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UNDERSTANDING THE OCCUPATIONAL THERAPISTS USE OF SPLINTING THE AFFECTED HAND OF ADULT PATIENTS WITH NEUROLOGICAL INJURIES

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A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree

of

Master of Science in Occupational Therapy

Johannesburg, 2013

DECLARATION

I, Lee-Anne Chazen declare that this research report is my own work. It is being submitted for the degree of Master of Science in Occupational Therapy in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University.

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ABSTRACT

This study explored the clinical reasoning expert therapists use in relation to splinting the affected hand following neurological injury. An exploratory, descriptive, qualitative methodology was used in three focus groups with occupational therapists, experienced in neurorehabilitation. Data was analysed based on priori themes, specifically

1. The Model of Practice Development (Higgs and Titchen 2001b) - most value was placed on Procedural knowledge or clinical experience; reflection on protocols, working with and learning from others and having clear outcomes. Undergraduate training and current literature is insufficient to provide guidelines for practice.
2. The Three Track Model of Clinical Reasoning (Fleming 1991) –splinting was used to improve range of motion, maintain muscle length and affect muscle tone. Effectiveness of the splints depended on the patient's response and the therapists' ability to adapt to preferences and goals. Interactive reasoning was essential in understanding the South African context. The study provided guidelines for a newly qualified therapist.

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To my dear husband Dylan and beautiful son Khalon, thank you for supporting me every step of the way.

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NOMENCLATURE

Hand- the use of the word hand within the context of this research report refers to the hand affected by neurological injury following stroke, unless otherwise stated.

Clinical reasoning - “the thought process that guides practice” (Rogers 1983).

Neurological injuries- For the purpose of this research, includes Stroke/ Cerebrovascular accident (CVA) and Traumatic brain injury (TBI)/ Head injury. Stroke refers to “neurological signs and symptoms that result from disease involving blood vessels”(Carr and Shepherd 2007) and TBI is used to describe “a physical injury to the brain, by an external mechanical force or projectile, that results in a loss of consciousness, post-traumatic amnesia and neurological deficits” (Carr and Shepherd 2007)

Splinting - The prescription of external devices designed to “maintain the limb in a specific position for a period of time or to stabilize particular joints and encourage desirable patterns of movement during activity”(Copley and Kuipers 1999). They are commonly made of mouldable plastics and can be applied over one or more joints (Teplicky, Law, and Russell. 2002)

A splint is “an externally applied device used to control or support a body part” (Turner, Foster, and Johnson 2002) (pg. 173). With regard to neurorehabilitation the function of a splint is determined by the design which is based on the therapist’s rationale for using the splint.

Practice development- Practice development occurs in the professional’s ‘own’ practice setting and focuses on the enhancement and growth of personal, professional and/or organisational standards and quality of services by involving and focusing on the patients’ and clients’ specific needs. Practice development requires team-working, interdisciplinary collaboration, effective communication, internal and external partnerships and a willingness to learn and share with and from each other (Mcsherry 2004) It also involves the promotion of improvements in quality of one’s own care and self. (McSherry and Driscoll 2004)

Professional development- This refers to the development of an individual's knowledge, skills and attitudes as well as their career path (Hamer and Collinson 1999)

Expert and Experienced Therapists- Expert and experienced therapists do not always need to make use of intensive cognitive process, abstract principles and strict protocols to make decisions (Schell, and Schell 2007) they are guided more by the client's cues, and do not rely on rules or guidelines but have an intuitive grasp on a situation (Benner 1984). Expert and experienced therapists are able to create a narrative, and simultaneously makes use of Procedural, Interactive and Conditional reasoning (Mattingly 1991; Dutton 1995) which allows them to perceive the complete situation, including the client-related factors; their condition, personal attributes, occupational and performance needs. There is no exact specification of the number of years a therapist should be qualified in order to be considered an expert or experienced however they should have been in practice for at least two to three years (Benner 1984).

