CHILDREN WITH CEREBRAL PALSY LIVING IN A RESOURCE CONSTRAINED COMMUNITY: THE EFFICACY OF A THUMB OPPONENS SPLINT – A CASE STUDY

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Declaration

I, **Michelle Lachenicht**, declare that this research report is my own work. It is being submitted for the degree of Masters of Science in Occupational Therapy at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other university.

(Signature of candidate)

On this 12th day of June 2018 at the University of the Witwatersrand

Abstract

Cerebral Palsy is a common diagnosis in childhood and is often associated with upper limb impairments affecting hand function and participation in daily activities including personal management. A case study based research design was used with a sample of five children with spastic hemiplegic CP at Tambo Memorial Hospital to evaluate the efficacy of a thumb abductor splint for thumb in palm deformity in a resource constrained environment. The children involved in the study continued to receive their typical monthly occupational therapy service as well as any other therapy services they were involved in the time of the study. They were all splinted with a soft neoprene thumb abductor splint which they were advised to wear during participation in functional activities. A range of outcome measures were used to assess their hand function and functional performance before and after splint application over the three month data collection period including the Movement ABC and the Pediatric Evaluation of Disability Impairment scale. In spite of the small sample size and the limited clinically significant findings of the study - a potential benefit to wearing the splint during functional activity participation was highlighted in a resource constrained environment.

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Table of Contents

List of Figures

List of Tables

Definition of Terms

Cerebral Palsy - a group of disorders characterized by poor development of movement and postural patterns which causes limitations in activity participation, often accompanied by impairments in sensory abilities, cognition, communication, perception as well as seizure disorders (Bax, et al., 2005).

Client factors – “Values, beliefs and spirituality, body functions and body structures which reside within the client that influence the client’s performance in occupations” (American Association of Occupational Therapy, 2014).

Hand function - the ability of an individual to handle and manipulate objects in one or both of their hands. This includes: grasp and pinch formation, release, in-hand manipulation and bilateral manipulation (Arner, et al., 2008).

Home programme - “therapeutic activities that the child performs with parental assistance in the home environment with the goal of achieving desired health outcomes” (Novak & Cusick, 2006).

Occupational performance - **“**The ability to perceive, desire, recall, plan and carry out roles, routines, tasks and sub-tasks for the purpose of self-maintenance, productivity, leisure and rest in response to demands of the internal and/or external environment” (Ranka & Chapparo, 1997).

Opponens splint - In this study the opponens splint is a soft splint made from a neoprene material made specifically with the intention of maintaining the thumb in a position allowing for opposition to facilitate formation of grasps and pinches.

Performance Skills – “observable elements of action that have an implicit functional purpose. Skills are considered a classification of actions, encompassing multiple capacities (body functions and structures) and, when combined, underlie the ability to participate in desired occupations and activities” (American Association of Occupational Therapy, 2014).

Resource constrained community – for this study refers to limitations notable as a result of lack of access to basic resources which are necessary for engagement in daily activities and therapy programmes. The communities observed in this study had limited access to basic resources such as water and electricity within their homes as well as limitations from hospital which included staffing and materials for treatment.

Abbreviations

CP	Cerebral Palsy
GMFCS	Gross Motor Functioning Classification System
MACS	Manual Ability Classification System
TMC	Trapezio-metacarpal
TMH	Tambo Memorial Hospital

CHAPTER 1 INTRODUCTION

1.1 Introduction

Cerebral Palsy (CP) is considered the most common cause of severe disability amongst children (Rogers, 2010) with the incidence in developing countries approximated at two children per 1000 live births (National Association of Cerebral Palsy, 2013). The condition is defined as a group of disorders characterized by poor development of movement and postural patterns which cause limitations in activity participation. Damage to the developing brain in utero, at birth or within the first two years of life is recognised as the aetiology of CP which is characterised by movement dysfunction, often accompanied by impairments in sensory abilities, cognition, communication, perception as well as seizure disorders (Bax, et al., 2005). Common movement dysfunction in children who are diagnosed with CP include hypertonicity, spasticity and rigidity of affected muscles; muscle weakness, ataxia and poor selective control of movement (Koman, et al., 2004). This affects the development of upper limb skill in up to 80% of these children which significantly alters the level of functional independence possible (Burtner, et al., 2008) (Jackman, et al., 2014).

Hand function, in particular, is often severely affected as a result of hypertonicity, with children typically presenting with wrist flexion and thumb adduction (also known as thumb in palm deformity) (Wilton, 2003). Movement of the trapezio-metacarpal (TMC) joint in particular is significantly affected (Kuo, et al., 2009) which results in impaired formation of grasps and pinches (Pons, et al., 2004). Impaired grasp and pinch formation has a negative impact on the child's ability to develop appropriate hand function or skills usually used within functional activity to achieve independence. Due to the impact hand function has on functional activity engagement, in children with the thumb in palm deformity, occupational therapy interventions have a central focus on addressing this deformity to improve hand function (Exner & Bonder, 1983).

It has been noted that there is positive research evidence that soft neoprene splints have the potential to reduce and prevent thumb in palm deformity (Wilton, 2003). Research in this field has considered body structure and function such as range of movement as well as performance factors assessed by upper limb function. In a systematic evaluation on the use of thumb opponens splints for children with CP, Ten Berge et al. in 2012 also indicated that this splint may have a positive effect when outcomes are measured in relation to hand function and goals are set for functional performance for personal management. They found that some children receiving outpatient therapy once a week, benefited from the splint when it was worn while others continued to benefit even when the splint was removed (Ten Berge, et al., 2012). However, their research was limited to children with hemiplegia and thumb opponens splints are a commonly used occupational therapy treatment technique with children with other types of CP with only moderate research evidence to support the efficacy of this modality (Jackman, et al., 2013).

As a result, therapists are also reliant on clinical experience and opinion to guide their use of splints within this population (Imms, 2011) (Burtner, et al., 2008) (Jackman, et al., 2014). This is true in the public health care sector in South Africa where the treatment offered for children with Cerebral Palsy may be constrained by a number of factors which could impact on the use of splinting with this population.

A case study was used to gain an in depth understanding of the factors related to the splinting intervention using thumb opponens splints offered to children with CP from a resource constrained community, within the specific boundaries of one regional hospital site in Gauteng. Case study research provided a methodology that allowed for an occupational therapy intervention to be studied and described for a specific context (Yin, 2011) as this research design can be used to study a small number of research participants (Salminen, et al., 2006). This was the situation in the occupational therapy service offered at the regional hospital in a resource constrained area where there was a limited opportunity to use splinting with children with CP who attend monthly therapy sessions as outpatients.

1.1.1 Current situation at the regional hospital site

The Occupational Therapy Department at Tambo Memorial Hospital (TMH) currently employs 10 occupational therapists who service approximately 500 inpatients. They also offer outpatient services to both paediatric and adult patients. One therapist is dedicated to service provision for paediatric outpatients – which was the sample of focus for this study. A second therapist is available for assistance in the weekly CP clinic.

A wide range of children with CP are seen in the Occupational Therapy Department at TMH. Approximately 80% of children present with spastic CP, while approximately 15% having dyskinetic CP and the rest present as ataxic or hypotonic in nature.

Approximately 110 individual therapy slots are available for booking for the paediatric therapist in one month. These sessions are usually booked for approximately 70 children each month, allowing space for some children to be seen more than once a month, if possible. On average 25 children with CP are seen on an individual basis each month by the paediatric therapist and an average of an additional 32 children are seen within the Cerebral Palsy clinic each month.

Often it is not possible for caregivers to bring the child with CP for more than one appointment with therapy services a month, usually due to financial constraints. This is due to transport to and from the hospital (particularly if their child is in a buggy) being difficult and expensive to arrange. Also due to the high care requirements for these children, and the lack of support services within environments (crèche/day care/school), primary caregivers are usually unable to work and consequently a majority of the caregivers rely on financial support from social grants which provide very limited income.

Typically children are referred between the ages of 6 months to 5 years as the therapy services at the hospital focus on early childhood development. This depends on the health care services they have had access to. Some older children (over the age of 5) would be referred through either the community clinic pathway or via the department of education as appropriate.

Children with Cerebral Palsy are typically seen in the department from the date of referral until either:

- The child begins to attend a school where they can receive therapy on a regular basis within their school environment. This occurs in limited cases due to the severely restricted access to schools for children with disabilities in the area that the hospital services.

- The child is deemed functionally fit for discharge from occupational therapy. This would mean that the child was performing to an age appropriate functional standard and was no longer considered developmentally delayed in their functional activity performance.
- The caregivers request a transfer of therapy services to another hospital or community clinic closer to their home to allow for easier access of services.

Individual therapy is offered to children with Cerebral Palsy on Gross Motor Function Classification System levels I – III (see page 23 for further details). This service is typically offered on a bimonthly basis with the children being seen for approximately 45 minutes every two weeks if possible, depending on the therapists' and caregivers' capacity and circumstances. Individual therapy may be provided solely by the occupational therapist or may be provided in a joint occupational therapy and speech therapy session when deemed appropriate. The individual sessions are based on the child's individual needs and goals and may include gross motor treatment, fine motor treatment, a perceptual element followed through with a focus on functional activity participation.

As a result of limited resources, many children are only seen once on a monthly basis – resulting in a single 45 minute session monthly. Consequently this results in a focus, in the therapy session, on home programmes and techniques and activities which the caregivers are encouraged to try at home to maximise carryover into the home environment and maximise the effect of therapy as a result.

A Cerebral Palsy clinic is also held in the department on a weekly basis. This clinic caters for children with more severe Cerebral Palsy and the children seen in this clinic typically present on GMFCS levels IV – V. In this clinic all members of the MDT are present (physiotherapy, speech therapy, occupational therapy and dieticians). The child is seen first by physiotherapy where the focus of treatment is on positioning and physical exercises which are encouraged to be completed in the home environment. The child will then be seen by occupational therapy and speech therapy in a joint session primarily focusing on play, communication and feeding as well as any other activities of daily living which are of primary concern for the caregivers. Elements of positioning for functional activity participation are practised with the caregivers. The caregiver is encouraged to be an active participant in the session – handling and positioning and interacting with the child with guidance from the therapists where appropriate. The child and caregiver will then consult the dietician if required for monitoring in terms of weight and supplementation where appropriate.

Seating and positioning equipment as well as mobility aids are commonly prescribed. Children are assessed for their positioning and mobility needs by an occupational therapist in conjunction with the physiotherapist and the caregiver. An order for the equipment is placed and when it arrives in the department – the caregiver is contacted and an appointment for fitting and issuing of the device is made when possible with the caregiver. Extended waiting times ranging from 1 - 6 months between ordering and issuing of devices is not uncommon in this setting. Along with seating and positioning equipment, children are currently splinted, if deemed appropriate, through a process of clinical reasoning employed by the therapists involved in the child's care. Splints frequently made include thermoplastic overnight anti-spasticity or cone splints for the child's hands. The splints are issued to aid with prevention of contracture formation and to facilitate hand hygiene.

A small number of children present with a thumb in palm deformity, which can be splinted using a thumb opponens abductor splint to maximise hand function. Factors affecting a child's appropriateness for use of this specific splint include the child's physical capacity to use their hands functionally based on the movement in their upper limbs, the child's tolerance for splints on their hands, the child's cognitive function and ability to follow instructions as well as the caregiver's insight into the application of splinting and the use of a home programme to support this intervention. Of the approximately 60 children with CP treated in the hospital per month over a five month period, only five children were deemed appropriate to include in this research project.

1.2 Statement of the Problem

Research indicates that ideally children with Cerebral Palsy should be seen on a daily or weekly basis if splinting programmes are to be implemented successfully to improve personal management (Ten Berge, et al., 2012). In a review of the therapy needs of the children attending TMH, splinting is not seen as a priority and can only be implemented on a monthly and home programme basis. Thus there may be limited opportunity to use splinting with children with Cerebral Palsy who attend outpatient therapy at a regional hospital in a resource constrained area in Gauteng. However, a previous study had indicated that the use of soft neoprene splints for in palm thumb deformity could be successful in this type of setting in South Africa. The outcomes measured in this study were upper limb function and compliance with a splinting programme (Hughes, 2013) which showed that compliance to the home programme prescribed by therapists as well as average time wearing the splint each day are important in determining the success of the splinting programme (Novak, et al., 2013). However, this research did not address the personal management outcomes and goals in relation to intervention. Therefore, is not known if using splinting as a treatment modality would be effective, given the environmental context of the children receiving therapy at a regional hospital, in terms of performance in personal management as well as client factors and performance skills related to hand function. This, as well as the therapist's ability to adapt splinting to the child's and caregiver's goals for the child (Ten Berge, et al., 2012), may be important if the intervention is to be successful and compliance with home programmes splint wearing are to be improved (Novak, et al., 2013).

1.3 Purpose of the study

The purpose of the study was to use a case study design to evaluate the factors affecting a splinting intervention programme using the thumb opponens splint, made from soft neoprene material, with children with CP, attending occupational therapy as outpatients at TMH. The outcomes of splinting, in terms of the child's body function as well as their performance skills (hand function) and participation in activities of daily living (personal management), were assessed. The study also determined the effects of the programme from the caregivers' and the therapist's perspective in terms of the feasibility related to factors affecting the implementation of the programme within this context.

1.4 Research Question

What are the factors affecting the effectiveness of a splinting intervention programme using the thumb opponens splint offered for children with CP from a resource constrained community attending a regional hospital in Gauteng?

1.5 Aim of the Study

The aim of this research was to explore and gain an understanding of the factors affecting a splinting intervention programme using soft neoprene thumb opponens splints with children with CP from a resource constrained community attending a regional hospital in Gauteng.

1.6 Research Objectives

- To determine the efficacy of a splinting programme for children diagnosed with CP with thumb in palm deformity, in changing body function, performance skills and participation in personal management activities attending an outpatient programme at TMH in Gauteng.
- To explore the factors which may affect the efficacy of the splinting programme from a therapy and home programme perspective.
- To explore the factors which may affect the efficacy of the splinting programme from an environmental and caregiving perspective.

1.7 Null Hypothesis

There will be no change in the body function, performance skills and participation in personal management activities of children with CP with a thumb in palm deformity after a three month period of wearing the soft neoprene thumb opponens splint.

1.8 Justification of the Study

This research will provide valuable information on the efficacy of soft splinting in improving hand function and the association of this change with functional ability in the self-care of children with CP within a resource constrained South African context. As this area of research has received little attention, no conclusive evidence exists to support or reject the use of splinting to improve self-care in children with CP. Due to the large population of children with CP in South Africa, it can be seen that this research is necessary in guiding and optimising treatment. The research will potentially provide evidence for the effective use of materials which is essential in a resource constrained setting such as that in government hospitals in South Africa.

1.9 Layout of Research Report

CHAPTER1: Introduction

ChAPTER2: Literature review

CHAPTER 3: Methodology

CHAPTER 4: Results

CHAPTER 5: Discussion

CHAPTER 6: Conclusion

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction

This literature review will focus on evidence from international and South African sources to explore the current knowledge and research on splinting of the thumb in management of the upper limb in children diagnosed with CP. Basic development of the upper limb and hand, techniques used in assessing the upper limb in children with CP as well as major theories influencing upper limb management in Cerebral Palsy will also be covered with particular reference to how splinting may be incorporated. Factors affecting compliance to treatment regimens will also be explored. Literature was searched using Pubmed, EBSCO Host, Ovid and Science Direct databases.

2.2 Cerebral Palsy

Cerebral Palsy is currently the number one cause of childhood disability in the world – with the incidence of Cerebral Palsy occurring in approximately two to three out of 1000 live births (Van Naarden Braun, et al., 2016). During an international symposium in 2005, Bax, Goldstein, Rosenbaum, Leviton et al. (2005) defined CP as a group of disorders characterized by poor development of movement and postural patterns which cause limitations in activity participation. This group of disorders is caused by permanent damage to the developing brain in utero, at birth or within the first two years of life (Bax, et al., 2005). Common causes and risk factors for Cerebral Palsy can be classified according to the time of insult on the young brain. Prenatal causes and risk factors which account for up to 80% of Cerebral Palsy cases include prematurity and low birth weight, maternal infection as well as intracranial haemorrhage. Up to 10% of Cerebral Palsy cases occur perinatally as a result of peripartum asphyxia as well as maternal infection. A further 10% of Cerebral Palsy diagnoses which occur postnatally include head trauma, hypoxic episodes and meningitis (Sewell, et al., 2014).

2.2.1 Classification of Cerebral Palsy

The classification of Cerebral Palsy is widely discussed within the current literature and as a result numerous different classifications are evident in the research. Classification of Cerebral Palsy should be discussed according to numerous criteria, including the following:

- **Motor impairments/disabilities noted** – the nature and type of motor disorder as well as the type of abnormal resting tone is an important factor to consider in the classification of children with Cerebral Palsy (Bax, et al., 2005).
- **Anatomical distribution of impairment** – the traditional classification according to the area of impairment in the body should still be discussed and all involved body parts including the trunk, the limbs as well as the oropharynx should be included in this form of classification (Bax, et al., 2005).
- **Functional motor abilities** – a recent need to classify children with Cerebral Palsy based on their functional abilities and limitations has emerged. The functional consequences of the identified motor limitations of Cerebral Palsy are important to classify and provide insight into the expected prognosis and development of the child (Bax, et al., 2005).

2.2.1.1 Classification of Cerebral Palsy by motor impairment

A classification of Cerebral Palsy according to motor impairments classifies children into the following broad categories: spastic, diskinetic (including athetoid, choreo-athetoid and dystonic), ataxic and mixed Cerebral Palsy (Shevell, et al., 2009; Bax, et al., 2005).

Children with spastic Cerebral Palsy account for up to 80% of all confirmed cases of CP (Rogers, 2010). This subtype of CP typically occurs due to damage to the cerebral cortex and primary motor areas of the brain (Rogers, 2010; Scheck, et al., 2014). Children with spastic CP typically have increased muscle tone/hypertonicity of their affected muscles (Kent, 2013; Rogers, 2010). Due to the noted hypertonicity of the affected muscles – children with spastic CP have limited movement of their affected body parts and, as a result, are at high risk of developing secondary impairments such as soft tissue shortening and contractures. Body parts are often held in sub-optimal positions, which limit the functional capacity of the child

(Delgado, et al., 2015; Koman, et al., 2004) . Due to the stiffness and poor positioning of their affected muscles and joints – children with spastic CP are commonly prescribed splints to maintain and increase range of motion, prevent contracture formation and facilitate functional use of their affected body parts (Jackman, et al., 2014; Steultjens, et al., 2004). Splinting within this population of children has been found to have inconclusive results – and often the research calls for further research to confirm the trends which are observed (Shamsoddini, et al., 2014; Imms, 2011; Koman, et al., 2004; Jackman, et al., 2013).

Children with dyskinetic CP account for up to 15% of confirmed cases of CP which typically occurs as a result of insult to the extrapyramidal motor tracts or the basal ganglia (Scheck, et al., 2014; Rogers, 2010). Dyskinetic CP is further classified into choreo-athetoid and dystonic CP (Rogers, 2010). Choreo-athetoid CP is characterised by involuntary movements of the affected body parts – most noticeable in the arms, legs and hands while dystonic CP is characterised by sustained contraction of the muscles of the trunk and limbs into more static postures (Kent, 2013). Children with dyskinetic CP often lack the stability required to perform functional activities and struggle to maintain positions for sufficient periods to allow functional activity performance (Rogers, 2010). These children are typically less likely to develop fixed contractures or soft tissue shortening due to their degree of movement (in spite of it being poorly controlled) and, as a result, splinting for these children is a much less commonly implemented treatment technique**.** Where splinting is used – its aim and purpose is to attempt to provide increased support and stability rather than to increase range of motion (Witoski, 1982).

Ataxic CP is a much less common form of the disease – accounting for only 5% of all CP diagnoses (Kent, 2013; Rogers, 2010). Ataxic CP typically affects a child’s balance and co-ordination of their movement due to insult in the cerebellum and typically does not directly impair the available movement of muscles and joints directly but rather affects the control of said movements (Rogers, 2010). Typically, children with ataxic CP do not struggle with stiffness and possible contracture formation in the hands and limbs – however, due to limited stability and control may be prescribed splints in order to facilitate fine motor control in the hand specifically (Witoski, 1982).

2.2.1.2 Classification of Cerebral Palsy by anatomical distribution of impairment

Classification of CP based on anatomical distribution of the impairment is once again highlighted as important in describing and understanding the motor limitations as well as the functional consequences of the impairments. Typical clinical patterns of involvement can include the following:

- Diplegia – where movement impairments are noted significantly in the lower limbs and to a minimal extent in the upper limbs (Koman, et al., 2004; Bax, et al., 2005).
- Hemiplegia – movement impairments affecting ipsilateral upper and lower limb (Koman, et al., 2004; Bax, et al., 2005).
- Quadriplegia – movement impairment affecting all four limbs significantly (Koman, et al., 2004; Bax, et al., 2005).
- Double hemiplegia – movement impairment is noted most significantly in the upper limbs but does affect both lower limbs too (Koman, et al., 2004; Bax, et al., 2005).

2.2.1.3 Classification of Cerebral Palsy by functional skills

Classification of CP based on function and participation in daily activities has emerged as crucial especially within the realm of occupational therapy. Numerous classification tools for functional classification of children with CP have emerged. The Gross Motor Functioning Classification System (GMFCS) was developed in response to an identified need to create a more consistent way of classifying CP according to gross motor skills and abilities in terms of sitting, mobility and ambulatory abilities (Palisano, et al., 1997). Designed only as a classification tool, the GMFCS is not designed to detect change and progress through therapy (Palisano, et al., 1997).

The GMFCS is broken up into age brackets on five different levels of mobility and has been found effective as a tool to predict prognosis and potential gross motor development for children diagnosed with CP (Palisano, et al., 1997). After the age of two years, it is unlikely that a child will progress through the levels of the GMFCS even with ongoing and intensive therapeutic input (Palisano, et al., 1997). The GMFCS is a useful tool in guiding therapeutic input as well as potential equipment and care needs for the child in the future (Palisano, et al., 1997). It has good interrater reliability of ICC = 0.84 and moderate to high criterion validity with two tests of gross motor function, the Peabody Gross Motor Scale and the Vineland Gross Motor Scale (r=0.66-0.80). Within the current study children on GMFCS levels II, III and IV were included – meaning that they have some active and controlled movement although they may still present with significant impairment in their motor control and gross motor function.

Another functional classification tool available for use with children with CP is the Manual Ability Classification System (MACS). Like the GMFCS, the MACS describes five distinct levels of functioning – these levels are based on the child's ability to handle objects with their hands and their need for assistance and adaptation to perform activities in their daily lives (Eliasson, et al., 2006). This classification tool is appropriate for use with children between the ages of four to 18 and aims to level children based on their typical functional abilities using both hands rather than assessing each hand in isolation. The MACS has been evaluated and deemed a valid and reliable classification tool for children with CP with interrater reliability for therapists and parents at ICC 0.97 - 0.96 (Eliasson, et al., 2006; Ohrvall, et al., 2013). This classification is a common tool used in discussion with parents and between team members to ensure consistency in communication about the child's abilities and can be used to guide goal setting for the child in a similar way to the GMFCS.

A tool for the classification of eating and drinking abilities of children with CP has also recently emerged - The Eating and Drinking Ability Classification System. This classification tool was not used in this study but is mentioned for sake of detailed information on classification systems for children with CP.

When used together – these functional classification systems will provide a good basic understanding of a child's current and projected skills and abilities and can be used to aid intervention planning and goal setting for children with CP effectively.

2.2.2 Hand function in children with Cerebral Palsy

Consensus was found in the research as to the numerous effects that CP has on the development and efficacy of movement and function. However, many discrepancies were noted in the components of hand function which should be assessed and treated in order to maximise engagement in functional activities. Since almost 80% of children diagnosed with CP present with upper limb involvement (Burtner, et al., 2008), the importance of well-researched treatment modalities in managing upper limb dysfunction in children has been emphasized. Due to the essential influence hand function has on a child's functional performance, hand function is often a primary component addressed within occupational therapy interventions and can therefore be considered as a priority for research (Exner & Bonder, 1983; Dekkers, et al., 2014; Jackman, et al., 2014). Available evidence focusing on the rehabilitation of the upper limb and hand in children with CP is however limited (Ohrvall, et al., 2010; Auld , et al., 2014). This impacts on the outcomes of treatment and rehabilitation techniques in improving functional capacity in children with CP.

Hand function is a complex performance skill resulting from the dynamic interaction between many composite components and client factors including physical structure of the hand, range of motion, muscle strength and muscle weakness, spasticity/ hypertonicity of muscles, selective control of movement. This influences a child's ability to form, maintain and release certain grasps and pinches, as well as the speed and accuracy of movement achieved (Arner, et al., 2008; Law, et al., 2008). Much of the available research focuses on changes in these client factors or physical abilities but does not consider the carry over effect this has on a child's ability to participate in functional activities (American Occupational Therapy Association, 2008; Schneiberg, 2008).

Considering participation in functional activities is important as development of hand function is closely linked with associated development of performance skills and functional abilities (Autti-Ramo, et al., 2005; Kimmerle, et al., 2003; Exner & Bonder, 1983). These factors all culminate to create a functional or non-functional hand which can have a significant effect on a child's ability to engage meaningfully in activities (Arner, et al., 2008; Burtner, et al., 2008).

Abnormal development of the upper limb and hand function is a common characteristic of children diagnosed with CP (Exner & Bonder, 1983; Hanna, et al., 2003).

Deficits in development include grasping which is a primitive movement response of the hand. This has a significant influence on how the hands are used during functional activity participation (Arner, et al., 2008; Burtner, et al., 2008). Numerous reflexive grasping patterns can be observed in young children and people with central nervous system impairment including mass grasp formation (Arner, et al., 2008; Burtner, et al., 2008; Hanna, et al., 2003). Mass/reflexive grasps are common in children under the age of six months and play an important role in the development of more complicated and complex grasping and pinching patterns. Persistence of this reflex beyond six months is commonly associated with CP and is also associated with poor development of further hand function and skills (Case-Smith, et al., 2010).

