREE
30. I feel less capable, less confident or less useful because of my arm, shoulder or hand problem. *(circle number)*	1	2	3	4	5

DASH DISABILITY/SYMPTOM SCORE = $\left[\left(\frac{\text{sum of n responses}}{n}\right) - 1\right] \times 25$, where n is equal to the number of completed responses.

A DASH score may <u>not</u> be calculated if there are greater than 3 missing items.

DISABILITIES OF THE ARM, SHOULDER AND HAND

WORK MODULE (OPTIONAL)

The following questions ask about the impact of your arm, shoulder or hand problem on your ability to work (including home-making if that is your main work role).

Please indicate what your job/work is:______________________________

❒ I do not work. (You may skip this section.)

Please circle the number that best describes your physical ability in the past week. Did you have any difficulty:

		NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	UNABLE
1.	using your usual technique for your work?	1	2	3	4	5
2.	doing your usual work because of arm, shoulder or hand pain?	1	2	3	4	5
3.	doing your work as well as you would like?	1	2	3	4	5
4.	spending your usual amount of time doing your work?	1	2	3	4	5

SPORTS/PERFORMING ARTS MODULE (OPTIONAL)

The following questions relate to the impact of your arm, shoulder or hand problem on playing *your musical instrument or sport or both*. If you play more than one sport or instrument (or play both), please answer with respect to that activity which is most important to you.

Please indicate the sport or instrument which is most important to you:________________________

❑ I do not play a sport or an instrument. (You may skip this section.)

Please circle the number that best describes your physical ability in the past week. Did you have any difficulty:

		NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	UNABLE
1.	using your usual technique for playing your instrument or sport?	1	2	3	4	5
2.	playing your musical instrument or sport because of arm, shoulder or hand pain?	1	2	3	4	5
3.	playing your musical instrument or sport as well as you would like?	1	2	3	4	5
4.	spending your usual amount of time practising or playing your instrument or sport?	1	2	3	4	5

SCORING THE OPTIONAL MODULES: Add up assigned values for each response; divide by 4 (number of items); subtract 1; multiply by 25.
An optional module score may not be calculated if there are any missing items.

Institute for Work & Health | Research Excellence Advancing Employee Health

Appendix D: Ethical Clearance Certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG
Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Miss Bhavika H Chhania

CLEARANCE CERTIFICATE	**M120713**
PROJECT	Upper Limb Function Home Programmes in Stroke Survivors
INVESTIGATORS	Miss Bhavika H Chhania.
DEPARTMENT	Department of Occupational Therapy
DATE CONSIDERED	27/07/2012
DECISION OF THE COMMITTEE*	Approved unconditionally

Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.

DATE 24/08/2012 **CHAIRPERSON** ....
(Professor PE Cleaton-Jones)

*Guidelines for written 'informed consent' attached where applicable
cc: Supervisor : Mrs J Freeme

DECLARATION OF INVESTIGATOR(S)
To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES...

Appendix E: Permission letter

Occupational Therapy

School of Therapeutic Sciences • Faculty of Health Sciences • 7 York Road, Parktown 2192, South Africa
Tel: +27 11 717-3701 • Fax: +27 11 717-3709 • E-mail: denise.franzsen@wits.ac.za

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

8 January 2013

Dr. George Mukhari Academic Hospital (DGMAH)
3111 Setlogelo Street
Ga-Rankuwa, 0208

To whom it may concern

RE: Permission to carry out research study on post stroke survivors as the partial fulfillment of the requirements for the degree in Masters of Science in Occupational Therapy

My name is Bhavika Harrilal Chhania. I am currently a registered student for the M.Sc. (O.T) course at the University of the Witwatersrand. The title of my research is: "Comparing the effectiveness of two occupational therapy stroke upper limb home programmes".

I would therefore appreciate it if you would please grant me permission to conduct my research study on post stroke survivors, whom receive treatment at DGMAH, The purpose of the study is to compare the two home programmes on the functional recovery of the affected upper limb in stroke patients, so that therapists can treat patients more effectively in the future.

This clinical trial protocol has submitted to the Faculty of Health Sciences Research Ethics Committee of the University of the Witwatersrand and written approval has been granted by the committee.