ABBREVIATIONS

ACPIN	the Association of Chartered Physiotherapists Interested in Neurology
DASH	Disabilities of the Arm, Shoulder and Hand outcome measure
EBP	Evidence Based Practice
EMG	Electromyography
HPCSA	Health Professions Council of South Africa
MAS	Modified Ashworth Scale
MEM	Manual Edema Mobilization
NDT	Neurodevelopment Therapy
PROM	Passive Range of Motion
RCT	Randomised Controlled Trial
RIP	Reflex Inhibiting Postures
ROM	Range of Motion
SASHT	South African Society of Hand Therapists
TBI	Traumatic Brain Injury
VAS	Visual Analog Scale for pain

CHAPTER 1 INTRODUCTION

The effectiveness of splinting the hand following neurological injury in occupational therapy remains a controversial topic (Neuhaus, Ascher, Coullon, Donohue, Einbond, Glover, Goldberg, Takai 1981, Wilton 1997, Edmans 2010, Pedretti and Early 2001) with insufficient scientific evidence to support or refute it. Despite the uncertainty surrounding splinting efficacy, it is routinely used clinically by occupational therapists to help reduce muscle tone and maintain joint range in the upper limb following neurological injury (McPherson and Becker 1985, Lannin and Herbert 2003, Lannin, Cusick, McCluskey, and Herbert 2007).

Practice development of the expert occupational therapist includes the knowledge and clinical practice of splinting the hand following neurological injury, this is developed through professional education, actual practice and professional and life experiences and reflection on them (Higgs and Titchen 2001a). This knowledge and these skills can be useful in the development of practice guidelines on this topic. Clinical reasoning is the ability to apply a general theory to a specific patient (Dutton 1995) and involves the analysis of the theoretical knowledge and the application of appropriate techniques for a particular patient, based largely on practical clinical experience (Dutton 1995). By analysing the clinical reasoning utilised by expert therapists one can better understand how they go about making a decision related to splinting the hand following neurological injury.

1.1 Statement of the Problem

There is insufficient, quality evidence available on splinting the hand following neurological injury, there is also no single solution for the prescription of splints in general (Stanley and Tribuzi 1992). The combination of these factors may lead to confusion and frustration for therapists who lack clinical experience in splinting following neurological injury. Evidence based practice cannot therefore easily be based on research and the clinical experience of expert and experienced occupational therapists needs to be investigated to support the effective prescription of splints to patients with neurological conditions.

1.2 Purpose of the study

To understand the professional development of experienced occupational therapists with regard to splinting the hand following neurological injury in order to assist less experienced therapists in their own professional development. The purpose is also to investigate the expert occupational therapists' clinical reasoning in the prescription of splints for the hand following neurological injury in order to develop a practice guideline for splinting following neurological injury.

1.3 Aim of the study

The aim of the study was to 'explore' and 'investigate' what experienced occupational therapists are using in practice with regard to splinting the affected hand following neurological injury.

1.4 Objectives of the study

- To understand the practice development of expert or experienced occupational therapists with regard to splinting following neurological injury.
- To explore the occupational therapists' clinical reasoning in the prescription of splinting the hand following neurological injuries.
- To identify the aspects that an expert therapist considers when deciding whether to splint or not to splint

1.5 Justification of the Study

As a therapist gains experience splinting adult patients with neurological injuries and reflects on this, the therapist may be responsible for significant improvements in competence of professional action and resulting client outcomes (Bright 1996).

Expert opinion from experienced occupational therapists (OT) is of great value due to the lack of literature supporting or refuting the effectiveness of thermoplastic splinting, poor guidelines on the design of splints and wearing regimes, where splints are costly and have contraindications. This experience is useful in providing practice guidelines for novices who wish to achieve competence in this field (Clouder 2000) and may provide clarity for less experienced therapists who have difficulty with making the decision to provide a thermoplastic splint for the hand of an adult with

neurological injury. This study aims to explore guidelines that may emerge from the themes in this study that can be used in clinical practice in the South African context.