If this primitive reaction persists, it often results in the child's hand closing reflexively with composite flexion of all fingers to any stimulus presented into the palm of the hand. This poses difficulty for children who present with thumb in palm deformity, as the thumb provides stimulation into the palm of the hand leading to reflexive fisting of the hand and reduced ability to achieve voluntary release and object grasping (Demirseren, et al., 2013; Goodman & Bazyk, 1991; Imms, 2011). This persistence of the grasp reflex also impairs the development and progression of selective control of movement of the hand and fingers and results in gross and poorly co-ordinated grasping of objects which are in turn difficult to release (Case-Smith, et al., 2010; Holfmefur & Krumlinde-Sundholme, 2010). Typically, the ability to achieve voluntary release of an object coincides with the integration of the mass grasp reflex occurring at around 5 - 6 months of age and develops to be more refined and controlled around 12 - 13 months of age (Case-Smith, et al., 2010).

Often children with CP learn to rely on the tenodesis action of the wrist to achieve release and extension of the finger rather than attempting controlled release of the fingers (Hanna, et al., 2003; Holfmefur & Krumlinde-Sundholme, 2010; Goodman & Bazyk, 1991; Kurt, et al., 2013). Reduced ability to release grasped objects has a significant effect on a child's ability to manipulate tools and materials with appropriate skill and efficiency as achieving appropriate grasp and release precedes the ability to manipulate objects within the hand.

Manipulation of objects in the hand is often demanded in participation in activities within the personal management, play and scholastic realms (Case-Smith, et al., 2010; Law, et al., 2008; Demirseren, et al., 2013) as this skill is a primary factor affecting the ability to achieve appropriate use of the hand in a range of activities (Burtner, et al., 2008; Kimmerle, et al., 2003; Fedrizzi, et al., 2003). Achieving appropriate manipulation within the hand is dependent on the client factors mentioned previously. Since children with CP typically make use of primitive mass grasps during functional activities, manipulation of objects between hands and within their hands is often significantly impaired (Fedrizzi, et al., 2003; Schneiberg, 2008). Limited isolated finger movement makes the appropriate formation and maintenance of pinches and grasps more difficult and also makes translation and adjustment of tools and objects within the hand more difficult to achieve (Schneiberg, 2008; Holfmefur & Krumlinde-Sundholme, 2010; Kurt, et al., 2013).

Thumb in palm deformity in children with CP is a common and well-documented impairment (Arner, et al., 2008) (Demirseren, et al., 2013; Goodman & Bazyk, 1991). Typically, two patterns of thumb deformity can be identified within children with thumb in palm deformity. The thumb flexors and adductors can either present with spasticity and hypertonicity or the thumb abductors and extensors can present with laxity and severe weakness (Bhardwaj & Sabapathy, 2011). Both of these patterns lead to reduced ability to move the thumb out of the palm and subsequently the thumb occupies the space in the palm. This leads to poor functional use of the thumb for grasping and pinching during daily activities (Bhardwaj & Sabapathy, 2011; Berge, et al., 2012). Thumb in palm deformity is commonly associated with impaired engagement in functional, daily activities and as such is commonly considered a priority in occupational therapy interventions (Berge, et al., 2012; Goodman & Bazyk, 1991).

Apart from motor impairments – many other factors can have an impact on the development of hand function and functional activity participation in children diagnosed with CP. Somatosensory impairments of the upper limb are a common associated impairment noted in children with CP. It is expected that approximately 50% of children diagnosed with CP have reduced somatosensory thresholds in their upper limbs and hands, most notably in two-point discrimination, proprioception and stereognosis. Diminished somatosensory perception has been associated with reduced tendency to involve the affected body parts spontaneously in functional activity and is often associated with impaired dexterity and manipulation of objects too (Wingert, 2007; Auld , et al., 2014).

Cognitive limitations often accompany the motor impairments which are characteristic of CP. More severe and disabling cognitive impairments are noted in children who have more significant physical and mobility impairments and these impairments result in further functional limitations (Hanna, et al., 2003; Sewell, et al., 2014; Aisen, et al., 2011). Other associated impairments such as seizure disorders, communication impairment, feeding difficulties, sleep disturbance and impaired vision and hearing are other common impairments associated with CP (Sewell, et al., 2014; Koman, et al., 2004). These associated impairments have a significant effect on the use of the hands in functional ability and overall participation in daily activities of children with CP and therefore need to be considered as integral in any treatment approach (Sewell, et al., 2014; Aisen, et al., 2011).

Within the CP population, upper limb and hand function impairment varies greatly, requiring in-depth and specific assessment (Hanna, et al., 2003).

2.3 Assessment of children with Cerebral Palsy

Due to the complicated and diverse presentation of children with CP, a comprehensive, wide-reaching and detailed assessment is considered essential in order to plan for intervention and monitor response to intervention. Ultimately, the purpose of initial occupational therapy assessment is to identify which aspects of impairment are most limiting a child’s ability to participate and perform appropriately in functional activity (Steultjens, et al., 2004). Within the occupational performance framework, a variety of assessments are used to gain a holistic understanding of the child and their strengths, weaknesses and functional limitations.

Many occupational therapists rely on the use of non-standardised assessments and observations to form part of their assessment milieu and clinical reasoning process. Many components of physical ability and functional skills are assessed this way. Although observations play a key role in the assessment process, the consistency of these assessments is noted to improve considerably with experience in clinical practice (Stewart, 2010; Herrero, et al., 2011). However, observations should be used in conjunction with other forms of assessment such as standardised assessments.

Standardised assessments provide a quantitative and objective measure of occupational therapy assessment which is important for a number of reasons: to identify the need for intervention and to monitor progress objectively in response to intervention and to validate and secure resources for intervention. They create a more evidence based therapeutic process when offering and evaluating intervention processes (Stewart, 2010) as well as measure progress quantitatively for research purposes (Richardson, 2010; Leemrijse, et al., 1999). Many standardised assessments used within the context of paediatric occupational therapy also tend to focus on client factors and performance skill assessment, with functional activity progress often being neglected. This results in occupational therapists relying on a diverse range of assessment tools to gain a holistic view of the child and their abilities within their environments.

Within the South African context, the use of standardised assessments is limited significantly due to limited availability of assessment tools in poorly resourced areas, high costs associated with the use of many of the tools and limited experience/ training in the use of the tools. Many of the tools available are also not standardised to the South African population, which limits the clinical validity of many of the tests in this context. Despite the difficulties, it is still of utmost importance to make use of these tools wherever possible to quantify objectively the efficacy of treatment techniques as well as to validate the allocation and prioritisation of intervention resources for children with CP in South Africa (Richardson, 2010).

2.3.1 Assessment of the hand

Assessment of the hand in children with CP is complex and requires a wide range of assessment tools including specific client factors such as muscle strength, range of motion and sensibility as well as general hand function and unilateral and bilateral function of the hands.

2.3.1.1. Assessment of client factors

Range of motion of joints and structures within the hand has been identified within the literature as key in assessing the hand of a child with CP due to the significant effect deformities and contractures may have on the child’s ability to use their hand in a functional capacity. The use of basic handheld goniometers in assessing range of motion in children with CP has been identified as reliable and a means of assessing range of motion through the use of appropriate positioning and measurement technique (Herrero, et al., 2011). Structured seating positions, positioning of the hand on the same table and using the same goniometer are some of the important factors to monitor and maintain consistently to achieve the most reliable and valid results (Norkin & White, 2016) (Carter, et al., 2009) (Herrero, et al., 2011).

Range of motion of the thumb into abduction is commonly measured using a goniometric tool called a pollexograph which has been deemed as reliable and valid for measuring range of motion of the thumb in children when certain structures and assessment rules are set out (de Kraker, et al., 2009). In resource constrained areas in the South African context, use of the more reliable and accurate electric goniometers is not a feasible solution due to the high price and limited applicability within the clinical realm.

The sensation and sensibility of the hand is also an important client factor to consider in the assessment of hand function in children with CP (Bhardwaj & Sabapathy, 2011; Fedrizzi, et al., 2003; Wingert, 2007). Numerous means of assessing sensation in children have been identified in the literature. The use of the Semmes-Weinstein monofilaments has been identified in research as having good validity and reliability in assessing tactile recognition in the hand in children with spastic CP (Hunter, et al., 1995; Cooper, et al., 1995). Stereognosis was identified in the literature as one of the key elements of sensibility affecting use of the hand in functional activity participation (Kinnucan, et al., 2010; Wingert, 2007) and was therefore identified as a key area of assessment within this study.

In order to complete a reliable and valid assessment of a child’s sensory ability, the child’s co-operation as well as a basic level of cognitive functioning is required however (Wingert, 2007).

2.3.1.2 Assessment of hand function and functional ability

The ultimate purpose of occupational therapy assessment is to identify which aspects are most limiting a child’s ability to participate appropriately in functional activity (Steultjens, et al., 2004). Typically in children with CP, hand function has a significant effect on a child’s ability to perform functional activities appropriate and as a result it is crucial for hand function to be considered in assessment.

Although limited specific hand function tests are available for children with CP (Ryll, et al., 2017) other standardised tests provide components which can be used to evaluate the use of the hands in functional activity. The Movement ABC was developed as a tool to aid in the assessment of motor ability and motor functioning in children between the ages of 3 and 16 years 11 months (Henderson, et al., 2007). The Movement ABC was devised to identify motor impairments impacting on a child's ability to participate in daily activities at home and at school and can assess a range of motor impairments/difficulties including fine motor difficulties, gross motor difficulties as well as muscle strength and tone dysfunction (Pearson Education, 2017). It has been used and deemed appropriate in the assessment of a range of paediatric conditions including CP (Leemrijse, et al., 1999) and has been deemed as a valid and reliable tool for this purpose. In terms of reliability, test-retest reliability was evaluated to have correlation scores between r = 0.73 and 0.84 for component scores. Test-retest reliability for manual dexterity items in particular range between r = 0.86 – 0.91 indicating good test-retest reliability (Henderson, et al., 2007). The Movement ABC 2 (as a revision of the original tool) has been evaluated to be sensitive enough to measure change in response to treatment provided (Henderson, et al., 2007) and was therefore deemed as appropriate for use within this study.

The Pediatric Evaluation of Disability Inventory (PEDI) is an assessment tool developed to assess functional capabilities and performance in children between the ages of six months to seven years (Haley, et al., 1992). It assesses skills and abilities in three key areas of function including self-care, mobility and social participation in order to identify and document functional delay and difficulties, as well as to identify any changes in response to therapy inputs. The PEDI can be used to identify key areas of function which can be targeted as intervention goals and takes into account the perception and input of the caregiver as central to the assessment which is different from most clinical assessments available currently. The PEDI was developed in a response to an identified need to assess a child's functional ability rather than solely focus on their client factor and performance skill capacities (Haley, et al., 1992). From research, it has been noted that the PEDI is a reliable and valid tool for use in children with mild to moderate physical disabilities. The interrater reliability studies found that intraclass correlation coefficients were high for the summary scores for each domain and were moderate to good for the content areas within each domain of the assessment (ICC= 0.91 to 0.56). The PEDI has been deemed a valid and reliable tool for assessment of functional performance in children. (Nichols & Case-Smith, 1996; Haley, et al., 1991).

2.4 Occupational therapy intervention for the hand and upper limb in Cerebral Palsy

The intervention offered to a child with CP needs to ultimately improve a child's ability to perform in daily functional tasks more consistently (Steultjens, et al., 2004; Law, et al., 1997). Many different treatment techniques are incorporated into occupational therapy treatment of children with CP. These treatment techniques can include treatment from neurodevelopmental therapy approach, motor learning approach and splinting of the hand and upper limb amongst others.

2.4.1 Neuroplasticity

A primary theoretical premise underlying the management of the hand and upper limb in children diagnosed with CP is the principle of neuroplasticity. Neuroplasticity can be defined as the adaptive capacity of the brain to alter its physical and chemical structure, as a result of expansive connectivity within the central nervous system, in response to internal and external pressures. Ultimately, neuroplasticity is the manner in which the brain is able to encode experience and learn new behaviours. Neuroplasticity is driven by behavioural, cognitive and sensory experience which is derived through interaction with the environment (Cramer, et al., 2011).

Children with CP often have altered interaction with their environments as a result of limited motor behaviours and, as a result, learning and experience may be influenced. It has also been demonstrated extensively through research that those neural networks which are used often tend to strengthen in connection, while those that are rarely used tend to become weaker or may even disappear (Aisen, et al., 2011) highlighting the importance of early and intensive management of affected upper limbs and hands in children diagnosed with CP in order to limit the weakening of cortical connections.

While splinting itself does not appear to have a direct effect on neuroplasticity, splinting has been associated with improvements in the underlying components needed for hand function in children with CP. Appropriate use of a splint appears to provide the child with an increased potential to use their affected hand and practise movements or positioning of their hands which were not possible prior to splinting which will allow for strengthening of associated neural connections for enhanced neuroplasticity.

2.4.2 Splinting in Cerebral Palsy

Splinting is a common therapeutic modality used by occupational therapists within the CP population; however, there is limited research available to either support or reject the use of this modality (Burtner, et al., 2008; Morris, et al., 2011; Steultjens, et al., 2004). As a result of the limited evidence available, occupational therapy clinicians have to rely on past experience and clinical reasoning rather than empirical evidence to support their decisions with regard to prescribing splints within this population group (Imms, 2011; Steultjens, et al., 2005).

Theoretically, splinting is a sound therapeutic tool and has been assumed to assist in the achievement of aims such as improving passive and active range of motion of affected joints, reduce spasticity or hypertonicity of splinted body parts, encouraging appropriate alignment of joints, facilitating improvement in muscle strength as well as ultimately improving motor function and functional use of the affected body part (Koman, et al., 2004; Jackman, et al., 2014; Lannin, et al., 2007). The use of splinting (especially in a static position) prevents a change in muscle spindle length thereby preventing excitatory input into the muscle and reducing the spasticity or hypertonicity of the muscle. This provides neutral warmth leading to muscle relaxation as well as a low load, long duration stretch in an optimal position (Lannin, et al., 2007; Jackman, et al., 2014; Goodman & Bazyk, 1991).

Many different splints can be prescribed within the CP population to achieve the goals of treatment. Broadly they can be categorised by the materials from which they are made: soft and hard thermoplastic splints which often correlate with their purpose. Hard thermoplastic splints are commonly fitted to the hands and feet of children with CP and are typically used within a biomechanical approach to splinting (Jackman, et al., 2014; Burtner, et al., 2008) Examples of thermoplastic splints which can be prescribed in the management of the upper limb in children with CP include resting splints, anti-spasticity splints as well as wrist extensor splints

(Burtner, et al., 2008; Exner & Bonder, 1983; Imms, 2011). Resting splints are applied largely to the volar surface of the forearm and hand and attempt to position the hand in an optimal position to allow for more appropriate alignment of joints and muscles as well as to prevent contracture development (Imms, 2011). Due to their greatly restrictive presence, these splints are typically worn at night when the child is sleeping so as not to affect functional activity participation (Imms, 2011; Morris, et al., 2011).

Anti-spasticity splints are typically applied to the dorsum of the forearm and then into the volar aspect of the palm (Exner, 2010). These splints are thought to avoid pressure over the flexor tendons of the hand and thereby reduce spasticity or hypertonicity of the hand while allowing for optimal alignment and preventing contracture deformity. Once again, these splints are worn at night time primarily due to their restrictive function (Exner, 2010; Jackman, et al., 2014; Lannin, et al., 2007).

Both resting and anti-spasticity splints tend to use a large amount of splinting material in their manufacture and both have limited evidence to support their use in the achievement of their respective aims. No studies to date support the use of these splints to improve hand function and functional engagement in children with CP. It is therefore essential to consider whether the provision of these splints can be considered an appropriate use of limited tools and materials (particularly in the resource constrained South African setting) or whether it may be more beneficial to implement a passive stretching routine in place of a splinting routine (Delgardo, 2006; Hughes, 2013).

Wrist extensor splints are often used for children with CP in order to position their wrist in an optimal position (approximately 20° wrist extension) typically for use during the day during participation in functional activities (Burtner, et al., 2008; Exner & Bonder, 1983; Imms, 2011). Theoretically, this allows for the hand to be positioned more appropriately to allow for more effective grasp and release of the fingers. However, limited evidence to support this notion currently exists within the available literature (Louwers, et al., 2011; Imms, 2011).

Soft splints are also commonly used for children with CP and are more commonly prescribed to support engagement in daily activities by supporting body parts in a more desirable positon rather than restricting movement and achieving a long stretch on a specific body part (Burtner, et al., 2008; Exner, 2010). As a result, soft splints are more commonly worn during the day during functional activity participation rather than at night and can often be more easily fitted into achievement of a child‘s and family’s goals for therapy (Exner, 2010).

Common soft splints prescribed to children with CP include the soft forearm supinator splint and the thumb abductor splint. Moving the thumb out of the palm of the hand through the use of a splint is assumed to assist in reducing the stimulation of reflexive mass grasp. However, it is uncertain whether this will in itself result in more controlled, isolated movement of the fingers of the hand in return (Lannin, et al., 2007) .

The purpose of splinting the thumb out of the palm of the hand is to allow for prolonged stretch of the adductors and flexors, positioning the thumb more appropriately for opposition and grasping opportunities and prevent stiffness and contracture of the web-space of the thumb (Lannin, et al., 2007; Berge, et al., 2012; Exner & Bonder, 1983). Soft thumb splints are often manufactured from materials such as neoprene or Pro-wrap and allow for active movement of the hand in spite of the presence of the splint (Delgardo, 2006). Many of the available studies present with limited sample sizes, as well as poorly executed research technique, leading to limited application of the results including Delgardo (2006) and Hughes (2013). Few randomised controlled trials evaluating the efficacy of splinting the thumb in the CP population were identified, highlighting a great need in the current available literature. One protocol for a future randomised control trial was identified which proposed research in a multicentre study to determine the effects of rigid wrist and hand orthoses in improving hand function and functional ability in children with CP when combined with typical multidisciplinary care (Wallen, et al., 2016). Research which does find improvement in client factors such as range of motion and pinch strength have not continued their evaluation through to include influence on functional performance and therefore it is currently unknown whether splinting can have an actual effect on improving participation in functional activities of daily living (Teplicky, et al., 2002; Blackmore, et al., 2006) .

Many studies found consensus that for any improvement in biomechanical function of the hand, related to client factors such as range of motion, strength, joint alignment, to be achieved compliance with the splinting routine is of utmost importance (Berge, et al., 2012; Koman, et al., 2004; Morris, et al., 2011). Splint wearing times of up to 16 hours a day, need to be adhered to achieve the desired results from the splinting programme. Research in the literature raises concerns from parents and children as it is not always possible to comply fully with the splinting programme. Reasons for difficulty with compliance include children refusing to wear the splint, the splint being uncomfortable and causing pain or irritation, limited change noted in biomechanical or functional goals of treatment as well as the child outgrowing the splint or the splint breaking (Morris, et al., 2011). All these factors need to be considered when a splint is issued to a child. It is essential to ensure frequent follow ups by the therapy team to check splint fit and condition as well as to check the integrity of the child’s hand and skin (Morris, et al., 2011; Autti-Ramo, et al., 2005). Without frequent follow up, compliance with a splinting protocol is assumed to be poor and splinting should be used cautiously.

Only two studies on the efficacy of hand splinting of children with CP within the under resourced South African context were found in the literature. One study by Delgardo (2006) focuses on the efficacy of an upper limb supinator splint after Botox injection. This study followed 10 children following Botox injection. The data collection period lasted six months for each participant. A positive correlation was noted between the number of hours each day the participant wore the splint and their improved supination ability. Delgardo (2006) found a clinically significant effect a supination splint may have on reducing spasticity when combined with Botox injections as well as when incorporated with regular occupational and physical therapy. Unfortunately, no control group was incorporated in this (2006) study limiting the strength of the results obtained.

Another study by Hughes (2013) focuses on the efficacy of a thumb opponens splint in improving hand function of children with CP. This study used an experimental study design with a total of 28 participants between the control and experimental groups. A clinically significant result was obtained for improvement in grasp, dissociated movements and weight bearing ability following a three month soft splinting protocol for children with thumb in palm deformity. She also found a high correlation between the numbers of hours spent wearing the splint by the participants and the improvement of grasp, weight bearing and protective extension while wearing the splint. Limited evidence for efficacy of splinting once the splint is removed was identified in this study, indicating that positive effects of splinting for thumb in palm deformity may only persist as long as the participant has the splint on. The study by Hughes (2013) was limited by a small sample size and wide comparative criteria. Both studies identified potential for splinting children with CP; however, neither study was able to draw significant clinical conclusions or make recommendations for the efficacy of this therapeutic modality in relation to functional activities in a situation with limited access to health care and therapy. This is supported in a systematic review by Jackman et al. (2013) who concluded that splinting has a small positive effect on upper limb function in children with CP if combined with therapy but that this effect may not be maintained at three months after splint removal (Jackman, et al., 2013).

Splinting cannot be used in isolation in the treatment of the upper limb of children with CP and other techniques should be included if comprehensive treatment is to be offered. These techniques include:

2.4.2.1 Neurodevelopmental Therapy

The neurodevelopmental theory is based on dynamic systems theory and considers neuroplasticity as possible and shaped largely by afferent inputs to the central nervous system. Neurodevelopmental therapy proposes that motor impairments associated with CP develop as a direct result of CNS dysfunction and the goal of treatment is therefore to establish normal motor development and prevent abnormal movement reactions (Bobath & Bobath, 1984; Law, et al., 1997). Hands on treatment in order to inhibit abnormal movement patterns and facilitating normal muscle tone are key in providing treatment through an NDT approach (Butler & Darrah, 2001). Within NDT the main goals of treatment can be considered to be as follows: to affect muscle tone of affected body parts and achieve greater selective control of movement, prevent associated reactions and abnormal movement reactions and achieve greater functional activity participation (Bobath & Bobath, 1984). Revised NDT theory for the management of children with CP emphasises alignment of body parts, considered essential in achieving desired movement and secondary factors such as muscle, joint and connective tissue integrity. (Bobath & Bobath, 1984; Butler & Darrah, 2001).

It has been suggested that splinting could be used as an adjunct to NDT in achieving the desired outcomes in children with CP (Law, et al., 1997). Achievement of reduced hypertonicity as well as greater performance in functional tasks and activities are common goals within both the NDT as well as in many splinting regimens. Within the revised NDT approach to treatment – maintaining and improving joint alignment, range of motion and integrity can also be viewed as essential which is also in agreement of splinting programmes for children with CP. The presence of a splint may be considered as an alternative to therapists' hands on positioning of the joints for optimal function which is considered important within the NDT approach. As with any occupational therapy intervention – it is essential for the therapy to be offered within functional activity participation in order to maximise carry over and application as much as possible.

2.4.2.2. Motor learning frame of reference

The motor learning frame of reference believes in making use of functional tasks and activities with active involvement of the child to assist in organising and achieving optimal behaviour or skill performance (Jarus, 1994). The focus of therapy through a motor relearning approach considers the child's ability to engage in meaningful functional activities as central and most important (Poole, 1991) (Zwicker & Harris, 2009). Within the motor relearning approach environmental supports and barriers are identified, task requirements, strengths and weaknesses of the child and the environment as well as task-child-environment matching are considered as vital (Zwicker & Harris, 2009; Jarus, 1994).

The main aim of therapy through a motor learning frame of reference is to achieve more consistent goal directed, meaningful and functional performance through the key principles of the motor relearning approach: verbal instruction, visual demonstration, manual guidance, verbal feedback and practice (Zwicker & Harris, 2009). Adaptations to the environment, to the task as well as to the child's skills and abilities are all appropriate approaches to implement within this frame of reference, with particular reference to the adaptations to the task and the environment (Jarus, 1994; Poole, 1991). Environmental modification and task adaptation are essential within this frame of reference.

With this in mind, the fit of splinting within a motor learning frame of reference can be viewed as limited. Splinting is a child focused intervention only considering the child's limitations in appropriate positioning/strength/alignment and neglects to address the environmental/task based factors limiting successful functional engagement. The application of the major treatment principles (verbal instruction, visual demonstration, manual guidance, verbal feedback and practice) is limited within the provision of a splint with the only principles possible to apply being practice and to an extent manual guiding. Splinting as an intervention method does not affect or influence the environmental and task based demands of an activity but rather focus solely on the child based limitations identified and therefore appears to have limited application ability within this frame of reference.

2.5 Contextual factors affecting the treatment of Cerebral Palsy in resource constrained communities

Treating complex neurological conditions within a well-resourced setting is considered a challenging feat. Treating and managing CP within a low resourced setting comes with its own specific set of challenges.

Often in the occupational therapy treatment of children with CP, assistive devices are issued in an attempt to maximize people with disabilities' independence and participation in daily activities of living (Huang, et al., 2008). Within resource constrained communities in a South African context, availability of these assistive devices is not always guaranteed and, as a result, children with CP often wait extended periods of time without the devices or never receive them at all. The context in which many children with Cerebral Palsy live in at home is often also limited in terms of access to resources and appropriate space for implementation of assistive devices within the home. Large bulky positioning devices such as buggies and corner seats take up significant space in a home and result in increased demands on the family in terms of maintenance costs and transport of the devices. As the cost of this to the family is not always sustainable, the implementation of some assistive devices within the resource constrained setting is not always appropriate. (Huang, et al., 2008)

The implementation of standardized assessments which is typically developed in well-developed and well-resourced settings is not always appropriate for direct implementation in lower resourced and less developed settings (Saloojee, et al., 2009). Due to differences in language of instruction, exposure to certain equipment and components of the tests as well as cultural interpretations of different items, it cannot be assumed that standardized assessments derived from more western developed settings are valid and reliable for use within a lower resourced South African context (Saloojee, et al., 2009). It is, however, still essential that objective measures of assessment are still incorporated in the assessment of children with CP within resource constrained settings for the numerous benefits already mentioned.

Within developing and typically lower resourced areas, it has been noted that the responsibility and burden of caregiving for a child with Cerebral Palsy falls largely on the family and immediate community in which the child lives (Adams, et al., 2011). The role of caregiving for a child with CP therefore needs to be understood within the greater context of the family and community in terms of access to resources, home contexts, generally limited health and wellness as well as widespread malnutrition and poor access to basic resources such as water and electricity in many cases. All these factors will significantly affect how therapists implement and offer therapy services within the lower resourced setting due to the carry over effect to home environments (Adams, et al., 2011). Hands on, practical and context based treatments have been found to be an essential part of treating children with CP in the resource constrained setting (Adams, et al., 2011). Parent and caregiver training rather than hands on treatment of the child with CP may be more effective in these settings due to the limited therapy time available per month for treatment as well as the increased effect caregiver training can have on the child within their home context (Adams, et al., 2011)

Another common challenge identified within the lower resourced setting in South Africa is the discrepancy and conflict which exists between modern medicine and traditional medicine in the diagnosis and treatment of CP. Many communities and families in which children with CP grow up have traditional beliefs about the cause and appropriate treatments for their neurological treatment – resulting in altered compliance with modern treatment techniques and options. The divide between modern and traditional medicine also places strain and stress on caregivers who are pressured by community members and traditional healers and doctors/therapists based in the clinics/hospitals to choose their way of managing the condition. This is an important factor to consider when forming and executing a treatment plan for children with CP in the lower resourced settings of South Africa.