Yours Sincerely

____

Bhavika Chhania
Student number: 0400598K
Tel: (012) 5213264

THERAPEUTIC Sciences

Appendix F: Letter of permission from Dr. George Mukhari Academic Hospital

DR. GEORGE MUKHARI ACADEMIC HOSPITAL

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

Enquiries: Dr. P Shembe

Director: Clinical Services

Tel no: (012) 529 3687

Fax no: (012) 560 0099

To: Ms. Bhavika Harrilal Chhania

Department of Occupational Therapy

Dr. George Mukhari Academic Hospital

Date: 20 January 2013

RE: PERMISSION TO CONDUCT RESEARCH

The Dr. George Mukhari Academic Hospital hereby grants you permission to conduct research on "Comparing the effectiveness of two occupational therapy stroke upper limb home programmes".

We note that you have already obtained ethical clearance from the Human Research Ethics Committee

This permission is granted subject to the following conditions:

That the hospital incurs no cost in the course of your research

That access to the staff and patients at the Dr. George Mukhari Academic Hospital will not interrupt the daily provision of services

That prior to conducting the research you will liaise with the supervisors of the relevant sections to introduce yourself (with this letter) and to make arrangements with them in a manner that is convenient to the section

Yours sincerely

DR. P SHEMBE
ACTING DIRECTOR: CLINICAL SERVICES

Appendix G: Information Sheet

PARTICIPANT'S INFORMATION LEALETS AND INFORMED CONSENT FORM FOR CLINICAL TRIAL/INTERVENTION RESEARCH

Dear participant,

My name is Bhavika Harrilal Chhania. I am currently a registered student for the M.Sc. (O.T) course at the University of the Witwatersrand. The title of my research is: "Comparing the effectiveness of two occupational therapy stroke upper limb home programmes".

INTRODUCTION:

You are invited to volunteer for a research study. This information leaflet is to help you decide if you would like to participate. Before you agree to take part in this study you should fully understand what is involved. If you have any questions, which are not fully explained in this leaflet, do not hesitate to ask the therapist conducting the research study. The occupational therapy department will be notifying your personal doctor that you are a participant in the study.

WHAT IS THE PURPOSE OF THIS TRIAL?

You have been diagnosed as suffering from a stroke and the therapist would like you to consider taking part in a research study comparing two different home programme interventions used by occupational therapists. One method is called the traditional home exercise programme and the other is a task-orientated home programme.

The purpose of the study is to compare the two home programmes on the functional recovery of the affected upper limb in stroke patients, so that therapists can treat patients more effectively in the future.

People who are chosen to take part in the study are patients that are admitted here at Dr. George Mukhari Academic Hospital who have suffered a stroke. During the study you will receive one of the programmes described earlier.

WHAT IS THE DURATION OF THIS TRIAL?

If you decide to take part in this study, you will be one of approximately 50 patients. The study will last for up to three months. After you have been discharged, you will be requested to attend occupational therapy every 2-3 weeks for approximately three months.

EXPLANATION OF PROCEDURES TO BE FOLLOWED

This study involves answering a questionnaire of how well you are able to use your affected upper limb in order to do everyday activities such as bathing, dressing etc. The occupational therapy technician will assist and guide you with the questions on the questionnaire that you must answer by yourself on discharge and thereafter 2-4 weeks upon follow-up as an outpatient. The questionnaire will take approximately half an hour to complete each time.

HAS THE TRIAL RECEIVED ETHICAL APPROVAL?

This clinical trial protocol has been submitted to the Faculty of Health Sciences Research Ethics Committee of the University of the Witwatersrand and written approval has been granted by the committee. The study has been structured in accordance with Declaration of Helsinki (last updated: October 2000), which deals with the recommendations guiding doctors and other health professionals in biomedical research involving human subjects. A copy of the declaration may be obtained from the therapist should you wish to review it.

WHAT ARE YOUR RIGHTS AS A PARTICIPANT IN THIS TRIAL?

Your participation in this trial is entirely voluntary and you can refuse to participate or stop at any time without stating any reason. Your withdrawal will not affect your access to other medical care. The investigator retains the right to withdraw you from the study if it is considered to be in your best interest. However, the study is focused on improving your ability to do everyday activities more independently, thus to discontinue may have an impact on your ability to do activities of daily living. If it is detected that you did not give an accurate history or did not follow the guidelines of the trial and the regulations of the trial facility, you may be withdrawn from the trial at any time.