CHAPTER 2
LITERATURE REVIEW

The literature review aims to understand splinting following neurological injury and how the use of splints has evolved. The review will then explore the current research related to evidence for splinting the neurologically affected hand. Evidence based practice including the research pyramid is reviewed to indicate the value of expert opinion as evidence. The literature review then explores practice development and clinical reasoning of occupational therapists in terms of splinting patients following neurological injury.

2.1. Splinting in neurological conditions

Neurological injury such as stroke or traumatic brain injury (TBI), may result in secondary contracture due to a loss of movement and strength in the upper limb. The contractures may be due to changes in the properties of muscles or changes in muscle tone and may be associated with pain and poor functional recovery and decreased occupational performance (Ada and Canning 1990). Patients with neurological injury may be provided with hand splints if they experience a loss of movement, but there are controversies around splinting practices for these conditions. Despite the uncertainty surrounding splinting efficacy, splinting is routinely used clinically by occupational therapists to help reduce muscle tone and maintain joint range in the upper limb following neurological injury (McPherson and Becker 1985, Lannin and Herbert 2003, Lannin, Cusick, McCluskey and Herbert 2007). Other aims of splinting include reducing oedema, pain (Gillen and Burkhardt 1998) as well as for protection of loss of sensation and improving function.

2.1.1.The history of splinting in neurological conditions

The first splints documented in literature for the purpose of prevention of contractures of the spastic wrist are found dating prior to 1911(Bobath 1978). Most of the early literature did not recommend the use of splints for the hemiplegic hand (Westcott 1966, Parry 1981). When splinting emerged as a form of therapeutic rehabilitation (McPherson, Kreimeyer, Aalderks, Gallagher 1982) research from the

1950s to the 1980s resulted in two main approaches being developed in relation to splinting the hand of patients with neurological injury.

2.1.1.1 Biomechanical versus Neurophysiological rationale

A *Biomechanical rationale* for splinting following neurological injury was the earliest approach used and followed the principles of normal alignment, mobility, stability and the prevention and management of length-associated changes in muscles and connective tissue of patients following neurological injury by mechanical means (Neuhaus, et al. 1981, Grossman, Sahrmann and Rose 1982, Langlois, Pederson, Mackinnon 1991, Pedretti 1996, Wilton 1997, Gillen and Burkhardt 1998, Gelber and Jeffery 2002). Very little early research is available to prove this rationale, however thermoplastic splints have been criticized for having an adverse effect if worn constantly as this resulted in muscle atrophy and joint stiffness (Bunnell 1956).

With the advance in understanding of neurophysiology in the 1960's the effectiveness of splinting was then considered in the light of neurophysiological theories. (Wilton 1997) What then emerged was the *Neurophysiological rationale,* which examined the effect of sensory input, sustained stretch and reflex inhibiting postures (RIP), provided by the splints, on spasticity. (Wilton 1997) Rood was one who questioned the use of the static, volar splints in achieving their biomechanical objectives as she felt their purpose (prevention of contractures) was defeated through the activation of touch, pressure and stretch stimulation on the palmer surface when a volar splint was used. This resulted in undesirable muscle contraction (Rood 1954) so she then suggested that if a volar splint was to be used that a firm cone be placed in the palm of the hand to provided constant pressure over the insertions of spastic finger flexors. She proposed that this would result in inhibition of spasticity of long flexors. (Stockmeyer 1967, Farber and Huss 1974). However research on the effectiveness of this splint in achieving its purpose is yet to be found and one study identified the ineffectiveness of the cone splint in decreasing EMG activity in the long finger flexors (Mathiowetz, Bolding and Trombly 1983). Thus the debate of whether volar or dorsal splints were more effective in patients with neurological injuries arose.