2.6 Summary

As a profession, occupational therapy is focused on achieving development and improvement in functional abilities and the ability of an individual to participate and engage in meaningful activities (Case-Smith, et al., 2010). Children diagnosed with Cerebral Palsy typically have significant difficulty achieving independence in daily functional activities. It is well documented that the development of function of the upper limb and hand plays a significant role in gaining functional independence and as a result upper limb and hand function is often a focus of therapeutic intervention for children with CP (Arner, et al., 2008). It is, however, essential for occupational therapists to maintain a focus on function rather than just on improvement of client factors and performance skills as it is well documented that improvement in these factors does not necessarily translate into functional activity performance improvement (Arner, et al., 2008).

One means available to occupational therapists in the management of the hand and upper limb of children with CP is splinting. A neoprene thumb abductor splint is a soft splint which can be applied to the hand of a child during participation in functional activities in an attempt to allow development of improved grasp, muscle strength and ultimately functional skills and abilities. As the splint achieves a stretch of the intrinsic muscles of the hand and more appropriate positioning of the thumb for functional activity participation, the splint can be employed in encouraging motor learning and skill development as an adjunct to regular occupation therapy treatment sessions (Hughes, 2013). Splinting needs to be used with the child’s and family’s goals in mind since there is only low evidence for the use of this technique in children with CP. Systematic reviews indicate that there is a need for further methodologically sound research to review the effectiveness of upper limb hand splints in this population.

CHAPTER 3 METHODOLOGY

3.1 Research design

The study design was a descriptive collective or multiple case study which includes a number of cases that are used to complete a description of the phenomenon of the effect of a splinting intervention for children with CP, provided at a regional hospital in Gauteng (Yin, 2011) (Stake, 2000). The case study considered what these interventions mean to participants, their caregivers and therapists, and it was used to focus on a process of intervention that was not easy to explore in an experimental study in the given context. From a practical point of view, case study research is a relevant approach for occupational therapists as it is a research method where single or multiple cases can be investigated within a specific context to explore real life experiences and situations using multiple data sources (Yin, 2011).

In occupational therapy, case study research offers a clinically relevant research approach exploring practice (Colborn, 1995) (Salminen, et al., 2006). Case study research was therefore a useful approach for studying professional practice and can assist in re-conceptualising clinical problems and validating existing methods, in relation to splinting in CP (Merriam, 1998). According to Salminen (2006), the use of both qualitative and quantitative approaches in a case study allows for an evaluation of the impact of intervention in a complex situation which has not been extensively researched within a defined environment.

The case study research used in this study also made use of multiple research methods including a number of assessment methods and measures to allow for triangulation of data (Yin, 2011). In order to fulfil the rigour required for scientific research, a systematic process of data collection which allowed the researcher to learn more about her clients and the interventions used was undertaken. This research method was suited to the situation as only a small number of cases could be assessed in the specific environment, and it also allowed several viewpoints to be taken into account including the subjective experience of the therapist and the children's caregivers. Case study research offered a methodology that is well suited to the development of clinical practice (Salminen, et al., 2006).

The study included collection of both quantitative and qualitative data (Yin, 2011). An overview of the research methodology is presented in Figure 3.1.

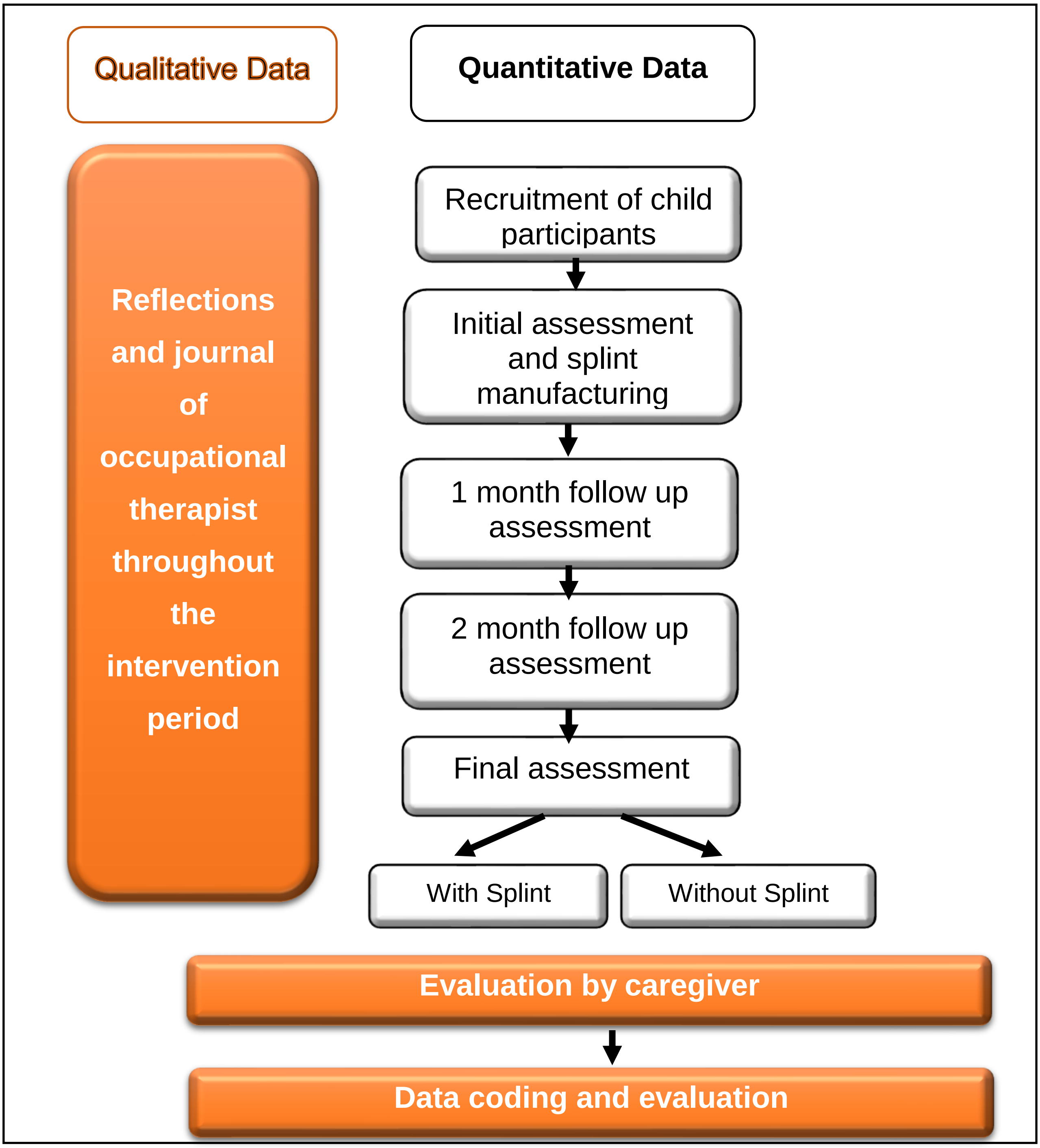


Figure 3.1 Outline of study

Part 1 Quantitative Data

Quantitative data was collected on the children with CP who were attending Tambo Memorial Hospital occupational therapy services and who met the inclusion criteria. Demographic data was gathered about each child and their primary caregiver. Various client factors such a range of motion and sensation, hand function and upper limb performance skills as well as personal management performance were assessed on an initial assessment. A neoprene thumb abductor splint was manufactured and a home programme was prescribed for them in the initial assessment session too. They were assessed again at one month, two months and three months. On the final assessment at three months, assessments were completed while the child was and then was not wearing the splint. Caregivers were asked to complete a compliance diary indicating the hours the splint was worn each day.

Part 2 Qualitative Data

The qualitative element of this case study was the smaller part of the study with a subjective qualitative questionnaire used at the end of the study to determine the caregivers' perception of the therapeutic intervention as well as difficulties in applying the therapeutic techniques. These questionnaires also explored the efficacy of a splinting programme and the factors which affect the efficacy of the programme in a resource constrained setting. These were used to quantify trends affecting compliance or non-compliance to the intervention programme and factors affecting caregiver perceived evaluation of the splinting intervention programme. The researcher kept field notes and a reflective diary throughout the study on each assessment and appointment so that observations and insights from the health care provider's perspective could also be included in the analysis.

The study took place over an eight month period in 2016. For the duration of their participation in the study, the participants still attended their routine physiotherapy, occupational therapy and speech therapy appointments. The participants also had one session with the researcher monthly to check the splints and perform assessments. Each participant was followed for a three month period from the commencement of splinting.

3.2 PART 1

3.2.1 Population and Sample

The population chosen for this research study was children between the ages of 3 -6 years who were diagnosed with CP on GMFCS levels II – IV and treated at TMH. Total population sampling was used to recruit participants for the study. Total population sampling is a form of purposive sampling in which all participants with a selected characteristic are included and invited to participate in the study (Laerd dissertation, 2012).

Five children who were referred to the occupational therapy department who fitted the inclusion and exclusion criteria were invited to participate in the study. All the participants attending this hospital are dependent on public health care and did not have access to private health care. Multiple cases were used as this added reliability to the study (Miles & Huberman).

The following inclusion and exclusion criteria were used to select participants for the study:

Inclusion Criteria

Children who

- are diagnosed with CP by a medical practitioner
- are male and female clients between the ages of 3 and 6 years of age
- Present on GMFCS level II - IV
- have a thumb in palm deformity of one or both hands
- can position their hands for function based on the movement in their upper limb
- tolerate splints on their hands
- can follow simple two step instructions.

Children whose caregivers

- give consent for the child to participate in research and are willing to carry out a home programme to support the splinting intervention.

Exclusion Criteria

Children who

- have fixed contractures of the thumb or wrist
- present with GMFCS levels I and V
- have progressive upper motor neuron lesion
- have moderate to severe cognitive impairment are unable to follow basic instructions.

A sample of only five children was achieved due to the difficulty in identifying children who met the inclusion and exclusion criteria.

3.2.2 Measurement tools

Measurement tools used in the study comprised a demographic questionnaire, aspects of standardised assessments, an adherence diary, a range of motion assessment and a caregiver questionnaire which was completed by the caregivers at the end of the study. Reliability and validity of each tool will be discussed under each individual tools description.

3.2.2.1 Demographics and personal background (Appendix A)

Each participant's demographic and personal background information was recorded on a form compiled by the researcher. Each caregiver was interviewed to obtain this information. Information obtained included the child's age and gender, therapies attended by the participant, school attendance of the participant, caregiver's knowledge of the participant's diagnosis and familial information (primary caregiver, level of education of caregiver, employment status of caregiver, income into the home and family make up within the home).

This information was used to determine the effects of personal and medical factors on the outcomes of the research study.

3.2.2.2 Assessment of client factors of the wrist and hand - range of motion, pinch strength, sensation, wrist movement (Appendix B)

Range of motion of the thumb, grip strength, sensibility of the hand and the ability to move the wrist against gravity are all important factors to consider when assessing hand function in children with CP (Demirseren, et al., 2013).

Measurement of range of motion for this study focused on movement of the thumb. The range of motion at the thumb into abduction both actively and passively was measured before splint application in the initial session. At the final assessment session, range of motion of the thumb was assessed with the splint off to assess any changes in this client factor as a result of the intervention. Range of motion was assessed using a custom-made 3D box protractor based on the design of the pollexograph. The use of the pollexograph in children as a valid and reliable measure of thumb abduction has been established (de Kraker, et al., 2009). The same box protractor was used for each of the children to increase the consistency of the measurement results.

The participant's ability to move their wrist against gravity was assessed. Each participant's range of movement of their wrist against gravity was measured using a hand held goniometer. The use of basic hand held goniometers in assessing range of motion in children with CP has been identified as a reliable and valid means of assessing range of motion through the use of appropriate positioning and measurement technique (Herrero, et al., 2011). Structured seating positions, positioning of the hand on a table and use of the same goniometer are some of the important factors to monitor and maintain consistently to achieve the most reliable and valid results (Norkin & White, 2016) (Carter, et al., 2009) (Herrero, et al., 2011). The researcher attempted to standardise the position of the child in all measurement settings. The children were positioned on the same chair in each assessment session, had their arm and hand resting on the same table and the same handheld goniometer was used in each of the assessment sessions to maximise validity and reliability of the results obtained.

The strength of each child's palmer pinch was measured using a handheld pinch gauge. This measurement was taken before splint application and immediately after splint application in the initial session as well as in each of the subsequent research sessions. Research suggests that the use of a handheld pinch gauge is a valid measure of pinch strength with the most reliable measurements being obtained when the mean of three consecutive measurements is used and, as a result, three consecutive measures of pinch strength were used to assess the children's strength at each measurement opportunity. Standard positioning of the child during assessment was used wherever possible as with goniometric measurements. Standard positioning has been shown to increase accuracy and replicability of pinch strength measurements significantly (Mathiowetz, et al., 1984).

Sensation of the hand was intended to be assessed using Semmes-Weinstein monofilaments as well as a stereognosis assessment. The stereognosis assessment was found to be ineffective and inaccurate for use in this population sample due to the young age and limited understanding of the participants. The participants in general were unable to follow the instructions associated with the stereognosis assessment – providing poorly reliable outcomes of assessment. As a result, only the Semmes-Weinstein monofilament assessment for sensation was used. The method used for assessment was to expose the child to each filament (from least notable to most notable) in order to determine when the child was able to perceive the presence of the stimulus. Semmes-Weinstein monofilaments have been identified in research as having good validity and reliability in assessing tactile recognition in the hand in children with spastic CP (Auld, et al., 2011).

Sensibility of the hand as well as wrist movement were not expected to be altered as a result of the implementation of the intervention provided in this study. However, due to their potential influence on the development of hand function and the effectiveness a splinting programme were still measured and assessed to provide valuable insight into the guiding principles to consider when deciding whether or not to splint a child with CP.

This information was recorded on a measurement form compiled by the researcher at each of the assessment sessions.

3.2.2.3 Movement ABC 2 — dexterity test (Appendix C)

The Movement ABC was developed as a tool to aid in the assessment of motor ability and functioning in children between the ages of 3 and 16 years 11 months (Henderson, et al., 2007). Test-retest reliability of the Movement ABC was evaluated to have correlation scores between 0.73 and 0.84 for component scores. Test-retest reliability for the manual dexterity items which were used in this study, in particular, range between 0.86 – 0.91 indicating good test-retest reliability (Henderson, et al., 2007). The Movement ABC 2 has also been deemed as a sensitive enough test to measure and assess change in response to treatment provided (Henderson, et al., 2007) and was therefore deemed as appropriate for use within this study.

Fine motor dexterity and manipulation was assessed using two of the three manual dexterity items from the Movement ABC 2nd edition. The items of the assessment used in this study included posting coins and threading beads. During engagement in these tasks, the researcher made qualitative observations about the participants' performance (including position of hand, grasp used during engagement, control of movement) and a quantitative raw score for each test item was given too. The raw scores obtained from each subtest were converted into standard scores (using normative data from the assessment manual) and the results were interpreted and recorded.

3.2.2.4 Pediatric Evaluation of Disability Inventory (PEDI) Self–Care section (Appendix D and E)

The PEDI is an assessment tool developed to assess functional capabilities and performance in children between the ages of six months to seven years, assessing abilities in three key areas of function including self-care, mobility and social participation (Haley, et al., 1992). From research it has been noted that the PEDI is a reliable and valid tool for use in children with mild to moderate physical disabilities. Interrater reliability studies found that intraclass correlation coefficients were high for the summary scores of each domain and moderate to good for the content areas within each domain of the assessment. The PEDI has been deemed a valid and reliable tool for assessment of functional performance in children.(Nichols & Case-Smith, 1996) (Haley, et al., 1991).

The caregiver of each participant was interviewed about their child's level of functional activity participation and independence in self-care tasks on the PEDI self-report score sheet (Appendix D). This measurement tool was used at the onset of the research period at the initial assessment session and again at the end of the research period at the final assessment session. In addition to the caregiver self-report on the PEDI, two functional activities were observed by the researcher in the initial and final assessment sessions. During the child's participation in the set functional activities, the researcher made qualitative observations with regards to their participation and timed the duration of the activity for each performance (Appendix E). The two activities selected for observation by the researcher were identified as feeding (use of utensils) and putting on shoes and socks. These activities were selected for their habitual nature within the participants' daily lives and as all the children were deemed to be involved in these activities on a daily basis. They were activities easy for the caregivers to implement in their home programmes. Observation of these two activities by the researcher allowed for extra qualitative data to be collected about the participants performance in functional tasks.

3.2.2.5 Compliance Diary (Appendix F)

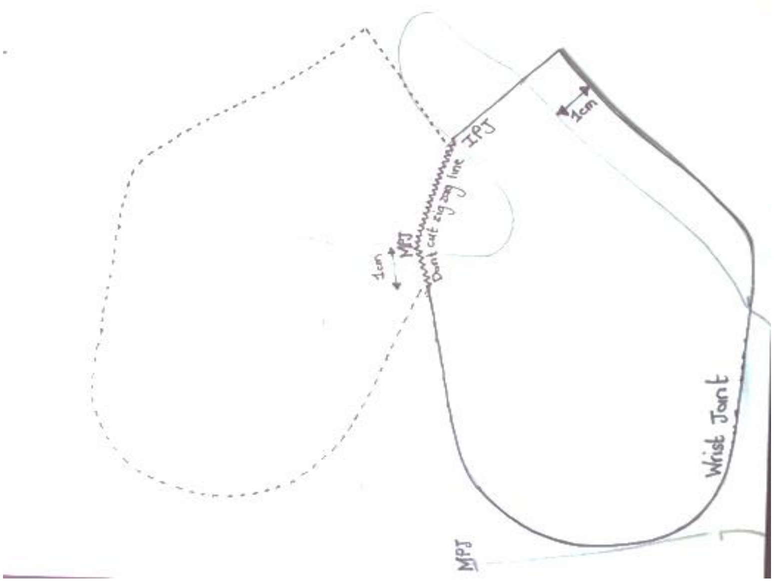
Much of the available literature on splinting the hand in children with CP highlights the significance of compliance in assessing the success of a splinting protocol (Delgardo, 2006) (Hughes, 2013). In this study, each caregiver was issued with a compliance diary compiled by the researcher at the initial session in order to determine for how many hours a day the child was wearing their splint – providing valuable information with regards to compliance and its effect on intervention success. The caregivers were instructed that the child should aim to wear their splint as much as possible during daily participation in functional activities such as play, feeding and dressing activities aiming for approximately 6 - 8 hours a day.

3.2.3 Research procedure

Once ethical clearance and permission to do the study had been received, suitable participants were recruited into the study. Once recruited, an initial assessment session was scheduled in which each caregiver was required to sign informed consent for participation in the study. If required, a translator was incorporated in this session to ensure that the caregiver understood what the study entailed and they were able to provide appropriate informed consent. Verbal assent was gained from children who were able to provide this during the initial assessment as well.

3.2.3.1 Data collection

The caregivers were then interviewed to obtain appropriate background and demographic information. At the initial assessment, each child’s data was recorded at baseline in terms of thumb range of motion, pinch strength, sensation ability, muscle strength and range of motion of the wrist, dexterity and participation in self-care activities engagement. A splint based on the pattern in Figure 3.2 was then manufactured for each participant.



MPJ – metacarpo-phalangeal joint of index finger

IPJ – Inter-phalangeal joint of the thumb

Figure 3.2 Pattern for thumb opennens splint

The splint manufactured in this study was a soft neoprene thumb opponens splint which fits snugly into the web-space between the thumb and index finger (Figure 3.3) and fastens along the ulnar border of the hand to provide thumb adduction.

Figure 3.3 Thumb opponens splint to provide thumb adduction

This splint is a functional splint and still allows for active use of the hand while wearing it and is therefore intended for use during the day in functional activity participation. This is a common splint used in the management of cerebral palsy thumb in palm deformity at Tambo Memorial Hospital and as a result was chosen for evaluation in the research study.

The participants' performance in pinch strength, dexterity and engagement in self-care activities was then re-assessed with the splint applied. All splints were made and issued by the researcher and were made specifically for each child. A photograph of each participant's hand before and after splint application was taken where appropriate consent was provided. Each caregiver was issued with a splint compliance diary which they were requested to complete each day at home. The technique for completing this diary was explained to the caregivers.

The caregivers were shown how to apply the splint correctly to ensure appropriate application in the home environment and were given the opportunity to practise removing and applying the splint in the session with the researcher's guidance. The caregivers of the participants were shown how to check their children's skin daily for any signs of pressure or discomfort and were advised what to do in case they noted any of these signs. The caregivers were advised to remove the splint and contact the researcher for an earlier appointment if they noticed signs of pressure areas developing.

The initial research session lasted approximately 90 minutes for each participant. A follow up appointment at the end of the initial assessment for review assessment and splint check was booked for a month after the initial assessment for each participant.

During follow up assessments the participants' splints were checked for appropriate fit and for any pressure areas and necessary adjustments to the splints were made during these follow up sessions. All adjustments and splint checks were performed by the researcher. At follow up assessment sessions, the participants once again were assessed for pinch strength, thumb range of motion and fine motor dexterity with this data being captured on the appropriate assessment forms.

At the final assessment, three months after initial assessment, the participants were assessed for range of motion, pinch strength, fine motor dexterity and functional ability (through observation of feeding and dressing tasks as well as through rescoring on the PEDI). These assessments were completed for the participant with the splint on and with the splint removed in order to assess any potential carry over effect the splint may have had on hand function and functional ability. Data from the final assessment was recorded on the assessment forms previously discussed.

During the data collection period the caregivers were contacted telephonically 2 - 3 days before their scheduled appointment in order to remind them of their appointment date and time and to ensure they were still able to attend. The caregivers of the participants were reimbursed for their travel expenses to participate in the study (reimbursement occurred at each session and was documented on a reimbursement sheet).

Data from all questionnaires and assessments as well as from the compliance diary were entered into a Microsoft Excel spreadsheet in order to allow for data analysis.

3.2.3.2 Data Analysis

Data were analysed using descriptive statistics including frequencies and medians. The difference in function over the four assessments for each participant was analysed using chi squared tests. Significance was set at a level of 0.05 for analysing change over the three assessments.

3.3 PART 2

3.3.1 Population and Sample

The caregivers of the children included in the study formed part of the sample for the qualitative aspect of this study. The caregivers of all the participants were female and ranged in age from 32 – 66 years of age. Five of the six participants' primary caregivers were their mothers and one of the primary caregivers was the child's maternal grandmother. All the caregivers were of African descent.

The highest level of education of the caregivers ranged from Grade Three to a higher diploma at university undergraduate level. Of the six caregivers, four of them were unemployed at the time of the study and two were employed (one as a teacher and the other as a researcher).

The researcher was a 27 year old female, a practising occupational therapist at TMH with approximately four years of clinical experience. She graduated from her undergraduate training at the University of the Witwatersrand in 2012 and started working at TMH in 2013 as a community service therapist.

3.3.2 Measurement Tools

3.3.2.1 Caregiver satisfaction questionnaire (Appendix G)

The gaining of functional skills and abilities is the primary goal of occupational therapy and an important aspect of assessing whether an intervention achieves this or not is to evaluate a caregiver's perception of the intervention method. The caregiver satisfaction survey in this study was designed by the researcher and contained five questions which examined satisfaction experienced by the caregivers with the splint prescribed, the wearing routine advised, the caregivers' belief in the interventions' efficacy in improving the participants' performance as well as any difficulties encountered with the splint.

3.3.2.2 Field notes and reflective diary

At each research appointment, the researcher made clinical notes about each participant in terms of their participation during the session, compliance to the splinting routine, tolerance of the splint in the session, comfort/fit of the splint and if the splint needed to be adjusted in any way during the session.

The researcher also kept notes on any comments or concerns raised by the caregivers in terms of the splints' comfort/fit or compliance and any other questions or concerns they may have had too.

A reflective aspect to these notes was also included focusing on barriers/difficulties associated with splinting this group of children in a resource constrained setting as well as any positive features noted by the researcher in this regard.

3.3.3 Research procedure

3.3.3.1 Pilot study

The caregiver satisfaction questionnaire was piloted in the Occupational Therapy Department at TMH by allowing for peer review by two paediatric therapists as well as two parents of children with CP who were already wearing splints. The participants of the pilot study were asked to comment on the questions included based on relevance, ambiguity and simplicity. The survey was then adjusted based on feedback provided from the survey.

Adjustments made included altering the wording of questions to maximise the ease with which they were understood, based on feedback from the pilot study. An important change was made to the first question presented on the feedback form. Initially the question stated: “Has the splint helped your child?” Feedback suggested that a subjective component should be incorporated to gain the caregiver’s perception and, as a result, was changed to: “Do you feel the splint has helped your child?”

3.3.3.2 Data collection

The caregivers of each participant completed a satisfaction survey independent of the researcher and placed the questionnaire into a sealed box which was only opened at the end of the data collection period in order to maintain the caregivers’ confidentiality. The research relationship was then terminated.

3.3.4 Data Analysis

The data from the questionnaires and the researcher’s reflections and notes were read to obtain a general sense of the data at the end of the study. The data were then analysed using content analysis and inductive coding by organizing the data into common ideas. A description from this information formed codes, which were combined into categories and themes. It was then determined how the categories and themes would be represented. These were then interpreted to capture the essence of the information (Creswell, 2003).

3.4 Control of variables and trustworthiness of qualitative data

As far as possible, language barriers were considered during participation in the study by ensuring access to a translator in each session during the data collection period. The same translator was used in each of the sessions when required by the participants/caregivers to maximise uniformity of the research procedure.

All splints were measured, manufactured, fitted and adjusted by the researcher according to a specific pattern. This allowed for the measurements and splints to be as uniform as possible during the study.

Throughout the study the same goniometer, pollexograph and pinch dynamometer were used in order to maximise uniformity of the assessment tools.