SOURCE OF ADDITIONAL INFORMATION

For the duration of the trial, you will be under the care of Ms. Bhavika Chhania. If at any time between your visits you feel that any of your symptoms are causing you any problems, or you have any questions during the trial, please do not hesitate to contact her. The telephone number is (012) 521 3264, through which you can reach her or any another authorized person.

CONFIDENTIALITY

All information obtained during the course of this trial is strictly confidential. Data that may be reported in scientific journals will not include any information which identifies you as a patient in this trial. Any information uncovered regarding your test results or state of health as a result of your participation in this trial will be held in strict confidence. You will be informed of any finding of importance to your health or continued participation in this trial but this information will not be disclosed to any third party in addition to the ones mentioned above without your written permission. The only exception to this rule will be cases in which law exists compelling us to report individuals infected with communicable diseases. In this case, you will be informed of our intent to disclose such information to the authorized state agency.

Thank you in advance for your participation,

Yours sincerely,

____

Bhavika Harrilal Chhania
Occupational Therapist
Dr. George Mukhari Academic Hospital
(012) 521 3264

Appendix H: Informed Consent

I hereby confirm that I have been informed by the investigator, Ms Bhavika Harrilal Chhania about the nature, conduct, benefits and risks of the clinical trial **"Comparing the effectiveness of two occupational therapy stroke upper limb home programmes"** I have also received, read and understood the above written information (Patient information Leaflet and Informed Consent) regarding the clinical trial.

I am aware that the results of the trial, including personal details regarding my sex, age, date of birth, initials and diagnosis will be anonymously processed into a trial report.

I may, at any stage, without prejudice, withdraw my consent and participation n the trial. I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the trial.

Participant's name: ____ (please print)

Participant's signature: ____________________ Date: ____________________

I, Bhavika Harrilal Chhania herewith confirm that the above mentioned patient has been informed fully about the nature, conduct and risks of the above trial.

Investigator's name: ____ (please print)

Investigator's signature: ______________________ Date: ____________________

Witness's name: ____ (please print)

Witness's signature: ________________________ Date: ____________________

* Consent procedure should be witnessed whenever possible.

VERBAL PATIENT INFORMED CONSENT (applicable when patients cannot read or write)

I, the undersigned, Bhavika Harrilal Chhania, have read and explained fully to the patient and/or his/her relative, the patient information leaflet which has indicated the nature and purpose of the trial in which I have asked the patient to participate. The explanation I have given has mentioned both the possible risks and benefits of the trial and the alternative treatments available for his/her illness. The patient indicated that he/she understands that he/she will be free to withdraw from the trial at any time for any reason and without jeopardizing his/her subsequent injury attributable to the treatment used in the clinical trial, to which he/she agrees.

I hereby certify that the patient has agreed to participate in this trial.

Patient's name: __________________________ (please print) Date: ____________________

Investigator's name: ____ (please print)

Investigator's signature: ________________________ Date: _____________________

Witness's name: ____ (please print)

Witness's signature: __________________________ Date: _____________________

(Witness – sign that he/she has witnessed the process of informed consent)

Appendix I: Demographic Information Sheet

DEMOGRAPHICS OF RESEARCH STUDY												
	Name of the patient:	Sex	Age	Date of admission	Affected side post CVA	Hand Dominance	Date of admission	Date of discharge	Date of follow-up	Type of Home Programme	DASH Score (Pre-test)	DASH Score (Post-test)
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												

Appendix J: Occupational Therapy Technician Data Collection Participant Code Sheet

PRE-TEST			POST-TEST		
Date of discharge	Patient Code	Name of patient	Date of follow- up	Patient Code	Name of patient
	1A			1B	
	2A			2B	
	3A			3B	
	4A			4B	
	5A			5B	
	6A			6B	
	7A			7B	
	8A			8B	
	9A			9B	
	10A			10B	
	11A			11B	
	12A			12B	
	13A			13B	
	14A			14B	
	15A			15B	
	16A			16B	
	17A			17B	
	18A			18B	
	19A			19B	
	20A			20B	
	21A			21B	
	22A			22B	
	23A			23B	
	24A			24B	
	25A			25B	
	26A			26B	
	27A			27B	
	28A			28B	