2.1.1.2 Volar versus dorsal splinting

Brennan in an early study in 1959 demonstrated the effect of volar splinting on peripheral, rather than central mechanisms affected by neurological injury (Brennan 1959, McPherson, Kreimeyer et al. 1982). He submitted the flexor muscles to a prolonged stretch with volar splinting for 24 hours a day for one year and an improvement in range and abnormal muscle tone was found (Brennan 1959). The quality of the research design however was poor and based only on the comparison of splinted versus non splinted joints on the same patient as a control. Compliance of patients was also questioned (Lannin and Herbert 2003). Another study (Zislis 1964) in support of volar splinting revealed less electromyographic (EMG) activity of the wrist and finger flexors with the volar splint compared to the dorsal splint or no splint. Electromyography is used frequently in studies as an effective measure of reflex excitability (vanderSalm, Veltink, Hermens, Ijzerman and Nene 2005), however the study had low internal validity and involved only one participant (Zislis 1964). There are no other studies reporting the effectiveness of volar splints, despite the support for the use of volar splinting for the purpose of the prevention of deformities and contractures caused by spasticity in early literature (Dinkin 1949, Huddelson and Henderson 1958, Zislis 1964, Licht 1968, Redford 1980). Other research on the effectiveness of volar splinting has yielded varying (Chariat 1968, McPherson, Kreimeyer et al. 1982, Rose and Shah 1987).

Other research questioned the effectiveness of volar splints in achieving their objectives of addressing contractures and tone changes and suggested that dorsal splinting facilitated functional recovery through, not only positioning which decreases reflex activity, but also the tactile stimulation of antagonistic extensor muscles which led to reciprocal inhibition of spastic flexors and improved functional use of the limb (McPherson, Kreimeyer et al. 1982, Mathiowetz, Bolding et al. 1983, Reid 1992, Kaplan 1962, Chariat 1968). These findings were confirmed by clinical observation, (Chariat 1968) and a study by Kaplan where 10 patients wore a dorsal textured wrist splint for a minimum of eight hours a day which showed a reduction of hypertonicity of flexors and improvement in functional strength of the hand and proved to be a useful supplementary approach to traditional neurorehabilitation (Kaplan 1962, Chariat 1968), although both studies had poor internal validity with no control groups for comparison and small sample sizes.

The use of a dorsal splint was challenged by other studies which showed no significant difference between the effectiveness of the dorsal and volar splint in the reduction of hypertonicity, measured by a spring-weighted scale and angle point of stretch reflex (McPherson, Kreimeyer et al. 1982, Rose and Shah 1987). Both techniques measure the resistance to passive movement, but neither method is able to differentiate between neurological and structural changes. Only an unpublished study has demonstrated its inter-rater and test-retest reliability of these techniques. (McPherson et al. 1982). Other authors discouraged the use of splinting as it results in immobility which leads to complications including sensory deprivation (Taub and Berman 1963), muscle contractures, joint changes such as capsular fibrosis, ankylosis and atrophy (DeLisa 1988).

In the 1990's the use of the dorsal volar splint, a variation to the dorsal splint, created by Snook in 1979 to inhibit reflex movement patterns, was described by Wilton (Snook 1979, Wilton 1997). The dorsal static splint with a palmar finger pan was reported to decrease spasticity by providing palmar pressure on the fingers and dorsal pressure over the forearm to reduce tone in the flexor muscles. Wilton reported however that the influence of the pressure from straps used to secure the splint had not been considered (Wilton 1997) but that this design was found to be superior to the volar resting splint because of its effective lever system, the ease of application with only one hand, ease of adjustment and the ability of the splint to control the fingers and wrist position. The dorsal volar splint, which has become widely used in practice, was shown to have positive effects on reducing hypertonicity in the short term only, but this evidence was based on case studies. The reduction of hypertonicity is important in preventing contractures and deformity in the hand/s of patients with neurological injuries.

2.1.1.3 Splinting to prevent deformity

Occupational therapists who followed the Neurodevelopmental (NDT) approach to therapy attempted to achieve reflex inhibiting postures (RIP) (Bobath 1978) in the hand and upper limb by splinting the limb into positions which would prevent abnormal postural patterns and hypertonicity (Doubilet and Polkow 1977, Snook 1979, Mills 1984). Numerous splints were designed for this purpose. A finger spreader splint designed to place the fingers in abduction to promote extension of

the fingers and decrease flexor hypertonicity in the whole upper limb (Doubilet and Polkow 1977) although this was found to increase EMG activity in wrist flexors(Mathiowetz, Bolding et al. 1983).