For the qualitative data the following were used to ensure trustworthiness:

- Credibility – credibility refers to the need to ensure that the study measures and investigates what it actually intended to measure (Shenton, 2004). This was achieved in this study by interviewing and incorporating appropriate participants to engage in the study and therefore ensuring confidence in the participants and their caregivers' experiences and the truth of the data. The use of triangulation in this study also allows for greater credibility of the data and results interpreted. Triangulation was used through the use of a variety of means of data collection including quantitative data measurements, caregiver interviews as well as observations made by the researcher (Shenton, 2004).
- Transferability – as qualitative research in general is specific to a small number of specific environments or individuals, it is important to demonstrate how the results and conclusions drawn may be applied in alternate settings or with different individuals (Shenton, 2004). In order to maximise possible transferability of the results and conclusions drawn in this study, a precise and in-depth description of the study's methodology have been presented so that the findings can be transferred more accurately to other occupational therapists who are interested in working within this specific field. This will allow for completion of similar studies in a range of contexts building on the available research regarding splinting in a South African context.
- Dependability – it is important to employ strategies to ensure that, if the research study was repeated in the same context, with the same methodology and with the same participants, similar results would be found and conclusions could be drawn (Shenton, 2004). In order to achieve this in this study, the methodology included is precise and specific allowing replication of the method if needed. The researcher only reported consistent and stable information gained from the interviews with the caregivers as well as from her own observations made during

participation in the study. Data analysis commenced with the assistance of an external auditor (co-coder), who would aid in ensuring that the researcher's biases do not influence the findings. Raw data from the study was stored as per the University of the Witwatersrand's requirements.

- Confirmability - within qualitative research it is important to ensure that the study findings are the result of the experiences and results of the participants rather than the biases and agenda of the researcher (Shenton, 2004). The researcher interpreted the data objectively and only reported findings which were derived from the participants. This was facilitated by making use of an external auditor (co-coder). Triangulation of data was once again essential in this study to ensure confirmability.

3.5 Ethical considerations

Ethical clearance for the study was obtained from the Human Research Ethics Committee at the University of the Witwatersrand (M150860)) (Appendix H). The Gauteng Department of Health was then approached for permission to conduct the research in the Occupational Therapy Department at TMH (Appendix I).

Written information sheets documenting the research procedure, purpose and risks of participation were given to the caregiver of each participant and the contents of the information sheet verbally explained to them too (Appendix J). Along with this information sheet, a separate sheet documenting how to care for the splint and factors to be aware of during the splinting programme was also explained to each of the caregivers and given to them to take home (Appendix K). The caregiver of each participant was informed that they were permitted to withdraw from the study at any point without any consequence to their child's treatment. Informed consent from each participant's caregiver was obtained prior to their engagement in the study (Appendix La). Each caregiver signed a consent form and gave permission for photographs of each participant's hand to be taken prior to and after splint application, if they consented to this (Appendix Lb). Lastly for those children where appropriate – the process of the project was explained to them and verbal assent gained (Appendix M)

The caregiver of each participant was informed that all the participant information was to be kept confidential through coding the participants. The name-code correlation was kept in a separate location away from the research measurements and was only accessible by the researcher.

Photographs of each participant’s hand were taken prior to splint application and immediately after splint application in the initial assessment as well as in the final session, if consented to by the caregiver of the participant. No identifying features of the participants were photographed and the photographs were coded to maintain confidentially.

For those children who displayed sufficient understanding, verbal assent was obtained. The purpose of the splint was explained to them and they were asked if they would be willing to wear the splint and participate in the assessment procedure. Only two of the five children in the study were capable of providing verbal assent due to cognitive limitations.

Caregivers of the participants received compensation for their transport expenses for attending the monthly research appointments. Documentation of this was maintained and the participants’ caregivers signed acknowledgement of the receipt of this compensation after each research appointment.

CHAPTER 4 RESULTS

4.1 Introduction

This multiple mixed methods case study design was based on the recruitment of similar participants with spastic hemiplegia with a thumb in palm deformity which was suited to the application of a neoprene splint. Five suitable participants accessing public health care and attending the CP clinic at TMH were recruited. All participants and their families lived in areas adjacent to the hospital which can be considered resource constrained in terms of the type of dwellings and a range of family incomes that placed them in a low to low middle socioeconomic bracket.

Only two of the five participants attended monthly occupational therapy appointments for four months and were assessed four times during the course of the research. The other participants did not attend due to financial constraints, being away in another province with their caregiver and difficulties getting to the hospital due to transport constraints.

Participant 2 did not return for the 2nd follow up visit or the final assessment.

4.2 PART 1: Quantitative Study

4.2.1 Demographics and medical information - Children with Cerebral Palsy

The five participants in the study ranged from three years to five years of age with 80% (n=4) being male and the remaining participant being female (20%). With the exception of one participant who suffered a head injury at the age of three months, all participants' caregivers reported birth complications resulting in CP. Only one caregiver reported a multiple birth as a complication with the other caregivers reporting prolonged and difficult labour as a contributing factor to their child's diagnosis.

There was a variety of home languages spoken amongst the participants and their caregivers. Three of the participants and their caregivers were fluent in English (60%, n=3). One participant and caregiver spoke Zulu as a first language and had

English as a second language with limited understanding, however. The remaining participant and caregiver spoke Portuguese as a first language and Zulu as a second language. This participant and caregiver do not speak or understand English at all. All assessment and research sessions were conducted in English with the help of a translator.

Only one of the participants presented with epilepsy as a comorbidity to their CP diagnosis. This participant's caregiver reported that his epilepsy is well controlled. No other participants presented with other co-morbidities.

Of the five participants, three presented on GMFCS level 2 and the remaining two participants presented on level 3. Four of the participants presented on MACS level 3 and the remaining participant presented on level 2.

Table 4.1 Demographics and medical history of children with Cerebral Palsy

		Participant 1	**Participant 2**	**Participant 3**	**Participant 4**	**Participant 5**
Demographics	**Age**	4 years	3 years 3 months	5 years 1 month	5 years 1 month	5 years 4 months
	Gender	Male	Male	Male	Female	Male
	Language	Zulu and English	Zulu and Portuguese	Zulu	English	English
Medical	**Diagnosis**	Spastic hemiplegia	Spastic hemiplegia	Spastic hemiplegia	Spastic hemiplegia	Spastic hemiplegia
	Side affected	Right	Left	Left	Right	Right
	Aetiology	Premature birth - a triplet	Head injury - 3 months old	Difficult birth	Difficult birth – lack of oxygen	
	Co-morbidities	None	None	None	None	Epilepsy - controlled
Functional	**Mobility**	Good	Good	Walking aid outside- falls often	Balance problems	Increased effort and tone changes
	GMFCS level	2	2	3	2	3
	MACS level	2	3	3	3	3

4.2.2 Client factors of the wrist and hand

Range of motion of the thumb, grip strength, sensibility of the hand and the ability to move the wrist against gravity were all assessed each time the participants attended therapy over a four month period. The results for each participant are presented according to each client factor due to the different measurements used for each factor.

4.2.2.1 Range of motion

Both passive and active ROM was assessed on both thumbs of each participant. All participants had full active and passive range in the thumb of their unaffected hand.

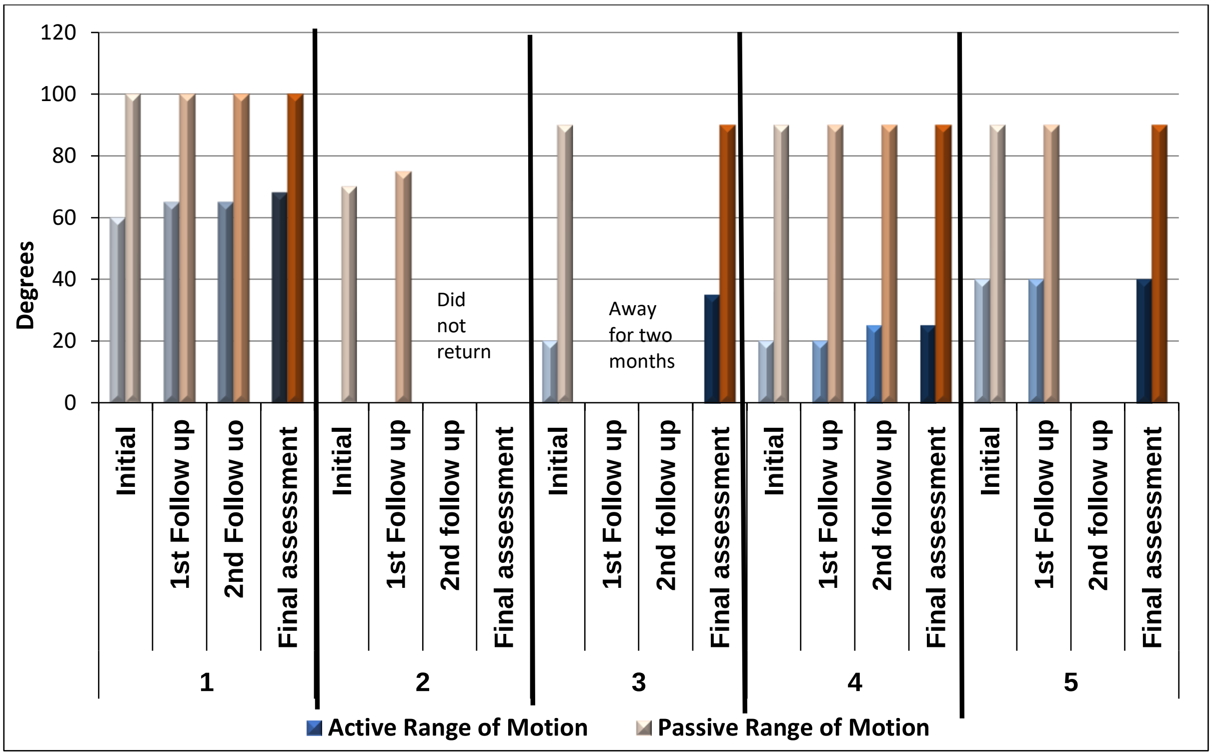


Figure 4.1 Change in range of motion for thumb abduction over four assessments

All the participants had a passive ROM of 90 degrees or more for thumb abduction, with participant 1 achieving full passive range of motion of 100 degrees (Figure 4.1).

The participants' active range of motion varied from 0 degrees to 60 degrees on initial assessment. Although three out of the four participants who were evaluated on the final assessment had improvement in the thumb abduction, the change for the four participants from the initial to the final assessment was only significant for Participant 3. Overall, for the participants, the increase in thumb abduction was not significant on the ANOVA Chi Squared. The Cohen r effect size for the increase in their thumb abduction from the initial to the final assessment was 0.80 which is large and indicates a clinically significant change at $p \leq 0.050$ (Table 4.2).

Table 4.2 Change in range of motion of the thumb for participants 1-5

	Passive Range of Motion			Active Range of Motion		
	Initial to final assessment	**Change**	**p value**	**Initial to final assessment**	**Change**	**p value**
Participant 1	100-100	0	1.000	60-68	8	0.706
Participant 2	70-75 2nd assessment	5	0.990	0-0 2nd assessment	0	1.000
Participant 3	90-90	0	1.000	20-35	15	0.023*
Participant 4	90-90	0	1.000	20-25	5	0.710
Participant 5	90-90	0	1.000	40-40	0	1.000

	Passive Range of Motion				Active Range of Motion			
	Chi squared	**p value**	**Effect size**	**p value**	**Chi squared**	**p value**	**Effect size**	**p value**
Group	0.03; .df 1	0.083	0.03	NS	64.00; .df 1	0.423	0.80	≤0.050*

Significance p≤ 0.05*

4.2.2.2 Pinch strength

Pinch strength of both the participants' affected and unaffected hands was assessed at each of the research appointments. All the participants except one were able to form the pinch required for assessment both prior to and post splint application. None of the participants achieved significant change in pinch strength although a greater increase was seen for all participants with the splint applied (Table 4.3, Figure 4.2).

In the final assessment session, the participants median pinch strength without the splint applied was 0.2kg compared to 0.4kg with the splint applied, but these results were not significant on the ANOVA Chi Squared with or without the splint.

Table 4.3 Change in pinch strength for participants 1- 5 with and without the splint

		Pinch strength (kg)			
		Unaffected hand	**Affected hand**		**p value**
			Initial and final score	**Change**	
Without splint	**Participant 1**	2.40	0-0.1.0	0.10	0.482
	Participant 2	5.60	0.0-0.5 (2nd assessment)	0.05	0.166
	Participant 3	2.50	1.0-0.9	-0.01	0.989
	Participant 4	1.00	0.00-0.10	0.10	0.428
	Participant 5	3.00	0.00-0.10	0.10	0.989
With splint	**Participant 1**	N/A	0.2-0.55	0.35	0.080
	Participant 2		0.0–1.0 (2nd assessment)	0.10	0.989
	Participant 3		0.8-1	0.20	0.327
	Participant 4		0.20–0.25	0.05	0.166
	Participant 5		Cannot form pinch		

	Without Splint				**With Splint**			
	Chi squared	**p value**	**Effect size**	**p value**	**Chi squared**	**p value**	**Effect size**	**p value**
Group	1.00; df = 1	0.317	0.73	NS	3.00; df = 1	0. 083	0.80	≤0.050*

Significance p≤ 0.05*

There was, however, a large effect size in the improvement without the splint of 0.73 which was not clinically relevant, while the 0.80 effect size for improvement on pinch strength with the splint on, was clinically relevant at p≤0.05 (Table 4.3).

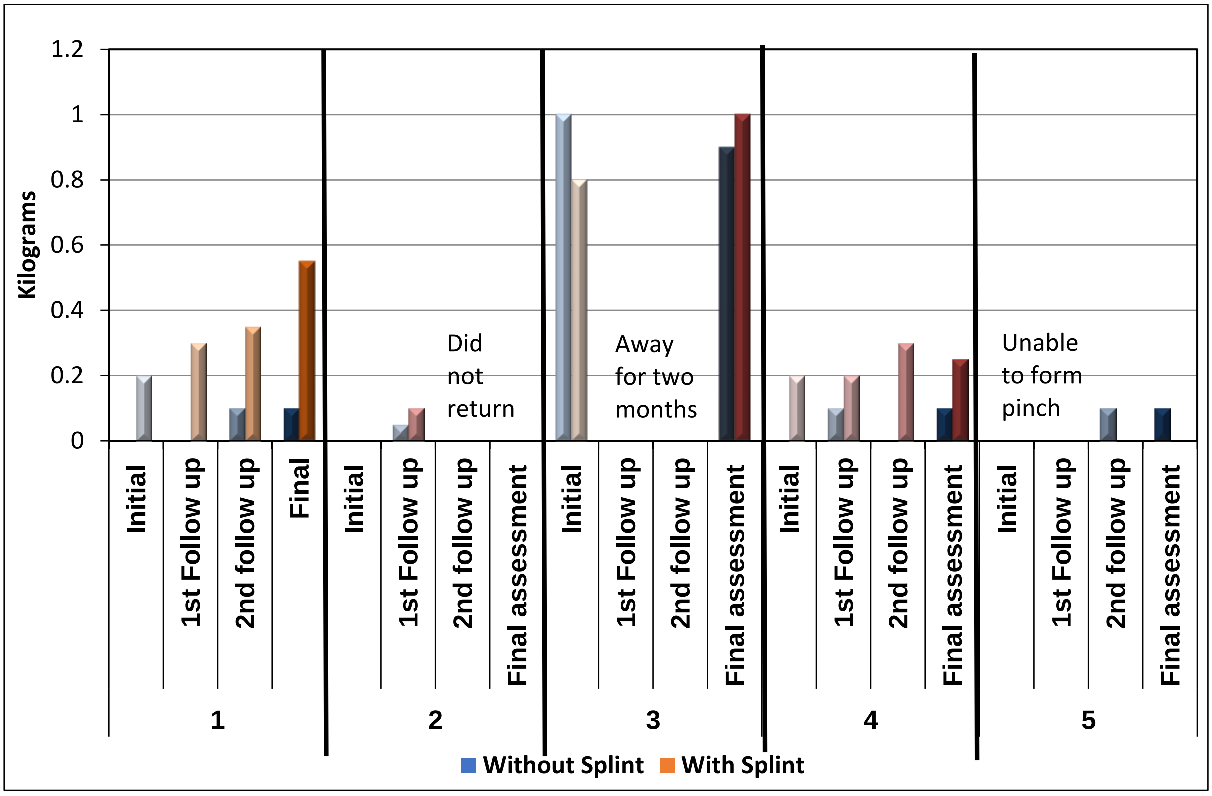


Figure 4.2 Change in pinch strength over four assessments

4.2.2.3 Sensation

All participants presented with intact sensation in both their affected and unaffected hands. All participants presented with the ability to distinguish tactile cues (Semmes- Weinstein monofilaments) appropriately and therefore this client factor was not reassessed throughout the data collection process.

4.2.2.4 Wrist movement

Active extension of the wrist was only measured at the initial assessment session in this research project. Wrist extension was assessed as a client factor which may have had an effect on the results of the splinting protocol. It was not expected that the splinting protocol would affect the participants' ability to achieve active wrist extension, as the splint primarily targeted the position of the thumb. Active wrist extension was therefore measured to assess its capacity to affect the results of a splinting protocol for the thumb.

Only two participants could achieve active extension of their wrist past neutral on their affected side. Participant 1 was able to achieve more active wrist extension with his unaffected hand than with his affected hand and participant 4 was able to achieve full active wrist extension of both hands equally. The remaining three participants could achieve a neutral wrist position (0° extension) but were unable to extend their wrists past the neutral position on their affected sides. These three participants could achieve full active range of motion of their unaffected hands into wrist extension. Of the five participants, three achieved increased active range of motion of their thumbs from initial assessment to the final assessment session. Participants 1 and 4 who were able to achieve active wrist extension against gravity and participant 3 who was unable to do so were the three who achieved increased thumb range of motion.

4.2.3 Performance Skills

Dexterity of the hand was assessed using the dexterity components of the Movement ABC standardised assessment. The assessments used were: posting coins (unilateral dexterity) and threading beads (bilateral dexterity). The results for each participant for each assessment are presented below.

4.2.3.1 Unilateral dexterity - Posting Coins

In the posting coins on the Movement ABC assessment at the initial assessment, four out of five of the participants scored better prior to the splints being applied. In Figure 4.3 and Table 4.4, it can be seen that the change in scores deteriorated for three of the participants who could post the coins without the splint applied but improved for the three participants who achieved the task with the splint applied.

Therefore, only Participant 1 showed improvement in hand manipulation with the splint applied and not applied. As Participant 5 was unable to form a pinch on the coins required after splint application in the initial assessment, he had a high score as he took an extended time to complete the activity. Participant 2 refused to attempt the assessment initially.

No significant difference was noted for the group without the splint applied using the ANOVA Chi Squared. The effect size for posting coins without a splint showed decreased ability and was small (-0.18) with no clinical relevance.

Table 4.4 Change in scores for posting coins for participants 1- 5

		Scores for posting coins			
		Unaffected hand	Affected hand		p value
			Initial and final score	Change in score	
Without splint	**Participant 1**	21	100-68	9	0.724
	Participant 2	30	Refused initially		
	Participant 3	53	250-265	-15	0.831
	Participant 4	57	155-165	-10	0.744
	Participant 5	62	300-315	-15	0.844
With splint	**Participant 1**	N/A	75-63	36	0.297
	Participant 2		Refused initially		
	Participant 3		175-120	55	0.095
	Participant 4		270-250	20	0. 749
	Participant 5		345-329	16	0.109

	Without Splint				With Splint			
	Chi squared	p value	Effect size	p value	Chi squared	p value	Effect size	p value
Group	2.16; df = 1	0.141	-0.18	NS	0.03; df = 1	0.862	0.91	≤0.050*

Significance p≤ 0.05*

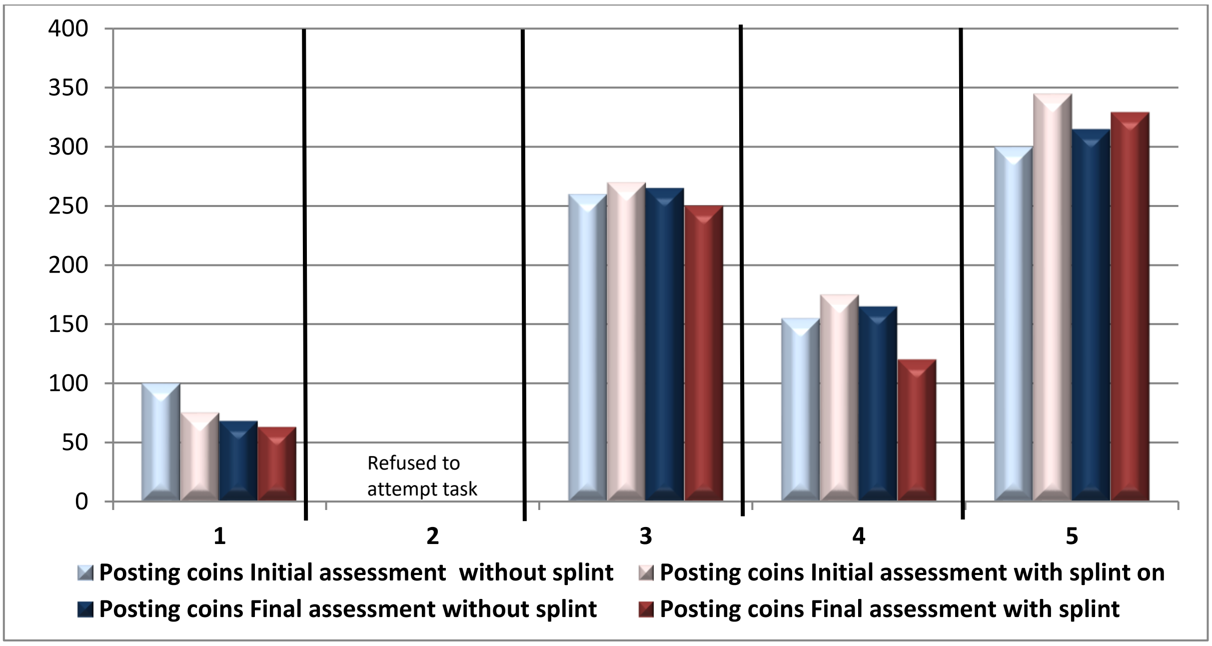


Figure 4.3 Change in unilateral dexterity - posting coins over four assessments

However, with the splint applied, the scores for three participants posting coins when the initial assessment was compared to the final assessment improved significantly on the ANOVA Chi Squared test, due to decreased time needed to complete the task. The large effect size of 0.91 indicated a significant clinically relevant result (p≤0.05).

4.2.3.2 Bilateral dexterity – Threading Beads

For threading beads on the Movement ABC assessment at the initial assessment, four out of five of the participants scored better in the initial assessment with their splints applied, except for participant 5 who was unable to form the required pinch with the splint on and thus took a long time to complete the task.

Table 4.5 Change in scores for threading beads for participants 1- 5

		Scores for threading beads		
				p value
		Initial and final score	**Change in score**	
Without splint	**Participant 1**	105-67	29	0.001**
	Participant 2	Refused initially		
	Participant 3	346-320	26	0.069
	Participant 4	300-245	65	0.104
	Participant 5	425-417	8	0.303
With splint	**Participant 1**	102-71	31	0.000**
	Participant 2	Refused initially		
	Participant 3	328-317	11	0.381
	Participant 4	240-240	0	1.00
	Participant 5	462-427	35	0.146

	Without Splint				**With Splint**			
	Chi squared	**p value**	**Effect size**	**p value**	**Chi squared**	**p value**	**Effect size**	**p value**
Group	1.36; df = 1	0.243	0.91	≤0.050*	1.04; df = 1	0.307	0.80	≤0.050*

Significance p≤ 0.05*
Significance p ≤ 0.01**

All the participants who completed the final assessment achieved lower on the final assessments without the splint applied. Only participant 1 achieved a significant change in the score, with and without his splint, with very little difference in a change in the scores (Table 4.5 and Figure 4.4).

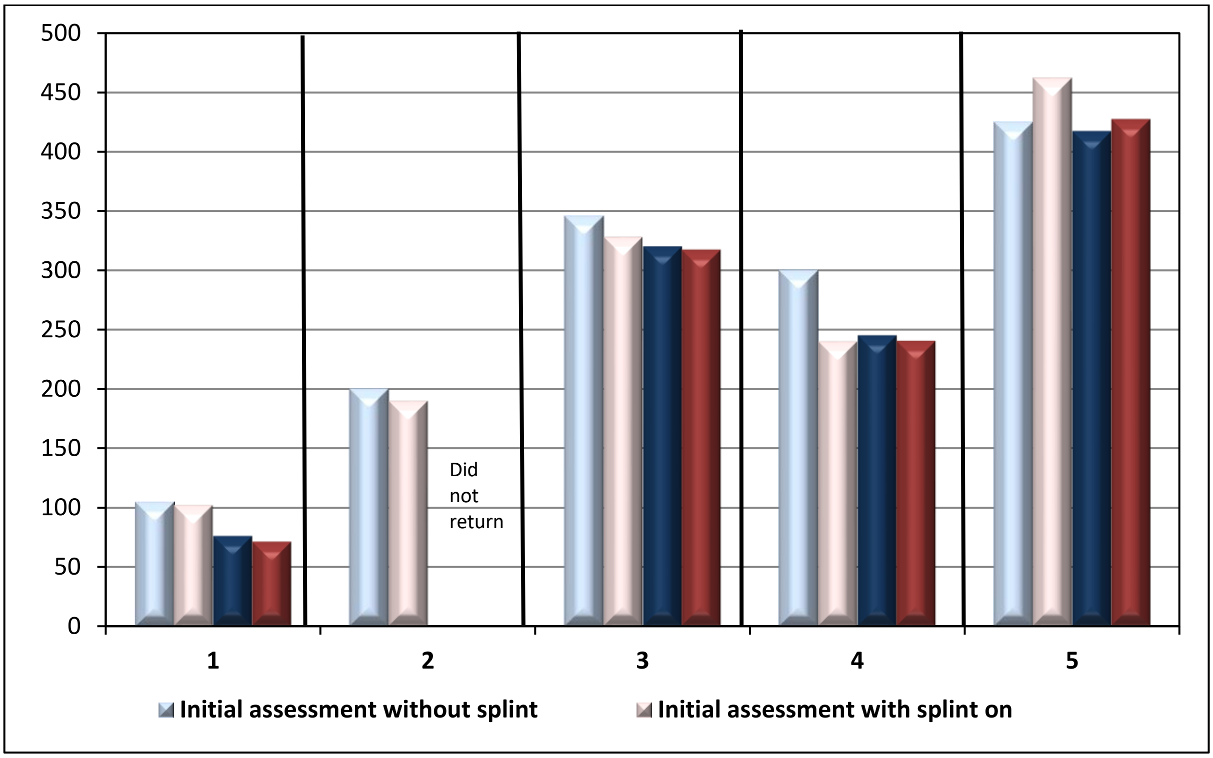


Figure 4.4 Change in bilateral dexterity threading beads over four assessments

There was no significant difference for the group with and without the splint on the ANOVA Chi Squared test. In general, the change in scores for performance with the splint applied was lower.

Both the assessment scores for splint off and on for each participant between the initial and final assessments showed clinical relevance at $p \leq 0.05$ with effect sizes of 0.91 and 0.80 for splint off and splint on respectively.

4.2.4 Occupational Performance

Occupational performance was scored from the interview with the caregivers as well as the observation of two activities – use of utensils for feeding and putting on shoes and socks.

4.2.4.1 Interview scores for the Pediatric Evaluation of Disability Inventory (PEDI)

None of the scores changed from the initial to the final scores in the interview with the caregivers (Table 4.6). It can be seen that Participant 1 had the highest median score for occupational performance and personal management activities with Participants 3 and 5 having the lowest scores.

Table 4.6 Scores on the Pediatric Evaluation of Disability Inventory (PEDI) from caregiver interviews

	Participant 1		Participant 2		Participant 3		Participant 4		Participant 5	
	Initial Score	Final Score	Initial Score	Final Score	Initial Score	Final Score	Initial Score	Final Score	Initial Score	Final Score
Food textures	4	4	4	DNA	4	4	4	4	4	4
Use of drinking containers	4	4	4	DNA	2	2	4	4	3	3
Tooth brushing	3	3	3	DNA	3	3	3	3	3	3
Hair brushing	n/a	n/a	n/a	DNA	n/a	n/a	2	2	n/a	n/a
Nose care	4	4	5	DNA	25	25	5	5	3	3
Hand washing	4	4	3	DNA	2	2	5	5	3	3
Body and face washing	4	4	4	DNA	1	1	4	4	2	2
Pullover garments	4	4	3	DNA	1	1	3	3	2	2
Fasteners	3	3	1	DNA	2	2	2	2	2	2
Pants	3	3	0	DNA	1	1	2	2	0	0
Toileting	4	4	2	DNA	2	2	2	2	0	0
Bladder management	5	5	4	DNA	2	2	3	3	0	0
Bowel management	5	5	3	DNA	2	2	3	3	1	1
Median Score	4	4	3		2	2	3	3	2	2

4.2.4.2 Observation scores and comments for the Pediatric Evaluation of Disability Inventory (PEDI)

Although the scores for the items observed by the researcher on the PEDI did not change, the following changes were noted for each participant in terms of the use of their affected hand and the time taken to complete the activity.

Table 4.7 Change in occupational performance items observed - Participant 1

		Feeding with utensils	**Putting on shoes and socks**
1	**Initial assessment**	**Score = 4** • Very limited active use of right hand in activity – holds spoon and fork in left hand and uses the edge of the table to push bowl against to scoop food up into utensil • With encouragement from mom able to use right hand to hold bowl but this fades as encouragement is withdrawn	**Score = 3** • 150 seconds to complete activity Very limited active use of right hand in activity • Right hand has significant associated reactions • Very weak grasp leading to frustration when trying to do up fastenings with both hands
	Final assessment	**Score = 4** • Increased independent use of right hand in activity – uses right hand to hold bowl while scooping food onto utensils	**Score = 3** • 138 seconds to complete activity • More spontaneous use of right hand noted • Grasp on fastenings appears tighter and less frustrating to child as he tries to manipulate using right hand

The changes noted were congruent with the participant's increased range of motion in the thumb, the increase in pinch grasp and unilateral and bilateral performance skills (Table 4.7).

Table 4.8 Change in occupational performance items observed - Participant 2

2	**Initial assessment**	**Score = 3** • Only uses right hand in feeding himself using a spoon. Refuses attempts to involve left hand in activity – when encouraged to use left hand refuses to continue participation	**Score = 0** • Hesitant to attempt activity by himself - is used to being assisted by his mom • Requires maximal assistance with activity. Refuses to incorporate left hand into activity at all • Able to get shoes and socks off using right hand only therefore decreased motivation to involve left hand
	Final assessment	DNA	DNA

This participant was not reassessed but initial observations are congruent with his lack of active movement for thumb abduction and lack of pinch strength (Table 4.8).

Table 4.9 Change in occupational performance items observed - Participant 3

3	**Initial assessment**	**Score = 2** • Only feeds using his right hand with no incorporation of the left hand into the activity. Tries to incorporate left hand with encouragement for very short durations but unable to sustain this involvement longer than 5-10 seconds	**Score = 1** • Very poor use of left hand in activity once again • Uses kicking of feet to assist in taking shoes off rather than using his hands to perform the activity • Only able to remove shoes with independence. Requires maximal assistance to put shoes and socks back on • Takes 1 minute 30 seconds to remove shoes and up to 5 minutes to be engaged in putting shoes and socks back on
	Final assessment	**Score = 2** • With encouragement able to use left hand for slightly longer periods of time in activity – up to 15 seconds to hold tub of yoghurt with left hand while feeding with right hand	**Score = 1** • Still struggles significantly to use left hand functionally in activity but does appear to use hand more spontaneously than previously • Grasp strength is still poor leading to a lot of slipping of the grasp and having to reposition item back in hand • 1 minute 20 seconds to get shoes off and approximately 4 minutes 30 seconds to get them back on still requiring maximal assistance to complete activity

The slight changes in functional hand use of his left hand were congruent with changes in active range of motion of the thumb and slight improvement in pinch strength with his splint applied. Little change in dexterity performance was noted which is congruent with the slight change noted (Table 4.9).

Participant 4 used her hand more consistently than the other participants from the onset of data collection. Her slight improvements in spontaneity of hand use and slightly improved time in functional performance is congruent with increased thumb range of motion, increased grip strength both with and without the splint applied as well as improvements noted in dexterity assessments (Table 4.10).

Table 4.10 Change in occupational performance items observed - Participant 4

4	**Initial assessment**	**Score = 3** • Good active attempts to engage both hands in feeding activity. Uses right hand to manipulate tools and materials and left hand to hold container of food. Able to lift container up to mouth to avoid messing when eating yoghurt	**Score = 3** • Able to take Velcro shoes and socks off with independence using both hands actively in activity within 1 minute 20 seconds. Uses left hand more as a support than an active manipulator but does involve it in activity
	Final assessment	**Score = 3** • Still using left hand as a support in the feeding activity – to hold the containers	**Score = 3** • Pinch strength appears to have improved in left hand and she is able to use the hand with greater consistency and less slipping of the grasp • Able to remove shoes in 1 minute 15 seconds

The results for participant 5 reflect the lack of change in the client factors and his inability to perform pinch grip with the splint in place. Although some improvement was seen in performance skills' times, this was not carried over into the occupational performance self-care observed by the researcher (Table 4.11).

Table 4.11 Change in occupational performance items observed - Participant 5

5	**Initial assessment**	**Score = 2** • Only uses left hand to complete activity. With encouragement attempts to engage right hand in activity, however only as a support. Uses hand as one unit in supporting bowl / container. Short lived involvement of right hand in activity	**Score = 1** • Uses feet to kick shoes and socks off. When encouraged to use hands, only uses left hand for activity. With encouragement able to attempt to use right hand but once again short lived. Become frustrated and wants to kick socks and shoes off • 6 minutes 45 seconds to remove shoes and socks using hands – mostly using left hand
	Final assessment	**Score =2** • Using left hand as manipulator and right hand as a support with encouragement. No real change in how hands are used in activity	**Score =1** • Still predominantly uses left hand. Grasp with right hand is very weak and not functionally appropriate for use yet • Still wants to kick shoes and socks off – with encouragement attempts to involve right hand but due to significantly weak grasp this is poorly functional and provides frustration

4.3 Summary

The participants of this study all live within the Ekurhuleni district of Gauteng and access therapy services for management of their CP diagnosis. Four of the five participants are of low socioeconomic background while one participant would be classed as a middle income family. The participants ranged between GMFCS levels II-III for participation in this study.

Improvements in active thumb abduction range of motion from initial assessment to final assessment was noted to have improved in three of the four participants who were assessed at their final appointments. Only Participant 3 had significant improvement of ROM of the thumb and, although the overall group change did not achieve statistical significance, the Cohen's r effect size revealed this result to be clinically significant.

Improvements noted between initial assessment and final assessment in terms of pinch strength were also evaluated. Improvements in pinch strength with the splint applied did not achieve statistical significance but the effect size showed clinically significant results. The results documented with the splint removed demonstrated no statistical or clinical significance.

The participants' engagement in unilateral and bilateral dexterity test items revealed the following: Unilateral dexterity showed no clinically relevant changes within the first session between initial assessment and initial splint application. No clinically significant change in dexterity between initial and final assessment without the splint applied was noted. However, with the splint applied in the initial and final assessments, a clinically significant improvement was noted. Bilateral dexterity test items showed similar results except for Participant 1 who improved significantly in the execution of this task. There was a clinically relevant improvement in bilateral dexterity between initial and final assessment for the group overall with the splint applied. A reduction in the time for bilateral dexterity between the initial assessment and final assessment without the splint applied was noted; however, this was not found to be clinically relevant.

The PEDI assessment scores were noted not to demonstrate any changes in the participants' functional abilities from initial to final assessment. Researcher observations and assessment during participation in select activities of daily living did, however, reveal slight changes in functional occupational performance.

Improved spontaneous involvement of the affected hand and reduced time for participation in feeding and dressing activities were noted in three of the five participants and appeared congruent with the observed improvements in active thumb range of motion, pinch strength and dexterity. Participant 5 demonstrated no notable change in his functional hand use during activities of daily living which was consistent with his lack of improvement in active thumb range of motion, pinch strength and dexterity.

From these results, the null hypothesis can be rejected with the exception of improvement of ROM and bilateral dexterity for two of the participants: There was no significant change in the body function, performance skills and participation in personal management activities of children with CP with a thumb in palm deformity after a three month period of wearing the soft neoprene thumb opponens splint. There was, however, a clinically significant change according to Cohen r effect sizes for ROM of the thumb, pinch strength and unilateral dexterity with the splint and bilateral dexterity with and without the splint in the three month period.

4.4 PART 2: Qualitative data

4.4.1 Context of the participants and their caregivers

In view of the importance of the caregivers' role in the implementation of the home programme and understanding the importance of the role of therapy and splinting, the caregivers' demographic data were collected. The stressors affecting the participants and the caregivers also needed to be considered in the context of this case study. Those external factors perceived by the caregivers and the therapist to play a role in the implementation of the splinting and home programme were considered in this part of the results.

4.4.1.1 Age, level of education and employment status of caregivers and monthly income

The ages of the participants' caregivers ranged from 33 to 66 years of age with all the primary caregivers being female. Four of the primary caregivers were the participants' mother (80%) and one of the caregivers was the participant's grandmother (20%).

In terms of highest level of education, one caregiver had a higher diploma (20%), one caregiver (20%) had completed her final year of high school (Grade 12) and one other caregiver (20%) had completed Grade 11.

Table 4.12 Context of children with cerebral palsy and their families

CONTEXT		Caregiver 1	Caregiver 2	Caregiver 3	Caregiver 4	Caregiver 5
Caregiver		Mother	Mother	Grandmother	Mother	Mother
Caregivers demographics	**Age**	33	37	66	42	39
	Gender	Female	Female	Female	Female	Female
	Highest level of education	Matric	Grade 5	Grade 3	Grade 11	Higher Diploma in Education
	Language	Zulu and English	Zulu and Portuguese	Zulu	English	English
Employment		None	None	Retired – runs a tuckshop	None	Teacher
Support for caregiver		Health services Social services	Health services	Health services Social services	Health services Social services	Good – community and health services
Family income		Father's salary and child care and Care dependency grants R2000/pm	Father's salary R2200/pm	Care dependency grant, Pension R3500/pm	Piece job payments and Care dependency grant R1800/pm	Parents' salaries R20,000/pm
Home environment	**Type of dwelling**	4 roomed house in a township	Shack in an informal settlement	4 roomed house in a township	Shack in an informal settlement	3 bed roomed house
	Number in family	4	9	4	5	5
Distance from Hospital		Walking distance	Accessible with public transport	In KZN for part of the year. Other times accessible by public transport	Accessible with public transport	Accessible with private transport
Health practitioner consulted		Hospital doctor	Hospital doctor and Traditional healer	Hospital doctor	Hospital doctor	Hospital doctor
Other services attended	**OT**	x	x	x	x	x
	Physio			x	x	x
	Speech			x	x	x
	Dietician			x		x
Schooling		Mainstream Nursery School 2 years	None	Crèche 2 years	None - left due to teachers lack of understanding	Crèche 3 years

Two of the caregivers had not completed primary school (40%). Three of the caregivers (60%) were unemployed for the duration of the research study, one caregiver was retired but was involved in running a tuckshop from her home premises during the day. The last caregiver was employed full time as a teacher (20%).

Of the five participants, three of the families relied on R1800 - R2500 per month (60%). One family relied on R3500 while the family of Participant 5 had access to R20 000 a month. Three of the families received social support in the form of a care dependency grant as well as other social grants (pension and child care grant). The other two families did not qualify for this social support. One family did not qualify as they were not South African citizens and the other family did not qualify as their monthly income from salaries was too high (Table 4.12).

4.4.1.2 Area of residence and dwelling type/resources available at home

All participants (100%) lived within the catchment area of Tambo Memorial Hospital within the Ekurhuleni district of Gauteng Province. One participant and caregiver spent part of the year in Kwa-Zulu Natal each year; however, still report Gauteng to be their permanent place of residence. Three of the participants (60%) and their families live in a formally built house, two of whom live in a township and the family of participant 5 live in a suburb of Boksburg. These families have access to running water and electricity within their homes. The remaining two families live in informal settlements in temporary housing (shacks) without access to running water and electricity. Three of the participants (60%) live within public transport access of the hospital relying on the use of taxis to get to appointments. One participant (20%) lives within walking distance of the hospital while participant 5 accesses the hospital through the use of private transport.

4.4.1.3 Health resources accessed by caregivers for their children

Four of the five participants’ caregivers (80%) trust in hospital based medicine solely for the management of their child’s diagnosis while one participant’s caregiver consults both doctors at the hospital and traditional healers for management of her child’s condition.

All the participants (100%) attend occupational therapy at least monthly. Three of the participants (60%) also receive physiotherapy and speech therapy on a monthly basis. Two of the participants (40%) also see a dietician monthly.

Three of the participants (60%) are currently attending mainstream crèche / nursery schools. These participants have been attending their schools for 2 - 3 years and their caregivers report they are happy with the service and support they receive at the schools. One of the participants (20%) has never attended school before while the final participant previously attended a mainstream crèche; however, recently left the school as her caregiver did not feel she received sufficient support from the teachers and felt as though the teachers did not understand her child’s condition.

4.4.2 Thematic analysis of qualitative data

For the qualitative analysis aspect of this research study, both the researcher and the participants’ caregivers shared their perceptions about the use of splints in a resource limited setting within a Gauteng government hospital occupational therapy service. The caregivers reported their comments through a caregiver questionnaire at the end of the research project while the researcher documented observations and perceptions throughout the research period. The results from this qualitative aspect of the research study will now be presented.

Table 4.13 Thematic analysis – themes, categories and codes

Themes	Categories	Subcategories	Codes
It was all worthwhile	Therapy related	Caregivers' experience	• Change in strength • Change in grasp
		Change in client factors, performance skills and occupational performance	• Immediate change of thumb position • Clinically relevant change
		Splint properties	• Facilitated function • Accepted by participants • Easy to maintain • Fabrication and fitting is not time consuming
		Standardised assessments	• Provides evidence • Effective use of resources
		Expectations of further improvement	• Will continue with splint • Positive feedback
	Home programme	Feasible	• Provided therapy at home • Did not require constant supervision and input
		Implementation	• Easy to do • Structure assisted compliance
Not all smooth sailing	Interfering challenges	Health system	• Referral issues • Staff availability • Resources
		Standardised assessments	• Not all suitable • Sensitivity to change of PEDI
	Environment	Caregivers' circumstances	• Responsibilities • Family attitude
		Resources	• Finances • Family support

Two major themes were identified from the evaluation of the qualitative data from the participants' caregivers and the researcher, namely: "It was all worthwhile" and "Not all smooth sailing" in relation to the splinting invention for children with thumb in palm deformity at TMH. The categories, subcategories and codes are presented above.

4.5 Theme 1 - It was worthwhile

4.5.1 Therapy related

4.5.1.1 Caregivers' experience

The caregivers of the participants who completed their splinting programme all had **positive perceptions** of the splint as an intervention method and all the caregivers requested for their children's splinting **protocol to continue**. The caregivers reported **changes in client factors including strength and grasp**.

- "*I want my child to continue - it is making her hand stronger."(C4)*
- *"The splint has helped him be able to hold objects tighter."(C1)*

4.5.1.2 Change in client factors, performance skills and occupational performance

The researcher noted and confirmed clinically relevant change in the group of participants and significant change in two of the participants in relation to client factors and performance skills as well as identifying some observed changes in the participants' participation and performance in the assessed daily activities within the short time of review.

A **change in thumb position was noted immediately** in the first session after splint application by the researcher and the caregivers and this change in position of the thumb is a source for encouraging compliance to the programme.

4.5.1.3 Splint properties

The splint used was soft and comfortable for children to wear

- *"[N]o problems with pressure areas or discomfort from wearing the splint." (r)* and **facilitated their hand function**. The splint used did not prevent active hand use by the participants and even for Participant 5 who could not pinch with the splint on, it was a tool to improve active functional performance.

- *"The use of this splint in particular supports treatment in connection with other occupational therapy interventions and not in isolation." (r)*

Once fitted in the initial session, it was easy to include the splint in other treatment sessions. The splint was easy to include in treatment activities focusing on functional activity participation (dressing, feeding, play) as well as in client factor centred treatments based on improving hand function components.

Soft splints appear to be more comfortable for and better tolerated by the children than hard thermoplastic splints. This increased caregivers' and children's willingness to continue wearing the splint as it was not disturbing to them and made it **acceptable to them.**

- "*The condition of the splints on return visits indicated they were being used regularly and caregivers reported they had no problem with washing and cleaning them as needed." (r)*

These soft splints were **also easy to maintain** and wash which is important in this age group of participants. As the participants were encouraged to use the splints during potentially messy activities such as feeding, washability of the splint was highlighted to be important. Caregivers indicated that even with limited access to running water this was not an issue for them.

After the initial assessment and splint manufacturing, replacement splints and small adjustments did not take long to implement.

- *"After becoming familiar with the splint design and gaining confidence in its production making replacement splints was much easier." (r)*

Fabrication and fitting replacement splints did not take up a whole treatment session and therefore other treatments could be incorporated into a standard 45 - 60 minute treatment session too. Velcro had to be sewn onto the neoprene fabric in construction of the splint and this was the only sewing required for splint manufacture.

4.5.1.4 Standardised assessments

The use of **objective measures** to evaluate therapy techniques is vital to ensure appropriate and effective use of resources. The use of standardised assessments offers a means for providing evidence/proof for efficacy of treatment techniques and protocols of treatment in occupational therapy.

4.5.1.5 Expectations of further improvement

The caregivers of the participants who were involved in the splinting treatment protocol all had positive perceptions of the splint and requested for their children's splinting protocol to continue in **expectation of further improvement and benefit in the future.**

- "*I want my child to continue with the splint."* (C1, C4)
- *"I think the splint is definitely helping him…..he may need more time to wear the splint."* (C5)

4.5.2 Home programme

4.5.2 1 Feasible

The caregivers of the child participants involved in the study identified splinting and **the use of a home programme as a feasible** method of intervention. Caregivers valued that the intervention was something that could be **carried out within their home environment.**

- *"It is good to have things that we can try at home to make him better…" (C1)*
- *"It is easy to use – I can use it at home."* (C3)

And that they did not have to constantly monitor the child and be with them during their busy day.

- *"The splint is something which can help my child without me having to be doing something with them all the time."* (C4)

4.5.2.2 Implementation

All caregivers reported it was **easy for them to implement the splinting programme** as applying the splint was not difficult and could be done before the child continued with their everyday occupational performance activities.

- *"It is very easy to use – it is easy to put on and use when he is playing or feeding himself."* (C3)

The structured programme encouraged **increased compliance.**

> "*Writing down how often my child was wearing the splint made me feel more responsible to put it on him."* (C1)

4.6 Theme 2 – Not all plain sailing

4.6.1 Interfering challenges

4.6.1.1 Health system

A common challenge within the context of the research project is the **late referral of children with CP to the Occupational Therapy Department.**

Delayed referral within this setting is associated with a few conditions:

- Limited caregiver awareness and insight about early development and therefore missing the early signs of developmental delay and possible CP
- Difficulty in getting to see a doctor due to long waiting times, delays in provision of services as well as long waiting times between receiving an appointment and further necessary investigations such as brain scans
- Waiting lists within therapeutic service delivery schemes result in a further delay in initiation of assessment and treatment for children

In general, the **severity of children referred to the service at Tambo Memorial Hospital seemed to be increased in comparison to more developed settings**. This contrast in CP severity makes the guidelines available for splinting of children within more developed areas less applicable to lower resourced areas within South Africa.

Another factor affecting provision of the splinting intervention is the **availability and experience of staff within the department.**

- *"Many therapists in the department lack expertise and confidence in splinting children with CP." (r)*

Access to necessary resources for splinting children with CP is not always available within resource constrained settings.

- *“The ordering and delivery of tools and materials needed for splinting is a time demanding process and often leaves departments waiting for months for required resources.” (r)*

The inconsistent presence of appropriate resources within the department poses the challenge of **issuing replacement splints** to children who have been started on a splinting protocol.

Splinting a child with CP can be a time demanding process which needs to be repeated at least every 4 - 6 months as a result of the child growing out of the splint and the stretching and wear and tear of the splints.

- *“Splint fitting can take between 15 - 30 minutes at a follow up appointment for each child depending on the therapist’s familiarity with the splinting pattern.” (r)*

4.6.1.2 Standardised assessments

Standardised assessments are, in general, expensive and unsustainable and as a result largely unavailable within a low resourced South African setting.

- *“In our department no formal standardised assessments for children with Cerebral Palsy are used by the therapists.” (r).*

Typically, the **standardised assessments** used in more developed or better resourced departments/centres **are inappropriate to use in lower resourced settings in South Africa.**

- “*In general, the severity of the CP of a majority of the children seen within the department makes the highly structured nature of many of the standardised tests inappropriate for use with a vast majority of the children.” (r)*
- *“Many of the children serviced by our department do not speak or understand English fluently which is the main language of instruction for a majority of the assessments.” (r)*

The occupational based assessments are not sensitive enough to identify change in performance through intervention and as a result measuring and recording a change in the children’s occupational performance was difficult to achieve objectively. The **PEDI standardised assessment was found to be insensitive to change** as a result of interventions offered within this study.

4.6.2 The environment

4.6.2.1 Caregiver circumstances

The manner and extent to which caregivers prioritise therapy visits influences compliance to therapeutic intervention programmes. Caregivers involved in the study were noted to have significant demands on them at home excluding the care of their child diagnosed with CP. **The high degree of pressure on caregivers within their home environment** is assumed to have an important impact on compliance to therapy programmes.

- *One of the caregivers involved in the study was noted to be the primary caregiver to six children under the age of 18. This caregiver reported "it is difficult to attend hospital for all the appointments for {…} because of transport money and time I need to look after my other children." (C2)*
- *Another caregiver reported that she felt "sufficiently supported at home and had many people available to help {…} attend his therapy appointments." (C5)*

Another caregiver reported the **difficulty associated with not being the person who brings her child to the hospital stating that:**

> *"… if my sister brings him to hospital, I don't know what has happened and what they have said I need to do … she doesn't always tell me." (C3)*

Potential tension and conflict within families and communities due to **differences in their understanding of the cause and subsequent treatment of CP is** also suspected to **impact compliance to an intervention programme.**

- "*My mother does not understand why my child is like he is … she believes he is bewitched so we are also seeing the traditional healer for his treatment."(C2)*

One of the biggest concerns for many of the caregivers identified by themselves was their **concern about where their child would go to school** and how they would access therapy resources once at school:

- *"I feel that I have support for my child now. I am worried where he will go to school when he is seven years old." (C5)*
- *"[T]herapy is helping me to support my child. I am not sure what will happen when he starts school at seven years and he can't come to hospital anymore."(C3)*
- *"I don't want my child to sleep at school when she starts." (C4)*

4.6.2.2 Resources

The researcher, together with the participants' caregivers, was able to identify numerous factors affecting the participants' ability to attend and benefit from therapy. **Financial resources** available to attend therapy are an important factor to consider in the compliance of children to their therapy routine.

- *"[I]t is difficult to attend hospital for all the appointments for {…} because of transport money."* (C2)

Because of this factor attendance of therapy appointment is not always considered as the highest priority.

4.7 Summary

In general, the caregivers of the participants involved in the research study had a positive perception of the splinting programme and all the caregivers of participants who completed the study requested for their children's splinting protocol to continue. Positive factors which afforded this opinion towards the splinting programme included the ease of splint use and application; the ease of cleaning and washing the splint; the benefit of having a treatment technique to employ at home that does not demand in itself more time and caregiver attention as well as the immediate change in thumb position noted by the caregivers when the splint was fitted initially.

Compliance to a therapy programme as well as to this splinting protocol is dependent on numerous factors. In this study, the following factors were identified as a factor affecting compliance to both the home programme as well as to attending follow up appointments at hospital: pressure on the caregiver to maintain a household, care for other children/dependents; familial and community pressure on caregivers with regards to the cause of CP for their children and consequently alternate treatment methods that should be followed; as well as financial resource constraints on caregivers which present difficulties in attending therapy sessions at hospital on a regular basis.

From the perspective of the researcher the following factors contributed towards a positive outcome of the splinting protocol: an immediate change in thumb position upon application of the splint in the initial assessment session was motivating and had a positive impact on further compliance. The splint used was noted to be soft and comfortable and at no point during the study were pressure areas or areas of discomfort noted for any of the participants. The splint allowed for continued active hand use due to its soft and mobile nature – which allowed for the incorporation of the splint into other treatment sessions and during active participation in activities of daily living.