The volar dorsal splint described above, designed by Snook in 1979 was based the NDT theory when she incorporated a RIP into the design (Snook 1979). Two case studies (Snook 1979) revealed a reduction in spasticity following splint use however further, objective evaluation of the splint revealed that the effects of the splint were not permanent, as spasticity increased after four weeks once the splint was removed., The author of the study acknowledged however that the study design was flawed due to a small sample size (five subjects), and poor homogeneity of subjects (from quadriplegia from unidentified aetiologies to TBI to a rare congenital neurological condition resulting in hemiparesis),. There was also poor validity in the spring-weighted fishing scale used for measurement of spasticity (McPherson 1981) as well as no specified daily regimen over a period of time making extrapolation of the results difficult. It is essential when reporting research on the effectiveness of a splint that the wearing regime is included.

2.1.1.4 Wearing time

Splinting protocols differ significantly with various studies reporting wearing times ranging from only one hour in three days, to two hours in a day to up to 23-24 hours a day (Lannin and Herbert 2003). Some studies (Mathiowetz, Bolding et al. 1983) examined the immediate wearing effect of splints only. Varying protocols makes data comparison a challenge as does the number of different evaluation methods and measurement techniques used to determine the effectiveness of the splints.

2.2 Evidence for efficacy of splinting in neurological conditions

Evidence based practice to determine the effectiveness of the splints requires accurate evaluation.

2.2.1 Measuring outcomes used with splinting in neurological conditions

The evaluation of hypertonicity including spasticity has always been difficult and contentious. While Lance defined spasticity as the hyper-excitability of the stretch reflex, or velocity dependent increase in tonic stretch reflexes with exaggerated

tendon jerks in 1980 (Feldman, Young et al. 1980) more recent literature describes spasticity as a component of the muscle hypertonia seen in patients with upper motor neurone lesions. Hypertonia which is not dependent on velocity, presents as resistance to passive movement and can be present with or without spasticity. Spasticity on the other hand is an increase in resistance relative to sudden quick passive movement (Magid, Bakheit et al. 2011, Sunnerhagen, Olver et al. 2013). The terms 'spasticity' and hypertonicity however have been used interchangeably in the literature and the techniques utilized to measure, particularly 'spasticity' are poor despite their frequent clinical use. (Snook 1979, Langlois, Pederson et al. 1991, Pizzi, Carlucci, Falsini, Verdesca and Grippo 2005)

Measurement techniques for spasticity utilized in early research, when evaluating the use of splints in neurological injury include; the joint angle at which the stretch reflex was elicited, the arc of un-resisted passive movement of the joint (Snook 1979, Mills 1984) and a torque motion analyser (Langlois, Pederson et al. 1991) . The challenge in measurement however comes when differentiating between mechanical or fixed changes in the tissues and 'spasticity'.(Magid, Bakheit et al. 2011) Some literature proposes that spasticity, defined as hyperexcitability of the stretch reflex, is the 'catch' felt with rapid passive resistance following a slow passive stretch to eliminate the 'catch' being due to contracture.

It has been noted that there is no direct method of measuring spasticity and scales frequently found in the literature such as the Modified Ashworth scale, the Ashworth scale and the Tardieu scales, as a measure of spasticity, have poor reliability (Noort, Scholtes et al. 2010). The Modified Ashworth scale, however, is most frequently described in the literature as a measure of spasticity however the Modified Rankin Scale is more reliable and valid and is used globally(Gregson, Leathley et al. 1999, Pandyan, Johnson et al. 1999, vanderSalm, Veltink et al. 2005, (Sunnerhagen, Olver et al. 2013)

Measures of spasticity which do not require subjective assessment and are therefore more reliable include Hmax/Mmax ratio (Ushiba, Masakado et al. 2004) (a broad based measure of neuromuscular excitability) and Electromyography (EMG) (vanderSalm, Veltink et al. 2005) (Mathiowetz, Bolding et al. 1983, Mills 1984). Electromyography is a useful neurophysiologic method used to distinguish the

contributions of spasticity and stiffness (Maye 1997, Noort, Scholtes et al. 2010) and is used frequently in studies as an effective measure of reflex excitability (vanderSalm, Veltink et al. 2005).