Difficulties noted with the splinting protocol were however identified. Within a government hospital in Gauteng, materials for splinting are not consistently available and so interruptions to splinting resources are a common occurrence which will clearly affect the outcome of a splinting programme. Many therapists within this environment lack confidence and expertise in making and issuing splints to this population of patients and so continuity of service is once again not guaranteed. Standardised assessments, which are essential for objective measurement of treatment outcomes, are once again expensive and not always available within the setting. The PEDI, used in this study, was identified not to be sensitive enough to pick up on changes as a result to the splinting programme within the study period and therefore provided little input to the data collection process.

CHAPTER 5 DISCUSSION

5.1 Introduction

This discussion will be structured by reviewing each of the participants and discussing the factors which affected their splinting programme as well as the results obtained from each assessment. The child and caregiver participants' demographic information will be discussed along with the quantitative data obtained through their engagement in the study when considering the efficacy of the splinting programme. The effect of factors or categories identified in the qualitative themes in view of therapy and caregiver perspectives through the study will be presented. The caregivers' perceptions and researcher's perceptions and reflections from observations made throughout the study will also be incorporated.

5.2 Demographics and access to health care

The participants in this study were all from low to low middle income families with only one participant coming from a family that did not rely on social grants. Their families are amongst the over 17 million South Africans who rely on social grants as a source of income (Patel, 2017). This provides them with access to free health care until the age of six years but the healthcare system they have access to is overburdened and constrained in terms of the resources available (Mayosi & Benatar, 2014). They do not have access to interventions which have proved effective such as botulinum toxin (BoNT), diazepam, and selective dorsal rhizotomy for reducing muscle spasticity. However, the occupational therapist in the context of this study was able to offer bimanual training and home programmes for improving motor activity performance and/or occupational performance in self-care, all of which have also been shown to be effective in the treatment of children with CP. (Novak, et al., 2013). Although constraint therapy rather than splinting has been found to be more effective for upper limb function in Cerebral Palsy, this was not an option in this context due to the intensity of daily therapy required (Deluca, et al., 2006).

The participants' caregivers' education levels and living circumstances varied and were reflective of their socioeconomic status. Little research about the effects of these factors on the implementation of home programmes is available but Davies (2016) reported that language rather than level of education affected the implementation of home programmes in South Africa (Davies, 2016).

The effects of the participants' demographics and medical history is further considered under the discussion for each participant.

5.3 Efficacy of an Opponens Splinting Programme in a Resource Constrained Setting

To address the first objective of the study to determine the efficacy of a splinting programme for children diagnosed with CP with thumb in palm deformity, in changing body function, performance skills and participation in personal management activities, attending an outpatient programme at TMH in Gauteng, the change for each participant and factors related to the change were considered.

5.3.1 Participants

5.3.1.1. Participant 1

Participant 1 demonstrated consistent improvements in the client factors and performance skills measured throughout the data collection period, namely thumb range of motion, pinch strength, unilateral and bilateral dexterity. Even though his right hand was the hand affected, he had developed adequate fine motor skills with his left hand and was the only participant to achieve a significant improvement in bilateral hand function seen when threading beads.

He was also the only participant to demonstrate notable improvements in performance in occupational activities of daily living measured within the study. This participant's success in the splinting programme may be attributed to a selection of factors which are central and integrated to his management. Upon initial assessment, it was noted that this participant had better hand function than the other participants in daily activities as assessed on the MACS scale of assessment (level 2).

He was also assessed to have the greatest range of active thumb abduction at initial assessment out of all the participants. As suggested by Goodman and Bazyk (1991), this greater range of motion allowed for an improved use of the thumb in the hand function (Goodman & Bazyk, 1991) and this seems to have also contributed towards his positive response to the splinting programme observed in this study.

Upon initial assessment of occupational performance, it was noted that this participant used his affected hand in activities with encouragement as a supporting hand. Without this encouragement, he did not usually involve his hand in activities, however. Over the course of the treatment programme, it was noted that, in comparison to his initial assessment, by the end of the assessment period, this patient involved his affected hand in daily tasks more spontaneously. This is assumed to be as a result of the improvements noted in his thumb range of motion, pinch strength and bilateral dexterity. This was the only participant who demonstrated a notable change in the functional use of his hand during daily activities.

5.3.1.2 Participant 2

Participant 2 was the youngest involved in this study and was noted to be the least engaging participant in the assessment sessions. He refused to participate in many of the assessment tasks and was observed to have a difficult temperament – demonstrating an unwillingness to engage with the researcher even though a great amount of time was invested. His lack of engagement in the data collection process may have resulted from several factors:

The participant’s age may have influenced his engagement in the assessment activities. As a 3 year old, this participant’s cognitive skills and instruction following abilities as well as problem solving skills, judgement and perseverance are all expected to be less developed than the other participants who were all a little older than him. This supports the suggestion of Law et al that casting and splinting should be introduced after the age of four years in children with CP (Law, et al., 1997).

This was the only participant who sustained brain damage leading to the diagnosis of CP 3 months after birth when he sustained a head injury. In addition to all the demographic and medical complications noted with this participant, it is also important to note that he presented at initial assessment with the most limited active thumb range of motion, poor pinch strength, poor active wrist extension against gravity and reduced use of his left hand in unilateral and bilateral dexterity tasks. He presented with a high degree of learned non-use and even with encouragement from his caregiver, refused to incorporate his affected hand in daily activities – opting to not engage at all rather than use his affected hand in the activity. This factor, which is associated with the neuroplasticity of the areas of the brain being involved in a specific task with hand use, has been associated with poor outcomes of other therapy interventions too as identified in research (Forssburg, 2008).

5.3.1.3 Participant 3

Participant 3 presented on initial assessment with a nearly full passive range of motion of his thumb but markedly impaired active range of motion. At initial assessment, it was noted that this participant presented with the best pinch strength in his affected left hand prior to splint application of all the participants. At final assessment, it was noted that this participant was the only participant who achieved a significant improvement in his active range of motion of his thumb. This improvement in range of motion, along with slight improvement in dexterity assessments noted in the final session were not consistently carried across to any change in the scores for his occupational performance. This participant's performance and changes noted during the data collection period may be attributed to a range of factors.

Upon initial assessment of occupational performance, it was noted that this participant engaged his hand very seldom in daily activities. Over the course of the treatment period, only slightly improved spontaneous use of his hand in daily activities was noted with little to no change in time of performance being observed. This potentially highlights the neuroplasticity principle of "use it or lose it" which suggests that frequent use of the hand will lead to greater areas of cortical mapping in the brain further resulting in improved functional use of the hand (Forssburg, 2008).

5.3.1.4 Participant 4

Participant 4 was the only female participant of the study and was a 5 year old African female. This participant was the only participant who presented with full active wrist extension of her affected right hand and she was also the participant who was noted at initial assessment to use her affected hand most spontaneously in daily activities. However, she still presented on a MACS level 3 indicating notable impairment in hand function and thus it was not known how much her use of the hand in daily activities could be expected to improve.

Participant 4 demonstrated some improvement in client factors and performance skills measured, namely slight improvement in thumb active range of motion, pinch strength and performance of unilateral and bilateral dexterity with and without the splint on. However, no change in the scores for her performance of occupational activities was noted. It can be noted that the slight changes in client factors and performance skills was not carried over into occupational performance of tasks.

Upon initial assessment of occupational performance, it was noted that this participant had the most spontaneous use of her hand in daily activities, without any encouragement. At final assessment, no real change in occupational performance because of the splinting programme was noted. The limited improvement in client factors and performance skills achieved by this participant did not result in a change in occupational performance or may have required a longer period of splinting to demonstrate the potential improvement. Research typically shows that spontaneous use of the hand prior to therapy input is a positive predictor of intervention outcome (Forssburg, 2008). However, in this case, spontaneous active hand use at initial assessment did not show to hold any benefit to achieving positive results from the implemented splinting programme.

5.3.1.5 Participant 5

This participant’s limited success in the splinting programme may be attributed to a selection of factors. Upon initial assessment, it was noted that this participant had markedly impaired hand function – and presented on MACS level 3. He was assessed to have very poor active range of motion of his thumb at the initial assessment and this was largely unchanged at the final assessment session indicating a fixed contracture. He was unable to form the required pinch to measure pinch strength at the initial assessment with or without the splint. At the final assessment, he was partially able to form the grasp without the splint.

Upon initial assessment, it was determined that this participant was the most significantly impaired participant in terms of functional performance. The lack of change in his client factors and performance skills was mirrored in his continued poor performance in occupational tasks both with and without the splint on, in the final assessment session too.

In addition to the observations and results obtained from each child in isolation, some general observations were made from the participants as a group. The following points were derived from the qualitative aspect of the study from the caregivers and the researcher's perspective throughout the data collection process.

5.3.2 Efficacy of the splinting programme in relation to client factors, performance skills and occupational performance

This case study confirms the difference in determining the outcomes achieved for different individual participants according to various factors that played a role in the use of an opponens splinting in children with CP. It is essential to consider the goals of the splinting and treatment programme prior to issuing a splint. If the purpose of the treatment is to increase range of motion and facilitate caregivers to care for their child (increasing range of motion and preventing contractures to allow for maintained hand hygiene), a splint may be appropriate for prescription in many cases. If the purpose of the splinting programme is to improve functional hand use, more specific requirements for the selection of the appropriate candidates must be employed.

In agreement with other available literature, the splinting programme offered in this study was not to be considered in isolation from other methods of occupational therapy, but rather as a tool to stimulate potential improvement in functional activity participation and performance (Jackman, et al., 2013). This study included an occupation based assessment and intervention outcomes essential in occupational therapy which it was found could be provided using a splinting programme for children with CP in a resource constrained setting. Since positive change in performance skills in unilateral and bilateral dexterity was greater with the splint on for most participants, this supports the literature which suggests that splints may need to be worn for a much longer period of time to have a positive effect on the functional abilities of the participants (Jackman, et al., 2013).

Although, when considered as a group, the participants demonstrated clinically significant improvement in some basic client factors and performance skills, this did not result in change in personal management tasks as only one of the participants demonstrated improvement in his functional performance. Therefore, changes in client factor and performance skill abilities did not directly translate into improvements in functional activity participation. One potential explanation of this is that perhaps the data collection period was not long enough and the intensity of therapy not sufficient to demonstrate a significant change in functional performance of the participants. Thus, children with CP in this setting may require a longer intervention period before a clinically significant effect on occupational performance as opposed to client factors and performance skills, is observed.

Most previous research has also reported similar improvement in client factors and performance skills with very little research measuring occupational performance outcomes in personal management. Ten Berge et al did show improvement in ADL tasks with intensive weekly therapy over a two month period intervention period (Ten Berge, et al., 2012), indicating that even the therapy intensity may have affected the results in this study. The increase in scores in their study may be due to the fact that the participants only practised one chosen ADL task and not all aspects of personal management as was assessed in this study.

A positive outcome was that most of the caregivers of the participants as well as the researcher noted a **change in thumb position immediately** in the first session after splint application. Very few occupational therapy treatment techniques result in such a quickly observable change. Despite inconsistent changes in client factors and performance skills during the splinting process, many of the caregivers reported this immediate change in thumb position as a motivation to use the splint at home and encouraged compliance to the therapy programme. Based on the results from this study, it appeared that children with better thumb range of motion benefit from the introduction of a soft thumb abductor splint in addressing their thumb in palm deformity and improving their functional ability. This supported the available research in the field (Hanna, et al., 2003) (Blackmore, et al., 2006).

Other factors which appear to have played a role in the efficacy of the splinting programme and that are reported in the literature include the participants' age as well as the severity of the hand function deficits according to the MACS level. While Law et al (1997) emphasised the importance of early intervention with children with CP, they felt their study indicated that before the age of four years children did not benefit more when splinting was added to the routine occupational therapy programme. Delayed referral to therapeutic services is believed by the researcher to lead to a poorer outcome from intervention. Due to delayed referral, children may present with more developed deformities of their hands resulting in poorer participation in therapy and occupational tasks. Delayed presentation to therapy service is also associated with increased prevalence of learned non-use of the more affected hand resulting in poorer therapeutic outcomes of therapy. This was observed most notably with participant 5 who was the oldest participant of the study and who presented with the most severe functional impairments. This participant demonstrated minimal change in client factors and performance skills and no change to his functional performance which may be attributed to his delayed referral to the occupational therapy service. The splinting programme may have been more effective in the short term if these deficits had been prevented.

Participants with a MACS score of 3 did not improve as much as those with a score of 2. This is not unexpected as participants at level 2 have more spontaneous use of the hand in activities and do not have to rely on the caregiver to prepare the activity for them to attempt to use their hand in the activity. Participants at MACS 2 were probably more likely to attempt bilateral hand use even when not with their caregivers.

Within the context of this study, a number of observations and perceptions were recorded which also appear to have had an effect on the splinting programme. These factors are considered under the therapy as well as the environment and caregiver perspective.

5.4. Efficacy of the splinting programme from the therapy perspective

Objective 2 explored the factors that affected the efficacy of the programme from the therapy perspective including compliance with the home programme for each participant and from the observations and reflective perceptions of the researcher and therapist.

5.4.1 Participants

5.4.1.1 Participant 1

This participant was assessed to have age appropriate cognitive function and was able to follow multiple step instructions as well as maintain his attention on activities for an age appropriate duration. This facilitated his ability to understand the purpose for splint application as well as allowed him to follow the instructions associated with engaging in the standardised assessments to the best of his ability. Research has shown that children with poorer cognitive function tend to have further impaired physical abilities and ultimately poorer functional performance too (Hanna, et al., 2003) (Sewell, et al., 2014). The results obtained from this participant reinforced this.

As this participant presented with no associated co-morbidities to his CP, he only attends occupational therapy appointments on a regular basis at the hospital. This is expected to have influenced the implementation of the splinting programme at home as this participant’s caregiver only had to focus on one home programme from the occupational therapist, potentially resulting in greater compliance to this therapy programme in the home. Both the participant and his sister attend school daily, leaving time for the caregiver to care for the home when they are away at school. This may have resulted in this participant’s caregiver having increased time available to bring her child to therapy appointments and also resulted in her recording the times for which the participant wore the splint. She reported this made her more responsible about finding time to engage with her child routinely at home in home exercises and in encouraging the therapy programme. She was positive about the splint and its continued use for her child.

5.4.1.2 Participant 2

Participant 2 was the youngest involved in this study and was noted to be the least engaging participant in the assessment sessions. This is the only participant who sustained brain damage leading to the diagnosis of CP three months after birth when he sustained a head injury.

He refused to participate in many of the assessment tasks and was observed to have a difficult temperament – demonstrating an unwillingness to engage with the researcher even though a great amount of time was invested. His lack of engagement in the data collection process may have resulted from several factors:

This participant's mother reported that she feels under immense pressure because of her responsibilities to care for her family and so, at times, does not have time to complete home programmes with her child. This caregiver has to care for seven children, collect sufficient water for drinking, washing and cooking as well as collect enough wood for warming their home and for cooking. Research has shown that compliance to therapy programmes, including home programmes, is dependent on the ability of the patient and the caregiver to prioritise therapy as essential and to fit into the pre-existing daily activity routine within the home (Humphry & Case-Smith, 2005).

5.4.1.3 Participant 3

This participant was assessed to have impaired cognitive function expected for his age. He was able to follow simple single step instructions but struggled to remain focused on a specific task or activity for longer than 2 - 3 minutes without cues and encouragement. This required constant supervision and guidance from the researcher to complete assessments required for the study and could have been carried over into the home setting. Therefore, it would be expected that, within the home environment in order to engage the participant in therapy oriented tasks and activities, his caregiver would have to be solely focused on that activity and would have to dedicate specific time towards engaging him in home programme tasks. This is expected to have an influence on his caregiver's ability to complete the home programme and his compliance to home programme performance as it requires hands on facilitation from a caregiver at all times – demanding a great amount of time and effort. Research has shown the effect of impaired cognition and concentration skills in therapy engagement (Hanna, et al., 2003) (Aisen, et al., 2011) and this was noted with the performance of this participant in the splinting programme.

This participant presented with language and feeding impairments as associated/ co-morbid impairments to his CP diagnosis. Due to these impairments, the participant attends occupational therapy, physiotherapy, speech therapy and dietician clinics monthly at the hospital. As it was not always possible to ensure that all the appointments fell on the same day, this is likely to place increased financial demands on the participant’s caregiver to attend hospital more regularly than some of the other participants. This was also expected to have put increased pressure on the caregiver in terms of carrying out home programmes for all areas of therapy within the home environment as the therapy team works independently and does not ensure that they are providing home programmes that address the same goals. Research has shown that in order for home programmes issued by therapists to be appropriately implemented within the home environment, the home programme needs to be a priority for the family and also needs to fit into their existing routines and habits easily (Humphry & Case-Smith, 2005). Incorporation of home programmes from a variety of therapy teams may be overwhelming if the goals and aims of the home programmes were not agreed across the service.

5.4.1.4 Participant 4

Participant 4 was assessed to have mild cognitive impairment and language difficulties and so struggled to follow multiple step instructions. She needed cueing and guidance to complete most aspects of the standardised assessments required in the study. She did, however, have good perseverance and presented with an easy temperament, warming to the researcher and complying well with the activities asked of her. Research has shown the effect of poor cognition in engaging in therapy programmes and the results from this study support that (Aisen, et al., 2011) (Hanna, et al., 2003). As a result of her language dysfunction and reduced mobility, this participant attends monthly appointments for speech therapy, physiotherapy and occupational therapy and also receives home programmes from each therapist.

As this participant does not attend school, she spends the days at home with her caregiver which may have provided time for her therapy home exercise programmes from various therapists to be completed, even if they have different goals of therapy. Having home programmes from a number of different therapists may also reduce the compliance with any of the programmes although this caregiver was positive about the splint and keen for the continued use of the splint at home.

5.4.1.5 Participant 5

This participant was the only participant who was diagnosed with epilepsy as a co-morbid condition to his CP. Along with his epilepsy, he also struggled with language and feeding impairments as well as reduced cognitive ability. He struggled to follow single stage instructions and required constant encouragement and cueing to ensure engagement in the assessment tasks. It is expected that this level of encouragement and hands on assistance would be required for many tasks within his home environment too – placing large demands for time on his caregivers.

As a result of his level of function and his identified co-morbidities – this participant attends occupational therapy, physiotherapy, speech therapy, dieticians and an epilepsy clinic monthly in order to maximise his treatment. This places pressure on his caregiver to get him to hospital for all the appointments as well as to practise all exercises and activities given as home programmes from the different therapy teams. His attendance of appointments at hospital was facilitated by using private transport to and from hospital either with his mother or with another family member when his mother was unable to get time off work. Although he is compliant about attending therapy appointments, his caregiver's lack of understanding of his condition probably had an effect on her ability to ensure his compliance to splinting at home and to practise carry over in the home too (Friedman & Litt, 1987).

This participant's monthly attendance at appointments was afforded by his family's financial resources and private transportation; however, he also received a number of different home programmes from different therapists. Due to his caregiver's full time employment, it is likely that there were significant pressures on her time in implementing the home programmes and practising of daily activities with the splint at home. The primary caregiver did not attend all hospital visits with the participant which may have affected her understanding of the home programme as well. However, she was positive about him wearing the splint but did reflect on the lack of improvement he achieved.

5.4.2 Observations and perceptions in relation to therapy and compliance with the home programme

In addition to the observations of each participant in isolation, some general observations were made about the programme and the factors affecting therapy derived from the qualitative aspect of the study.

A benefit observed during the study was the **properties of the splint itself.** The splint being made from soft, mobile neoprene material was noted to be beneficial as it ensured the comfort of the child while wearing the splint. A more mobile and less restrictive splint was observed to encourage active hand use more than static splints would have allowed (Burtner, et al., 2008). The caregivers valued that the splint was easy to put on and remove and to care for in terms of washing the splint. This made the splint an appropriate option for children to wear when they are engaged in daily tasks. Typically, soft splints have been issued with the intention of improving functional hand use in occupational performance tasks and as a result the use of this splint in this study was deemed appropriate (Burtner, et al., 2008).

Throughout the data collection procedure, no areas of redness/discomfort were noted by the caregivers or the researcher and this demonstrates that the splint, if fitted correctly and monitored for size, is appropriate for use in growing children. Splinting as a treatment should only be considered when children are available to come back for regular fitting checks to ensure pressure areas and skin damage do not occur (Morris, et al., 2011) (Autti-Ramo, et al., 2005).

The research noted that the **use of standardised assessments** provided both benefits and restrictions in this study. Usually no formal standardised assessments for children with CP are used by the therapists at TMH, Occupational Therapy Department. There is no funding available for purchasing of the assessments and those that are available have not been developed for resource constrained settings in South Africa and they are often very costly and not sustainable once purchased. The lack of standardised assessments within the department does lead to difficulties documenting and evaluating a child’s progress in therapy objectively.

This research indicated that the standardised assessments, while providing essential objective measurements to document results and success of the splinting programme, were not all suited to the context. The occupational based assessment used within this study was found not to be sufficiently sensitive to measure a change in occupational performance during the intervention process. Documentation obtained from the PEDI was unable to provide sufficient insight into the participants’ performance before and after intervention. A more sensitive assessment to determine small changes in occupational performance would provide evidence of change after a short period and perhaps motivate the child and caregiver. While the standardised assessments for client factors and performance skills were responsive to change, it is difficult to use client factor assessments with children.

Although literature has found that a pinch gauge dynamometer is an appropriate tool for measurement of pinch gauge in children with CP when standard positioning techniques are employed (Mathiowetz, et al., 1984), in this study it was identified that the pinch gauge was not sensitive enough to the child’s ability to form the required grasp and to detect in small enough increments change in the strength of the pinch.

The Movement ABC was found to be an effective tool to use in the assessment of unilateral and bilateral dexterity of the hand in this study. As documented in recent literature, the Movement ABC has been deemed an appropriate test to use to assess hand function and dexterity components of children between the ages of 3 years to 16 years and 11 months and has been deemed to be sensitive enough to measure a change in response to interventions offered (Henderson, et al., 2007). In this study it appeared that children who attended school and most likely had access to stimulation activities such as posting boxes and threading activities were more able to perform these activities as they were more familiar with the tasks and their requirements.

A lack of experience is reported to result in a lack of confidence in splinting skill (Adrienne & Manigandan, 2011). At Tambo Memorial Hospital, access to more experienced and confident clinicians was available. This was a positive aspect in this study which resulted in the continuity of the splinting service. However, with a high staff turnover, valuable knowledge and experience is lost. An important aspect to consider prior to splinting a child with CP is whether staff with adequate expertise are available to continue the programme. If a child is splinted and benefits from the prescription of the splint, and then service is halted – it will have a negative consequence towards the treatment of the child and may cause more harm than if the child had never originally been splinted.

Access to necessary resources for splinting children with CP are not always available within resource constrained **settings.** Ordering and delivery of tools and materials needed is a time demanding process and often leaves departments and therapists waiting for months in between ordering and delivery of materials. This results in the therapist being unable to deliver the same service to each child who attends the department. The researcher identified this as a frustration and another potential reason that therapists may choose to rather avoid the use of splints completely with children with CP. The inconsistent access to resources for splinting also affects the issuing of replacement splints. Ideally each child will be provided with two splints at a time to ensure there is always a splint available when one is being washed or is lost. It was clear from this case study that it is essential not to use splinting as a blanket technique for all children with CP struggling with thumb in palm deformity. Factors that affect the efficacy of splinting must be considered so that essential resources which may be more appropriately used in other circumstances are not wasted.

Splinting a child with CP is a time demanding process which needs to be repeated at least every 4 - 6 months as a result of the child growing out of the splint and due to the wear and tear on the splint. Each splint fitting appointment takes approximately 30 minutes depending on the therapist's familiarity with the splint pattern and confidence in using the sewing machine. Within the research period of three months, two splints had to be replaced at least once due to the child outgrowing their splint. The high demand of time splinting intervention requires can affect other service provision in an already resource restricted setting. However, if a clinician is experienced and familiar with both the child and the splint being applied, this time requirement can be reduced and may then be an effective technique for use in occupational therapy practice.

Based on the results from this study, it appears that children with **better cognitive functioning** and **fewer co-mobilities** benefit to a greater extent from the introduction of a soft thumb abductor splint in addressing their thumb in palm deformity and improving their functional ability. This appears to support the available research in the field (Hanna, et al., 2003) (Blackmore, et al., 2006).

As a few of the participants attended numerous therapies and treatment clinics within the hospital (including physiotherapy, speech therapy, dietician clinics and occupational therapy), it was noted that these participants had numerous home programmes to carry out from each of the therapy departments. Although the caregivers never reported strain as a result of this – it was noted to have a potential influence on the overall success of therapy as well as effective compliance to occupational therapy home programmes. Limited integration and joined goal setting between therapies has been found to limit and affect the overall compliance and buy in to the therapy programmes in general – limiting child and caregiver participation in home programmes specifically and ultimately reducing the success of therapy outcomes (Hinojosa & Anderson, 1991) (Singhi, 2004).

The use o**f compliance diaries in this study** was encouraged by the researcher. Each caregiver was issued with a daily compliance diary and requested to complete the times her child wore the splint each day during the data collection period. As literature suggests an optimum time each day that splints need to be worn in order to be effective in achieving improvements in client factors and performance skill components, it was deemed that these compliance diaries were an important aspect of the study.

The caregivers reported that having to document when their child wore the splint during the day was encouraging to ensure they tried to use the splint as often as possible. However, the researcher has noted that the manner in which the compliance diaries were expected to be completed may have been inappropriate – demanding significant time to complete over the three month data collection period which led to inaccurate documentation and therefore limited reliability of the information obtained.

5.5 Efficacy of the splinting programme from an environmental and caregiver perspective

Objective 3 was to determine the perception of caregivers of the children diagnosed with CP, about the efficacy of a splinting programme and the factors which affect the efficacy of the programme.

5.5.1 Participants

5.5.1.1 Participant 1

This participant's primary caregiver has a secondary level of education and was aware and accepting of her child's diagnosis. The caregiver was unemployed, and spent her day caring for her family in the home. The family has access to basic amenities such as running water and electricity in the home creating a lower burden in terms of care of the home.