The effect of splinting on contractures or changes in the muscle extensibility is a common outcome measured in research. This measurement differs from other types of joint mobility measures such as active and passive joint ROM (Berryman and Bandy 2002). and techniques used to measure extensibility in human studies include the use of a spring-weighted scale (McPherson 1981, McPherson, Kreimeyer et al. 1982, McPherson and Becker 1985) and a measure found to have high validity, standardized torque (Katalinic, Harvey et al. 2011) which is able to identify changes in passive biomechanical properties of the muscle. (Weppler 2011). Observation and pictures, utilised for case studies (Snook 1979) and the use of range of joint movement with fingers extended have also been reported (Lannin, Cusick et al. 2007), Other outcome measures used in research on the effectiveness of splinting in patients with neurological injuries include measures of upper limb function such as the Motor Assessment Scale (Pizzi, Carlucci et al. 2005, Carr and Shepherd 2007, Lannin, Cusick et al. 2007) and the Disabilities of the Arm, Shoulder And Hand Outcome Measure (DASH) (McConnell, Beaton et al. 1999). Visual analogue scales have been used to assess for pain, while the Penn Spasm frequency score (Penn, Savoy, Corcos, Latash, Gottlieb, Parke and Kroin. 1989) was used to assess the presence or absence of spasms and clonus (Pizzi, Carlucci et al. 2005). Expectations, satisfaction and compliance (Langlois, Pederson et al. 1991) outcomes were established in studies that asked the participants to express subjectively if they felt the splints had helped (Pizzi, Carlucci et al. 2005).

2.2.2 Published evidence for splinting in neurological conditions

The majority of the outcomes measured in studies described above have not provided positive evidence for splinting the hand in patients with neurological injuries.

Splints appear to have no effect on tissue extensibility (Lannin, Horsley et al. 2003, Lannin, Cusick et al. 2007), a statistically non-significant effect on upper limb function and self-reported disability but it can result in decreased function and performance if the hand is immobilised. Splinting was also found to have no

significant effect on the reduction in pain (Lannin, Horsley et al. 2003), (Lannin, Cusick et al. 2007). Research has however shown significant relationships between the expectations and compliance and the satisfaction and compliance of splint use (Langlois, Pederson et al. 1991).

One study that evaluated the effect of splinting on spasticity used EMG to evaluate spasticity in limbs splinted into extension compared to non-splinted limbs. The study revealed no significant changes in EMG activity and only changes in the joint position and elongation of the muscle. The researcher concluded that splinting was able to control postural deficits but only because it placed a limb in a more anatomically beneficial position and not because of its effects on spasticity (Mills 1984).

The lack of conclusive evidence about the efficacy of splinting following neurological injury in this older research may be due to a lack of research, inadequate definitions and measurement devices (Rosenada and Ellwood 1961). Studies also had poor homogeneity of subjects, small sample sizes, threats to internal validity and varying study designs, methods, splint design, regimen and outcome measures. There were many case studies and most papers published were based on researcher opinion. The low number of RCT's in the early literature results in an inadequate evidence base from which to inform clinical decision making (Lannin and Herbert 2003).

Current evidence for splinting in neurological conditions has been reviewed from studies reported in the 1990s to the present date because of the introduction of new theories in the treatment of patients with neurological conditions in this time frame. In the late 1980's Carr and Shepherd developed the motor relearning approach, a theory of rehabilitation based on the dynamic systems theory of motor control which emphasises the ability of the body and CNS to adapt to functional demands following brain injury (Carr and Shepherd 1989, Trombly and Radomski 2002, Carr and Shepherd 2007). This theory has emerged as a popular form of treatment as good quality evidence has proven its effectiveness. The theory has developed, based on scientific evidence, to focus on task-related training of motor performance. The use of this theory in practice needs a comprehensive understanding of musculoskeletal changes (Carr and Shepherd 2007). This has resulted in the most recent literature on splinting to addressing the adaptive changes to the musculoskeletal system,