Although this participant comes from a family with a low socioeconomic status, he was fully compliant in attending all appointments at hospital and this was assumed to also be afforded by the family's home being in close proximity to the hospital.

This participant could attend therapy appointments by walking to hospital with his mother and therefore no financial implications on attending therapy were placed on the participant's caregiver. This was assumed to have benefited compliance with the therapy programme.

5.5.1.2 Participant 2

Neither the participant nor his caregiver was able to understand English, having come from outside of South Africa. This participant and his mother spoke Portuguese as a home language and had only a basic understanding of Zulu. A translator was used to maximise their understanding in the assessment sessions; however, the language barrier was assumed to have had a large impact on the child's participation in, and success from the splinting programme. This participant does not attend school and, as a result, is in his mother's care all day. His decreased exposure to unfamiliar children and adults within a school environment may also be an influencing factor leading to his unwillingness to participate in therapy activities.

This participant's mother has a primary school level of education but it may be the language rather than this which influenced compliance with and understanding of the splinting programme (Davies, 2016).

This participant lives in a family of eight in a home in an informal settlement without access to basic amenities such as running water and electricity. As a result of being a foreigner in South Africa, this participant and his family do not qualify for social support in the form of social care grants and rely entirely on his father's income from piece work he can obtain. Due to the high demands placed on this caregiver's time and lack of financial resources, attending hospital appointments for monthly therapy is not always viewed as a priority which has contributed towards his poor compliance to therapy programmes.

This participant's mother consults with a traditional healer as well as health services at the hospital for his care. This participant's caregiver reported that his grandmother believes that he is disabled because of a curse being placed on him and the only way to remove the disability and the curse is to seek assistance from a traditional healer. The caregiver reports she does not believe this; however, due to family pressures, she does take him to a traditional healer too. This aspect may have had an effect on the compliance of the participant with therapy appointments as well as incorporating the home programme within the home environment. Research has shown that family support facilitates true compliance with and buy in to a therapy programme (Dimatteo, 2004) and therefore inconsistent beliefs about cause and treatment of impairments is a factor which needs to be considered before implementing a therapy programme.

5.5.1.3 Participant 3

As neither this participant nor his primary caregiver speaks or understands English, a translator had to be used in assessment sessions to maximise understanding. The use of a translator in administering standardised assessments as well as provision of therapy service has been shown to affect the clinical outcomes of therapy as there is an altering in the manner in which the instructions are given and understood – unless the test has been assessed for validity and reliability within the translated language (Richardson, 2010) (Davies, 2016).

This participant's primary caregiver has not completed a primary school level of education. She is also the only caregiver who is not the participant's mother but his grandmother. This participant is the only child within his home environment and has access to water and electricity at home. His caregiver is retired and spends her days at home providing care for her family. This participant attends a local day care, giving his caregiver time to run a small tuckshop from her property while he is away at school. This is likely to have allowed his caregiver sufficient time to engage routinely with her child at home in home exercises which could have contributed towards the positive results noted from the splinting programme. Although when in Johannesburg this participant complies with all therapy appointments, he does spend up to 4 months of the year away from home in Kwa-Zulu Natal with other members of his family which disrupts his therapy programme. This factor may be associated with the poor carryover of improvement in client factors and performance skills into occupational performance noted with this participant.

Upon initial assessment of occupational performance, it was noted that this participant rarely engaged his hand in daily activities. Over the course of the treatment period, only slightly improved spontaneous use of his hand in daily activities was noted with little to no change in time of performance being observed. This potentially highlights the neuroplasticity principle of "use it or lose it" which suggests that frequent use of the hand will lead to greater areas of cortical mapping in the brain further resulting in improved functional use of the hand (Forssburg, 2008).

5.5.1.4 Participant 4

This participant attended appointments with her caregiver via public transport and always attended her appointments despite her family having the lowest income of all families in the study.

This participant's primary caregiver has a secondary level of education and is aware and accepting of her child's diagnosis. This participant's caregiver is unemployed, and spends her day caring for her family in the home. As the family do not have access to water and electricity, the caregiver has to collect water and fuel for heating the home and cooking.

5.5.1.5 Participant 5

This participant's caregiver presented with the highest level of education of all the caregivers involved in the study. This was assumed to be associated with a better understanding of the diagnosis and result in better compliance with therapy. However, it was noted that in this study, this caregiver demonstrated an impaired understanding of her child's CP diagnosis. She reported that she was not aware of the name of the condition and was not aware of what had caused the impairment either. It is likely that, with the caregiver's level of education, rather than being unaware of these factors, she is more than likely in denial about her child's diagnosis.

The family have access to amenities such as a separate bathroom and electricity within their home. Both the participant and his sister attend school daily while their mother is at work.

Although this participant comes from a family with better socio-economic benefits than the other participants within the South African context, this did not provide the participant with a more positive outcome in terms of the therapeutic splinting programme.

In addition to the observations and results obtained from each child in isolation, some general observations were made from the participants as a group. The following points were derived from the qualitative aspect of the study in relation to the environment in which the children live and their caregivers.

5.5.2 Perceptions in relation to the environment and caregivers

Within the resourced constrained context of therapy at TMH, it was identified that the prescription and **implementation of home programmes are positive** and can be extended beyond a splinting programme. Many of the caregivers remarked that they appreciated being able to offer support for therapy to benefit their children within their home environment. The researcher noted that having a concrete structured home programme to implement with the participants within their home environment was beneficial. The use of a specific individually designed home programme with clear instructions applied to each child is thus recommended and supported by this study and the literature (Davies, 2016) (Humphry & Case-Smith, 2005).

Caregivers appear to value intervention methods that are easy to apply and accessible within their own environment (Humphry & Case-Smith, 2005). The caregivers also noted that the splint was a form of intervention that did not demand constant input from them while using it at home. This feature of the splinting programme facilitated the intervention fitting into the caregivers’ routines and, as a result, is likely to have facilitated compliance with and buy in for the intervention technique.

The use of home programmes within resource constrained South African contexts can be used to overcome the limited amount of individual therapy that can be offered within the hospital context. As many of the participants only attend therapy once a month – a majority of the learning, development and therapeutic input will need to be applied within the home context. Home programmes are therefore an appropriate method to maximise therapy goal achievement within the resource constrained setting (Humphry & Case-Smith, 2005).

The language of instruction used in therapy is often limited by the therapists’ knowledge of South African languages. As evident from the participants of this study, many of the children within the occupational therapy service at TMH do not speak or understand English fluently and, as a result, the use of English as the language of instruction for the assessment and intervention affects outcomes of the therapy. Although translators are used, this study confirmed that this factor appears to continue to affect the efficacy of therapy including splinting and home programmes (Richardson, 2010) (Davies, 2016).

Language was therefore one of the main factors which affected understanding of the therapy programme and was observed to have an effect on compliance with and benefit from the implementation of this splinting programme. The participants and caregivers who were able to communicate directly with the therapist, because of their language proficiency, appeared to have been more consistent in their attendance of therapy appointments and, with the exception of participant five, appeared to have demonstrated an improvement in client factors and performance skills as well as a slight change in their occupational performance. Participant 2 who was unable to communicate with the therapist (and who was also seeking treatment from a traditional healer indicating poorer buy in to the therapy programme) was not compliant with the therapy programme and did not return for the remainder of the data collection period.

It also became apparent that for success to be achieved in a splinting programme, the caregiver of the child being splinted needs to be invested in their child’s therapy programme and have time and resources available to implement and practise activities within the home environment. The two participants who struggled most in applying the home programme and in achieving the desired results from the splinting programme were participants 2 and 5. Environmental pressures prevented the caregiver of participant 2 from attending her child’s therapy appointments and his home programmes could not always be a priority for her. The caregiver of participant 5 works full time and consequently is not at home as much as the other caregivers to implement a home programme with her child. This caregiver also presents with denial about her child’s condition which could have further impaired her implementation of the home programme. It is likely that with the time pressures on both these caregivers, they were able to invest less time encouraging their children to engage in daily activities with their splint. It is therefore noted that in order for a splinting programme to be appropriately implemented within the home environment, it is essential that the child‘s caregiver has time and resources available to engage with her child and that the programme should be adjusted to fit into the caregiver’s schedule (Davies, 2016).

Within the context of this study, it was noted that splinting intervention offered in a resource constrained setting does not directly prevent the implementation of a home programme. It is rather expected that time constraints on the caregiver which affect her ability to spend time implementing the programme may have a greater effect. Also from this study, it became apparent that the participant's and caregiver's environmental situations could have an effect on implementation; however, this case appears not to have been affected by socio-economic status and household income.

5.4 Limitations of the study

The small number of participants in the study is a major limiting factor when it comes to the generalisation of results of this study. Due to the severity of diagnosis of many of the children with CP at TMH and the exclusion of many of these children due to the inclusion and exclusion criteria of the study – only a few children were deemed appropriate for participation. The dropout rate of 20% of the study was also a limiting factor.

The use of the PEDI as an outcome measure brought into doubt the sensitivity of the test to assess changes over the intervention period of three months. The limited sensitivity resulted in little objective data being drawn from the scores of the pre-intervention and post-intervention ranking on the scale. This resulted in functional changes in participant performance having to be assessed by the researcher only and with no sensitive standardised outcome measure.

The completion of compliance diaries by the caregivers is not believed to be a specific and accurate measure of compliance due to how it was required to be completed. Expecting a caregiver with already limited time resources to complete an hour-by-hour timetable each day for 3 months was not an effective manner in which to assess the average time of wearing and could have been altered to just documenting how many hours each day the participant wore the splint rather than documenting hour by hour.

As the study was completed in a case study manner without the presence of a control group – the possible biases of the researcher have not been able to be excluded. Although attempts were made to ensure objective measurement of the data, researcher bias is always a factor to consider when a randomised control trial is not employed.

5.5 Summary

In summary, it appears that the following factors will afford the benefits of a splinting programme on functional activity performance for children diagnosed with CP in resource constrained settings within South Africa: Fair to good functional hand use at initial assessment (MACS level 2); fair to good cognitive ability for age (Sewell, et al., 2014); ability for the child and caregiver to communicate effectively with the clinician; caregivers being aware of and accepting of their child's diagnosis (Dimatteo, 2004); caregivers who are available and involved in implementing home programmes with their child and a child's willingness to involve their affected hand in functional activity, with encouragement if necessary and not necessarily spontaneously with independence, but should have a willingness to attempt to use hand in daily activities (Forssburg, 2008); a capacity to make regular follow ups at the hospital for splint checks to ensure that the splint is not causing irritation or pressure areas to the skin of the hand is also essential (Autti-Ramo, et al., 2005) (Berge, et al., 2012).

Despite some of the clinically significant results obtained from the study – due to the limited sample size and population involved in the study, the positive results obtained cannot be generalised. As a result, further research is still needed into the potential effects splinting may have on thumb in palm deformity in children with CP in poorly resourced treatment settings in order to reach a more solid conclusion. However, the guidelines derived from this study can be used to guide clinical reasoning for clinicians when trying to decide whether or not splinting is an appropriate treatment technique to trial with this population of children.

CHAPTER 6 CONCLUSION

Firstly, it is important to note that the significance of this research was to determine the effect of a low resourced setting of splinting as a treatment technique for children with CP within the South African context. With the high incidence of CP noted, particularly in developing countries where resources are limited, it is essential to identify effective treatment methods to improve not only the client factors and performance skills of these children but as occupational therapists their performance in occupational activities as well (Van Naarden Braun, et al., 2016).

Within the setting of TMH, an average of 60 children with CP are treated in the occupational therapy department each month. Of these children, approximately 45 attend monthly CP clinic appointments due to the severity of their diagnosis. Many of these children are diagnosed with spastic quadriplegic CP with significant co-morbidities and are typically on a GMFCS and MACS level 5 with severely limited engagement in daily activities. As a result of their extremely low level of functioning and cognitive impairment – these children could not be considered for engagement in the study due to the exclusion criteria. All the participants of this study were diagnosed with spastic CP in accordance with this being the most prevalent form of CP, contributing to up to 80% of documented diagnoses (Sewell, et al., 2014). Four of the five participants are expected to have sustained the brain damage leading to their diagnosis of CP either during prenatal development or at birth which again is in accordance with typical statistics of the diagnosis (Sewell, et al., 2014). Only one of the participants sustained his CP diagnosis due to a postnatal head injury. Because of the inclusion criteria for the study, all of the participants were noted to have significant involvement of their upper limbs which is once again noted in up to 80% of CP cases – highlighting the significance of identifying effective treatment methods (Burtner, et al., 2008).

Typically in the literature – children diagnosed with spastic CP are splinted with two separate intentions for treatment. Firstly, splinting can be implemented to increase range of motion, to decrease the occurrence of contractures and maintain body structure for function and secondly to improve performance in activities of daily living (Jackman, et al., 2014) (Steultjens, et al., 2004). From this study, it became apparent that splinting children with spastic hemiplegia resulting in a thumb in palm deformity appears more consistent in achieving an improvement in range of motion, preventing contractures and maintaining body structure as opposed to improving performance in occupational tasks. This is an important outcome to consider when prioritising the use of resources and time for splinting children with CP. Limited efficacy of splinting children with CP in improving functional outcomes needs to be considered in an attempt to save and use resources carefully in already resource limited settings.

6.1 Recommendations

To repeat this study in other resource constrained environments with a longer follow up period in order to maximise the data obtained and therefore allow for greater generalisation of the data and to create more stringent guidelines for splinting of children with CP.

Ideally the study should be done over a longer data collection period in order to allow for more participants to be recruited to the study and to assess the implications of splinting in a wider range of children. Alternatively, the study could be replicated in numerous settings to achieve the wider sample size and variation desired. This in itself may present potential limitations as a variety of clinicians and a range of people from a variety of environments would be participating – making standardisation of the study more challenging.

A study specifying the amount of time required for splint wearing to achieve successful outcomes would be beneficial. Different groups of participants could each be prescribed different periods to wear their splints during the day to evaluate the optimal wearing period.

A more sensitive outcome measure for functional engagement should be considered for use. Although the PEDI did provide information about the baseline level of functioning of the participants – it was not sensitive enough to identify change as a result of the intervention during the three-month period.

Due to the potential effect of delayed referral to therapy services on outcomes of therapy, future studies should take note of time of referral noting in particular the child's age and functional level as well as degree of learned non use of their hand at the start of treatment.

As there were insufficient participants to use an experimental study design, this would be recommended in future research to contrast the effect of splinting and home programme implementation rather than just home programme implantation on the development of hand function.

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APPENDIX A

DEMOGRAPHIC QUESTIONNAIRE

TO BE KEPT SEPARATE

PARENTS NAMES

MOTHER

FATHER

PRIMARY CAREGIVER _

NAME______________________________

CHILDS NAME_________________________________

CONTACT NUMBER___________________________________

ALTERNATE CONTACT NUMBER____________________________

IF DIFFERENT CARER WHO ATTENDS OCCUPATIONAL THERAPY WITH THE CHILD

NAME______________________________

CHILDS NAME_________________________________

CONTACT NUMBER___________________________________

ALTERNATE CONTACT NUMBER

Date of interview________________________ Client code

Information about the child:

1. **How old is your child?______________________________**
2. **What is the gender of your child**

Male		**Female**	

3. **What treatment does your child recieve and how often?**

Health professional	**Tick**	**How often?**
Occupational Therapist		
Speech Therapist		
Dietician		
Physiotherapist		
Doctor		
Traditional healer		
Social worker		
Other:		

4. **What do you understand about what is wrong with your child? Who explained this to you?**

____

____

____

____

____

5. **Does your child go to school / crèche? Since when have they attended?**

Yes		**No**	

____

____

____

____

Information about the child's family:

1. **Who is the child's primary caregiver?**

Mother	
Father	
Grandparent	
Sibling	
Aunt / uncle	
Other	

2. **How old is the child's primary caregiver?____________________________**
3. **What is the primary caregiver's highest level of education?**

Less than grade 7 (standard 5)	
Grades 7 – 11 (standard 5 – 8)	
Matric (grade 12 / standard 10)	
College or technikon	
University	
Other (specify)	

4. **Does the primary caregiver work? What work do they do?**

____

____

5. **What is the average monthly income into the house?**

____

____

6. **From where is income into the house obtained?**

Wages / salary	
SASSA grants • **Child care grant** • **Care dependency grant** • **Pension**	
No income	
Other (specify)	

7. **What ethnic group does your family belong to?**

Black	
White	
Mixed race (coloured)	
Indian	
Other (specify)	

8. **How many people live in the home with the child? (Write the number of people under the correct age band)**

Age band	**Number of people**
0-6 years	
6-18 years	
18 – 65 years	
65+ years	

9. **Do you feel like you have enough support and information to cope with your child at home?**

____

____

____

10. Is there anything else you would like us to know about your child or your family?

____

____

____

APPENDIX B

Biomechanical and sensory assessment of the wrist and hand

INITIAL ASSESSMENT **Date of assessment:____________**

Range of motion

Initial				**After splint application**			
Active		Passive		Active		Passive	
R	L	R	L	R	L	R	L

Pinch strength

	Initial		**After splint application**	
	Right	**Left**	**Right**	**Left**
1st attempt				
2nd attempt				
3rd attempt				
Average				

Sensation (before splint application)

	Left hand	**Right hand**
Semmes - Weinstein filaments		
Stereognosis (out of 5)		

Wrist movement (before splint application)

	Left hand	**Right hand**
Degree of movement against gravity		

APPENDIX B
Biomechanical and sensory assessment of the wrist and hand

FINAL ASSESSMENT **Date of assessment:**_____________

Range of motion

With Splint on				**With splint removed**			
Active		Passive		Active		Passive	
R	L	R	L	R	L	R	L

Pinch Strength

	With Splint on		**With Splint Removed**	
	Right	**Left**	**Right**	**Left**
1st attempt				
2nd attempt				
3rd attempt				
Average				

Sensation

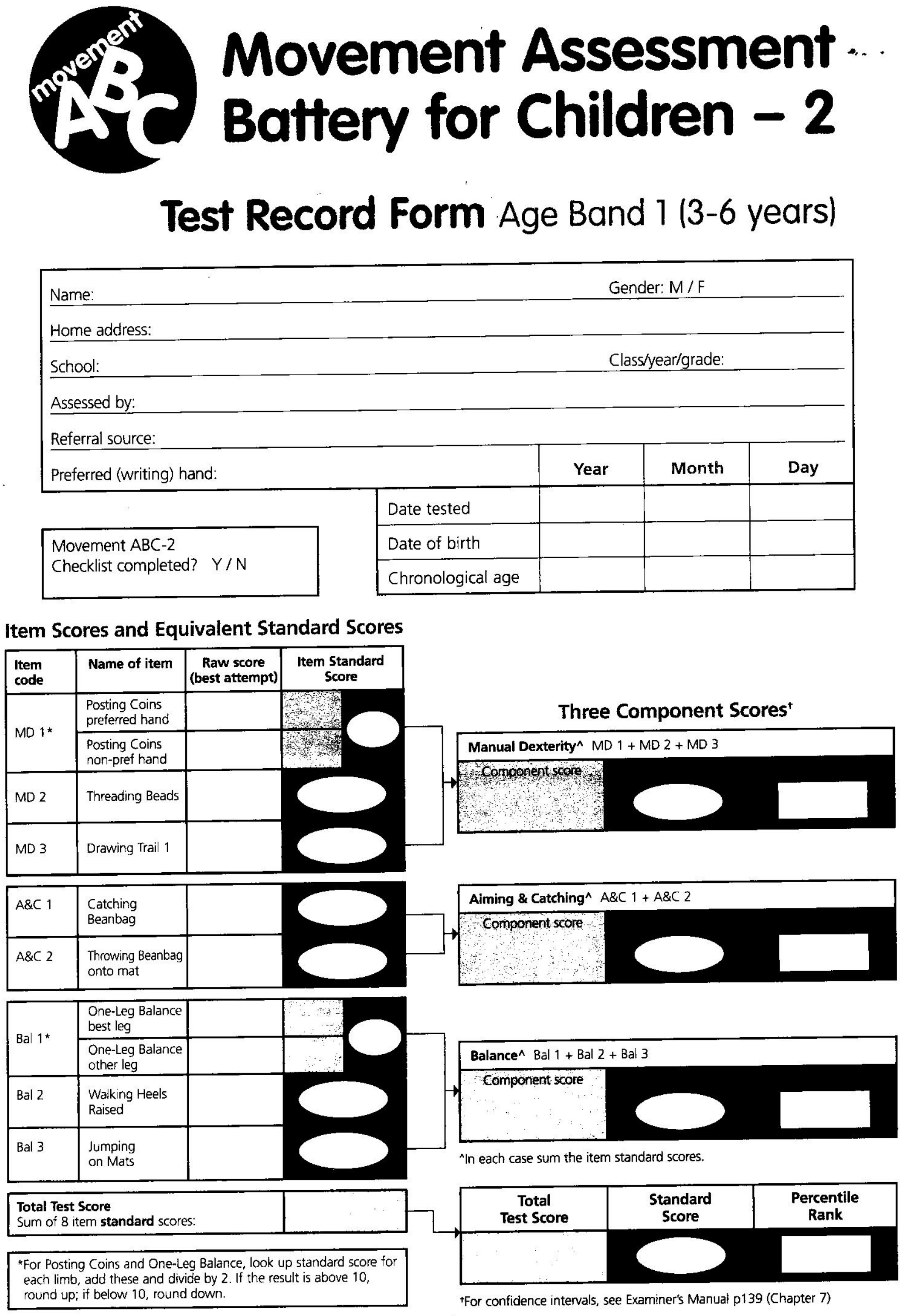
	Left hand	Right hand
Semmes-Weinstein monofilaments		
Touch localisation (out of 5)		
Stereognosis (out of 5)		

Wrist movement

	Left hand	**Right hand**
Degree of movement against gravity		

APPENDIX C

MOVEMENT ABC 2$^{\text{ND}}$ EDITION



Movement Assessment Battery for Children – 2

Test Record Form Age Band 1 (3-6 years)

Name: Gender: M / F
Home address:
School: Class/year/grade:
Assessed by:
Referral source:
Preferred (writing) hand:

	Year	Month	Day
Date tested			
Date of birth			
Chronological age			

Movement ABC-2
Checklist completed? Y / N

Item Scores and Equivalent Standard Scores

Item code	Name of item	Raw score (best attempt)	Item Standard Score
MD 1*	Posting Coins preferred hand		
	Posting Coins non-pref hand		
MD 2	Threading Beads		
MD 3	Drawing Trail 1		
A&C 1	Catching Beanbag		
A&C 2	Throwing Beanbag onto mat		
Bal 1*	One-Leg Balance best leg		
	One-Leg Balance other leg		
Bal 2	Walking Heels Raised		
Bal 3	Jumping on Mats		

Total Test Score
Sum of 8 item **standard** scores:

*For Posting Coins and One-Leg Balance, look up standard score for each limb, add these and divide by 2. If the result is above 10, round up; if below 10, round down.

Three Component Scores†

Manual Dexterity^ MD 1 + MD 2 + MD 3
Component score

Aiming & Catching^ A&C 1 + A&C 2
Component score

Balance^ Bal 1 + Bal 2 + Bal 3
Component score

^In each case sum the item standard scores.

Total Test Score	Standard Score	Percentile Rank

†For confidence intervals, see Examiner's Manual p139 (Chapter 7)

1

Manual Dexterity 1: POSTING COINS

Note: 6 coins for 3-4 years, 12 for 5-6 years

Record: Preferred hand: R / L (should be same as for Drawing Trail); Time taken (secs); **F** for failure; **R** for refusal; **I** if inappropriate (note reasons below)

Preferred hand	
Trial 1	
Trial 2	

Non-preferred hand	
Trial 1	
Trial 2	

Qualitative observations

Posture/body control

Sitting posture is poor ☐
Holds head too close to task ☐
Holds head at an odd angle ☐
Does not look at slot while inserting coins ☐
Does not use pincer grip to pick up coins ☐
Exaggerates finger movements in releasing coins ☐
Does not use the supporting hand to hold box steady ☐
Does extremely poorly with one hand (asymmetry striking) ☐
Changes hands or uses both hands during a trial ☐
Hand movements are jerky ☐
Moves constantly/fidgets ☐

Adjustment to task requirements

Misaligns coins with respect to slot ☐
Uses excessive force when inserting coins ☐
Is exceptionally slow/does not change speed from trial to trial ☐
Goes too fast for accuracy ☐
Other ______________________________

Comments: ______________________________

Manual Dexterity 2: THREADING BEADS

Note: 6 beads for 3-4 years, 12 for 5-6 years

Record: Time taken (secs); **F** for failure; **R** for refusal; **I** if inappropriate (note reasons below)

No. of seconds	
Trial 1	
Trial 2	

Qualitative observations

Posture/body control

Sitting posture is poor ☐
Holds materials too close to face ☐
Holds head at an odd angle ☐
Does not look at bead while inserting tip of lace ☐
Does not use pincer grip to pick up beads ☐
Holds lace too far from tip ☐
Holds lace too near tip ☐
Finds it difficult to push tip with one hand and pull it through with the other ☐
Changes threading hands during a trial ☐
Hand movements are jerky ☐
Moves constantly/fidgets ☐

Adjustment to task requirements

Sometimes misses hole with tip of lace ☐
Picks up beads the wrong way round ☐
Is exceptionally slow/does not change speed from trial to trial ☐
Goes too fast for accuracy ☐
Other ______________________________

Comments: ______________________________

Manual Dexterity 3: DRAWING TRAIL 1

Note: Berol pen to be used

Record: Hand used: R/L/Both; No. of errors; **F** for failure; **R** for refusal; **I** if inappropriate (note reasons below)
Number of errors should be counted after testing using scoring criteria provided in Appendix A of the Manual.

	No. of errors
Trial 1	
Trial 2	

Do not administer a second trial if the child completes the first trial perfectly (i.e. no errors).

Qualitative observations

Posture/body control

- Sitting posture is poor ☐
- Holds head too near paper ☐
- Holds head at an odd angle ☐
- Does not look at trail ☐
- Holds pen with an odd/immature grip ☐
- Holds pen too far from point ☐
- Holds pen too close to point ☐
- Does not hold paper still ☐
- Changes hands during a trial ☐
- Moves constantly/fidgets ☐

Adjustment to task requirements

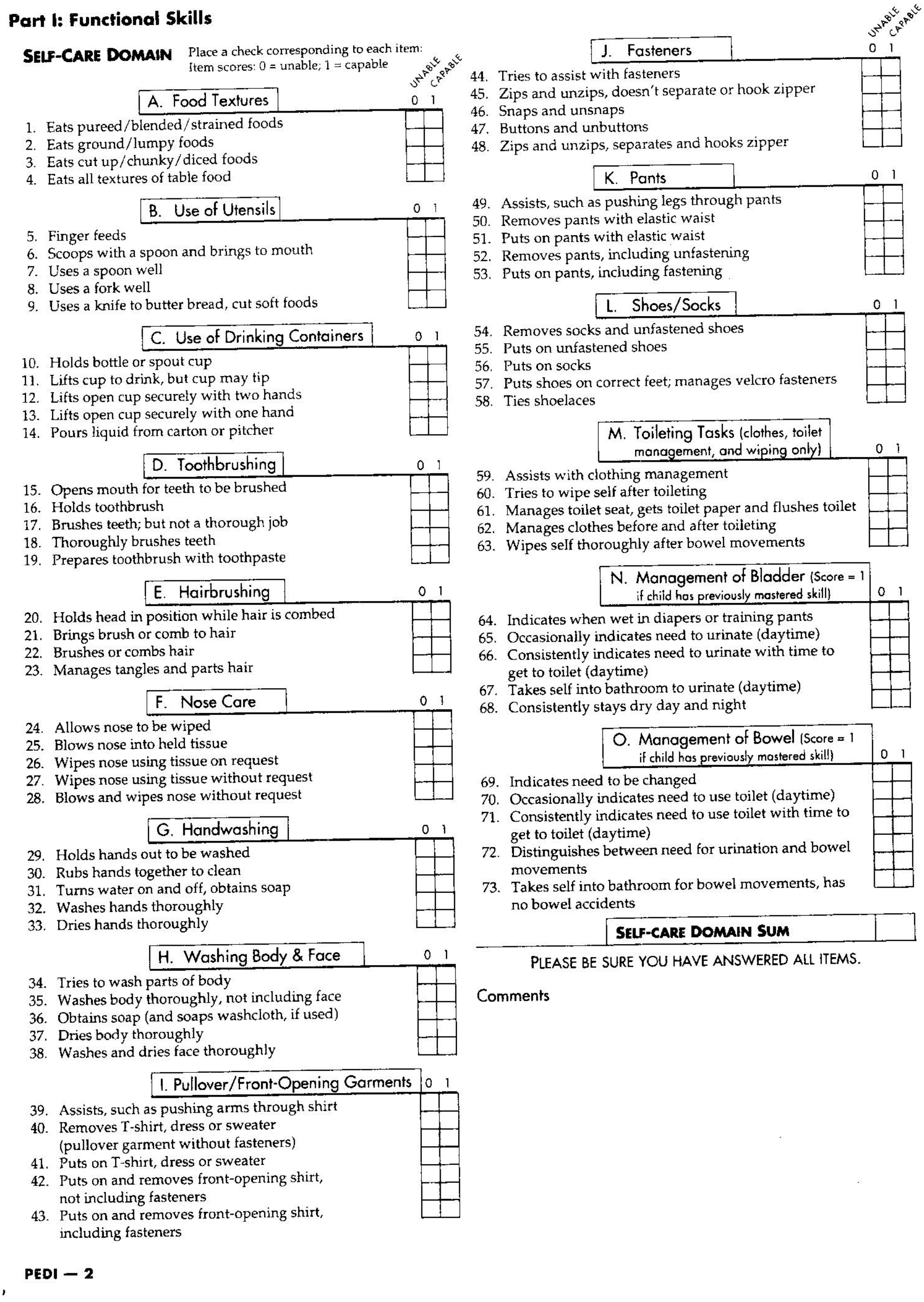
- Progresses in short jerky movements ☐
- Uses excessive force, presses very hard on paper ☐
- Is exceptionally slow ☐
- Goes too fast for accuracy ☐

Other ______________________________

Comments: ______________________________

APPENDIX D

PEDI



Part I: Functional Skills

SELF-CARE DOMAIN Place a check corresponding to each item:
Item scores: 0 = unable; 1 = capable

UNABLE CAPABLE

A. Food Textures	0	1
1. Eats pureed/blended/strained foods	☐	☐
2. Eats ground/lumpy foods	☐	☐
3. Eats cut up/chunky/diced foods	☐	☐
4. Eats all textures of table food	☐	☐

B. Use of Utensils	0	1
5. Finger feeds	☐	☐
6. Scoops with a spoon and brings to mouth	☐	☐
7. Uses a spoon well	☐	☐
8. Uses a fork well	☐	☐
9. Uses a knife to butter bread, cut soft foods	☐	☐

C. Use of Drinking Containers	0	1
10. Holds bottle or spout cup	☐	☐
11. Lifts cup to drink, but cup may tip	☐	☐
12. Lifts open cup securely with two hands	☐	☐
13. Lifts open cup securely with one hand	☐	☐
14. Pours liquid from carton or pitcher	☐	☐

D. Toothbrushing	0	1
15. Opens mouth for teeth to be brushed	☐	☐
16. Holds toothbrush	☐	☐
17. Brushes teeth; but not a thorough job	☐	☐
18. Thoroughly brushes teeth	☐	☐
19. Prepares toothbrush with toothpaste	☐	☐

E. Hairbrushing	0	1
20. Holds head in position while hair is combed	☐	☐
21. Brings brush or comb to hair	☐	☐
22. Brushes or combs hair	☐	☐
23. Manages tangles and parts hair	☐	☐

F. Nose Care	0	1
24. Allows nose to be wiped	☐	☐
25. Blows nose into held tissue	☐	☐
26. Wipes nose using tissue on request	☐	☐
27. Wipes nose using tissue without request	☐	☐
28. Blows and wipes nose without request	☐	☐

G. Handwashing	0	1
29. Holds hands out to be washed	☐	☐
30. Rubs hands together to clean	☐	☐
31. Turns water on and off, obtains soap	☐	☐
32. Washes hands thoroughly	☐	☐
33. Dries hands thoroughly	☐	☐

H. Washing Body & Face	0	1
34. Tries to wash parts of body	☐	☐
35. Washes body thoroughly, not including face	☐	☐
36. Obtains soap (and soaps washcloth, if used)	☐	☐
37. Dries body thoroughly	☐	☐
38. Washes and dries face thoroughly	☐	☐

I. Pullover/Front-Opening Garments	0	1
39. Assists, such as pushing arms through shirt	☐	☐
40. Removes T-shirt, dress or sweater (pullover garment without fasteners)	☐	☐
41. Puts on T-shirt, dress or sweater	☐	☐
42. Puts on and removes front-opening shirt, not including fasteners	☐	☐
43. Puts on and removes front-opening shirt, including fasteners	☐	☐

UNABLE CAPABLE

J. Fasteners	0	1
44. Tries to assist with fasteners	☐	☐
45. Zips and unzips, doesn't separate or hook zipper	☐	☐
46. Snaps and unsnaps	☐	☐
47. Buttons and unbuttons	☐	☐
48. Zips and unzips, separates and hooks zipper	☐	☐

K. Pants	0	1
49. Assists, such as pushing legs through pants	☐	☐
50. Removes pants with elastic waist	☐	☐
51. Puts on pants with elastic waist	☐	☐
52. Removes pants, including unfastening	☐	☐
53. Puts on pants, including fastening	☐	☐

L. Shoes/Socks	0	1
54. Removes socks and unfastened shoes	☐	☐
55. Puts on unfastened shoes	☐	☐
56. Puts on socks	☐	☐
57. Puts shoes on correct feet; manages velcro fasteners	☐	☐
58. Ties shoelaces	☐	☐

M. Toileting Tasks (clothes, toilet management, and wiping only)	0	1
59. Assists with clothing management	☐	☐
60. Tries to wipe self after toileting	☐	☐
61. Manages toilet seat, gets toilet paper and flushes toilet	☐	☐
62. Manages clothes before and after toileting	☐	☐
63. Wipes self thoroughly after bowel movements	☐	☐

N. Management of Bladder (Score = 1 if child has previously mastered skill)	0	1
64. Indicates when wet in diapers or training pants	☐	☐
65. Occasionally indicates need to urinate (daytime)	☐	☐
66. Consistently indicates need to urinate with time to get to toilet (daytime)	☐	☐
67. Takes self into bathroom to urinate (daytime)	☐	☐
68. Consistently stays dry day and night	☐	☐

O. Management of Bowel (Score = 1 if child has previously mastered skill)	0	1
69. Indicates need to be changed	☐	☐
70. Occasionally indicates need to use toilet (daytime)	☐	☐
71. Consistently indicates need to use toilet with time to get to toilet (daytime)	☐	☐
72. Distinguishes between need for urination and bowel movements	☐	☐
73. Takes self into bathroom for bowel movements, has no bowel accidents	☐	☐

SELF-CARE DOMAIN SUM ☐

PLEASE BE SURE YOU HAVE ANSWERED ALL ITEMS.

Comments

PEDI — 2

APPENDIX E

PEDI RESEARCHER OBSERVATION

Initial Assessment

	Feeding (use of utensils)	Shoes and socks
Time for performance		
Score		
Qualitative observations		

Final assessment

	Feeding (use of utensils)	Shoes and socks
Time for performance		
Score		
Qualitative observations		

APPENDIX F

SPLINT COMPLIANCE DIARY

Mark with a cross (x) when your child wore the splint during the day. Try be as accurate as possible.

WEEK 1	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**
06:00-07:00							
07:00-08:00							
08:00-09:00							
09:00-10:00							
10:00-11:00							
11:00-12:00							
12:00-13:00							
13:00-14:00							
14:00-15:00							
15:00-16:00							
16:00-17:00							
17:00-18:00							
18:00-19:00							
19:00-20:00							
20:00 – 21:00							

APPENDIX G

Parent Satisfaction Survey

1. Do you feel that the splint has helped your child?

   ____

   ____

2. Was the Splint easy to use? Why?

   ____

   ____

3. Did you notice any change in the way your child’s hand looks or the way your child uses their hand over the past 3 months? Explain?

   ____

   ____

4. Would you like your child to continue wearing the splint?

   ____

   ____

5. Any other comments?

   ____

   ____

APPENDIX H –

ETHICAL CLEARANCE CERTIFICATE

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

R14/49 Ms Michelle Lachenicht

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M150860

NAME: (Principal Investigator)	Ms Michelle Lachenicht
DEPARTMENT:	Occupational Therapy Tambo Memorial Hospital
PROJECT TITLE:	The Efficacy of a Soft Neoprene Thumb Opponens Splint in Children with Cerebral Palsy in Relation to Hand Function and Participation in Self-Care Activities
DATE CONSIDERED:	28/08/2015
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Dr Denise Franzsen
APPROVED BY:	Professor P Cleaton-Jones, Chairperson, HREC (Medical)
DATE OF APPROVAL:	02/12/2015

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Secretary in Room 10004, 10th floor, Senate House, University.
I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**.

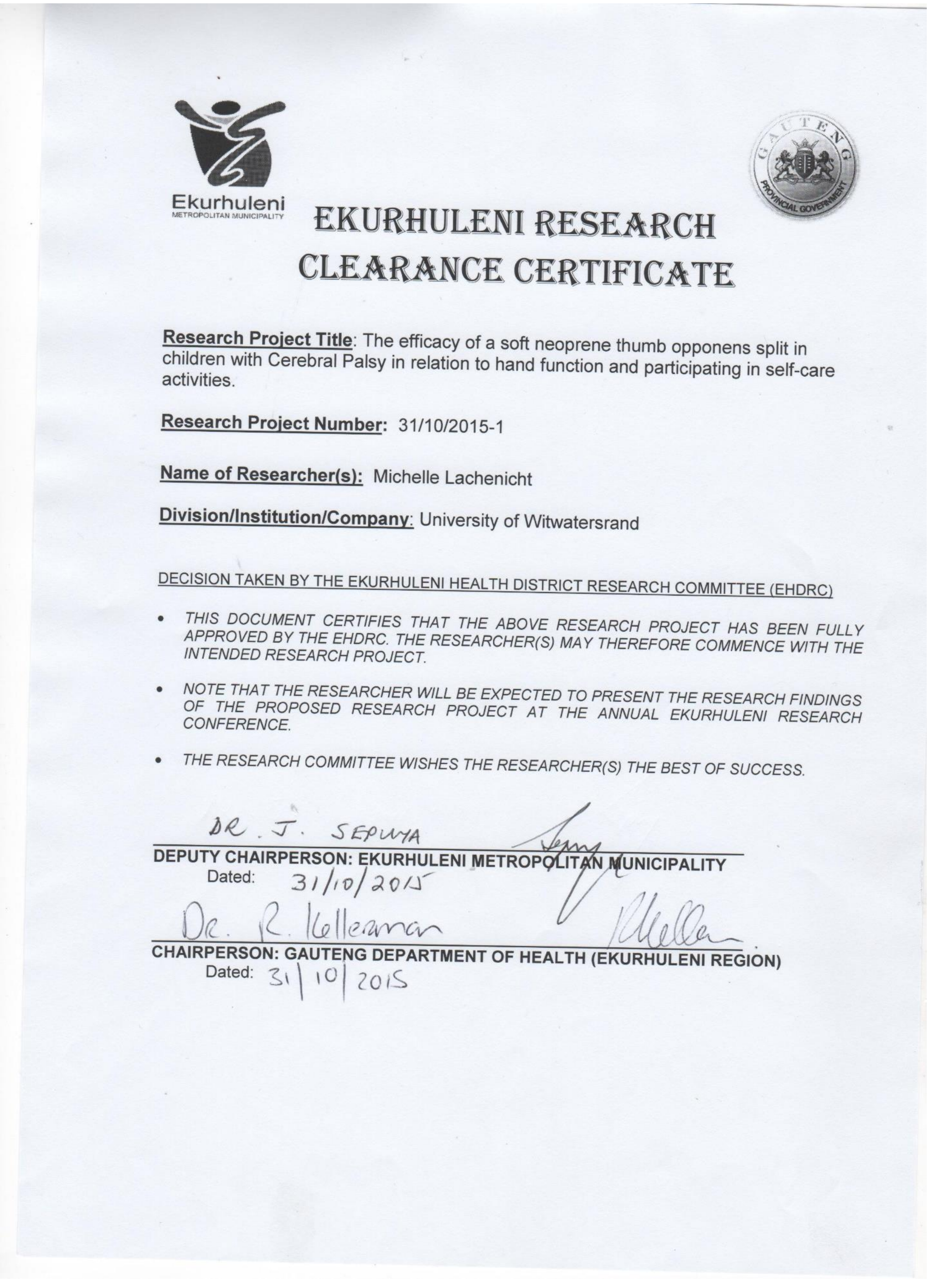
Principal Investigator Signature

Date

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

APPENDIX I –

DEPARTMENT OF HEALTH CLEARANCE CERTIFICATE



Ekurhuleni
METROPOLITAN MUNICIPALITY

EKURHULENI RESEARCH CLEARANCE CERTIFICATE

Research Project Title: The efficacy of a soft neoprene thumb opponens split in children with Cerebral Palsy in relation to hand function and participating in self-care activities.

Research Project Number: 31/10/2015-1

Name of Researcher(s): Michelle Lachenicht

Division/Institution/Company: University of Witwatersrand

DECISION TAKEN BY THE EKURHULENI HEALTH DISTRICT RESEARCH COMMITTEE (EHDRC)

- *THIS DOCUMENT CERTIFIES THAT THE ABOVE RESEARCH PROJECT HAS BEEN FULLY APPROVED BY THE EHDRC. THE RESEARCHER(S) MAY THEREFORE COMMENCE WITH THE INTENDED RESEARCH PROJECT.*
- *NOTE THAT THE RESEARCHER WILL BE EXPECTED TO PRESENT THE RESEARCH FINDINGS OF THE PROPOSED RESEARCH PROJECT AT THE ANNUAL EKURHULENI RESEARCH CONFERENCE.*
- *THE RESEARCH COMMITTEE WISHES THE RESEARCHER(S) THE BEST OF SUCCESS.*

DR. J. SEPUYA

DEPUTY CHAIRPERSON: EKURHULENI METROPOLITAN MUNICIPALITY

Dated: 31/10/2015

Dr. R. Kellerman

CHAIRPERSON: GAUTENG DEPARTMENT OF HEALTH (EKURHULENI REGION)

Dated: 31/10/2015

APPENDIX J –

PARTICIPANT INFORMATION SHEET

Good day,

I, Michelle Lachenicht am an occupational therapist registered for a Masters in Occupational Therapy at the University of Witwatersrand. As part of my studies I will be doing research at Tambo Memorial Hospital on the use of splints in children diagnosed with Cerebral Palsy in improving their hand function ability as well as their ability to participate in daily activities.

Very little research is available to support or reject the use of splinting in children diagnosed with Cerebral Palsy and as a result we are really not sure if this type of therapy actually works. I would like to introduce a splinting programme for children with CP at Tambo Memorial Hospital so that I can assess whether or not it is effective in changing the hand function and participation in self care of children with CP.

I am inviting you and your child to take part in the study and I would be most grateful if you would consider participating.

What will you be expected to do if you allow your child to participate in the research study?

If you choose to allow your child to participate in the study, your child's hand will be splinted with a soft splint and your child will continue to receive other therapies at the hospital.

The research study will require your child to attend an initial assessment session which will take approximately 2 hours. In this session a splint will be made and issued to your child. A follow up session will be scheduled for 3 months after the initial assessment session to see whether or not the splint has been effective or not. You will only have to attend these 2 sessions for the purpose of the research. Your child will continue to attend regular therapy at the hospital while they are engaged in the study.

It will be requested that your child wears their splint whenever they are awake if possible – you will be asked to complete a diary indicating for how long your child wore the splint each day. Please be honest about the time they wear the splint as there are no consequences if they are not able to wear the splint all day. At the end of the study (in the final assessment session) you will be asked to complete a satisfaction questionnaire about the splint.

After the research study, you will continue to attend therapy at the hospital and if the splint is effective, it will be continued too.

Are there risks or benefits to participation?

The benefits to being a part of this study are that there is potential that the splint may be effective in improving your child's ability to use their hands and as a result their ability to participate in activities may improve. At the end of the research study, you will have access to the results which will state whether or not the split is or is not effective in improving children with CP's ability to engage with their hands in daily tasks.

Possible risks of the study are that the splint may cause discomfort for your child. If your child does find the splint uncomfortable during their participation in the study, please contact me so it can be adjusted. The wearing routine may also be discussed with the therapist and participation in the study still achieved.

May I withdraw from the study?
You are allowed to leave the study at any point during the research process without giving a reason. If you choose to leave the research study, it will not affect your child's therapy, and they will continue to attend therapy as normal at the hospital. If you wish to withdraw from the study, but still want to continue with the splint, you will also be able to do so.

What about confidentiality?
Any and all information that you provide during the course of the research study about you, your child and your family will be kept confidential during your engagement in the study as well as after the study is complete. Your child's name (or your name) will not appear on any sheets used to collect information during the course of the research.

If you consent, photographs of your child's hand will be taken before the splint is applied, straight after the splint is applied and with the splint removed at the end of the study. From these photographs you will not be able to tell who the person in the photo is and the photos will be coded with your participant number to ensure confidentiality. When the results of the research are being compiled, your child will continue to remain anonymous.

If you have any questions please contact me at the Occupational Therapy Department on 011 898 8299

If you have any queries, more information may be obtained from Mrs Franzsen (Research Coordinator) at (011) 717 3701. If you have any ethical concerns please contact the chairperson of the Wits Human Research Ethics Committee, Prof P Cleaton-Jones on 011 7171234 or at zanele.ndlovu@wits.ac.za

Thank you for taking time to read this information. If you agree for your child to participate in the study please read and sign the consent form.
Thank you for your co-operation

Michelle Lachenicht
BSc OT (Wits)

APPENDIX K –

SPLINT INFORMATION

There are some important things you need to know about the splint that your child will be wearing:

- It may cause your child some discomfort, but it should not cause pain. If your child complains that the splint is hurting them, please remove the splint and contact me as soon as possible to adjust the splint for your child
- If the splint gets dirty, you can hand wash the material in warm water with sunlight soap. Leave the splint inside (out of the sun) to dry and then your child can continue wearing it
- Do not was the splint in hot water or leave it in the sun as this may stop the material from working
- When you remove the splint from your child's hand, please check their hands for any signs of redness, irritation or injury. If you notice any of these signs please contact me as soon as possible to fix or adjust the splint
- We encourage you to allow your child to wear the splint for as many hours a day as possible while they are awake and using their hands. Your child does not have to wear the splint when they are sleeping or when they are bathing.

Thank you
Michelle Lachenicht
011 898 8299

APPENDIX La

INFORMED CONSENT FORM

I, ______________________________ (name of client) have read the client information sheet or had it read to me by the researcher**.** I consent for my child_________________________(name of child) to become a participant in the research project:

The efficacy of a soft neoprene thumb opponens splint in children with CP in relation to hand function and participation in self-care activities.

I understand what the study is about, the expected treatment program and intervention and what participation in the research will require. I am choosing to participate in the study of my own free will and to follow the proposed treatment program for the study.

I accept the potential risks and benefits to my child relating to splinting of my child's hand. I understand my rights and that I am permitted to withdraw my child from the research at any time if desired.

I consent for photographs of my child's hand to be taken for the purpose of the research. I understand that these photographs will not contain any identifying information of my child and that my childs confidentiality in the study will be maintained.

Signature of Client	**Date**
_______________________	________________________
Signature of Researcher	**Date**
______________________	________________________

APPENDIX Lb

PERMISSION TO PHOTOGRAPH CHILD'S HAND

I, _______________________________ (name of caregiver) have read the client information sheet or had it read to me by the researcher**.** I consent for photographs of my child_________________________(name of child) to be taken for the purpose of the research study. I understand that no identifying features of my child will be in the photos and the photos cannot be used for any other reason.

The efficacy of a soft neoprene thumb opponens splint in children with CP in relation to hand function and participation in self-care activities.

Signature of caregiver **Date**

________________________ _________________________

Signature of Researcher **Date**

_______________________ _________________________

APPENDIX M - VERBAL ASSENT

Hello,

My name is Shelley and I am trying to see if we can help you use your hand better. We are going to try some activities with your hands – these won't hurt you. The activities include moving your hand, holding objects, putting on shoes and feeding yourself.

I am going to make something for your hand – it is soft and it shouldn't hurt you either. I would like to be able to see if it can help you use your hand while you do different activities during the day.

If the splint is hurting you or is uncomfortable you must tell me or (mom/dad/caregiver) so we can fix it for you.

You will see me today and then again in a little while to check if the splint has helped you at all. We will do the activities today and then again when you come back to visit me again.

If you want to ask anything you are allowed to at any time.

Thank you

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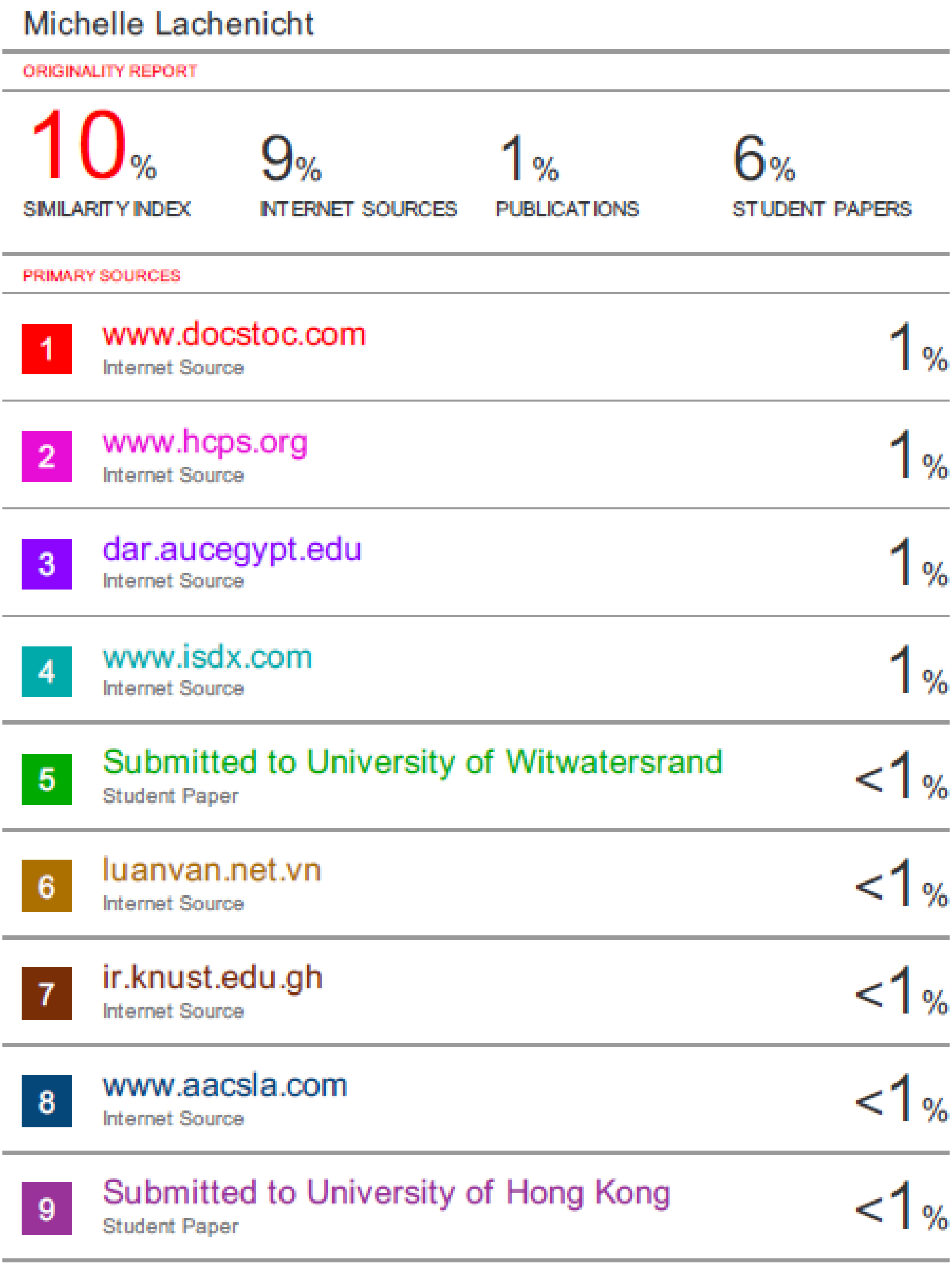

Michelle Lachenicht

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