rather than spasticity, with Langlois, Pederson et al. (1991), Sheehan, Winzeler-Mercay et al. (2006) and Lannin, Cusick et al. (2007) supporting the concept that splinting controls postural deficits rather than affecting spasticity (Langlois, Pederson et al. 1991, Sheehan, Winzeler-Mercay et al. 2006, Lannin, Cusick et al. 2007). It appears that there is no clinically worthwhile change in spasticity following splinting, particularly in the short term (less than five weeks) (Langlois, Pederson et al. 1991)

2.2.3 Levels of evidence for splinting following neurological injury

Traditionally in the single-hierarchy Evidence Based Practice (EBP) model the value of research for clinical practice has been defined by the literature on evidence-based practice. Studies that conform to the strictures of classical experimental methodology like systematic reviews and, randomized controlled trials are considered to present level I evidence and are at the top of the single-hierarchy EBP model. Case reports are considered and present as level V evidence. (Arbesman, Scheer et al. 2008) The current evidence which includes literature and research from the 1990s, to either support or refute the use of splinting the hand following neurological injury will be presented in according to this research model.

When reviewing experimental research no meta analyses have been published related to splinting following neurological injury so the highest level of evidence that could be found were systematic reviews and randomized controlled trials. There are only 10 studies (Lannin and Herbert 2003, Lannin, Horsley et al. 2003, Steultjens, Dekker et al. 2003, Pizzi, Carlucci et al. 2005, Teasell, Foley et al. 2005, Harvey, Long et al. 2006, Sheehan, Winzeler-Mercay et al. 2006, Lannin, Cusick et al. 2007, Katalinic, Harvey et al. 2011,(Basaran, Emre et al. 2012) which examine splinting following neurological injury ranging from 1990-2012.

2.2.3.1 Level 1 evidence: Systematic reviews

Systematic reviews executed by Lannin and Herbert in 2003, Steultjens, Dekker et al.in 2003, Teasell et al.in 2005 and Katalinic et al.in 2011 reveal the following related specifically to splinting the upper limb;

- Due to low methodological quality there is insufficient evidence that splinting is effective for decreasing muscle tone (Steultjens, Dekker et al. 2003).

- Limited (Level 2) evidence from one "poor" quality RCT that hand splinting does not improve motor function or reduce contracture formation in the upper extremity (Teasell, Foley et al. 2005).

- Good evidence to refute the effectiveness of volar hand splinting for the treatment of contracture management in stroke patients who are receiving a daily stretching programme, five days a week and then insufficient evidence to either support or refute the effectiveness of hand splinting for adults following stroke who are not receiving prolonged stretches to the upper limb (Lannin and Herbert 2003). The majority of these studies have threats to their internal validity and most had small sample sizes. The studies also had low homogeneity of study designs, methods, splint design, regimen and outcomes, which made the pooling of data a challenge. Only five of the studies were randomised control trials (RCTs). This low number of RCT's therefore resulted in an inadequate evidence base from which to inform clinical decision making (Lannin and Herbert 2003).

- Splinting interventions for preventing and treating contractures are more effective when combined with passive stretching programs than when used alone. The overall study findings deduce that regular stretch does not produce clinically important changes in joint mobility (and ROM) for persons following neurological injury. (Katalinic, Harvey et al. 2011). However, studies were criticized for not taking into account the changes within the muscle, which has been demonstrated in animal studies, as well as the patients or therapists perception of resistance to stretch (Katalinic, Harvey et al. 2011, Weppler 2011).

Based on the evidence presented in the above-mentioned studies there is insufficient, quality evidence to prove the effect of splinting on muscle tone, improvements in motor function, reductions of contracture formation and joint ROM for patients following neurological injury.

2.2.3.2 Level 2 evidence: Randomized Controlled Trials

A study by Langlois in 1991 published as a RCT examined the effect of hand splinting on spasticity and then examined client's expectations of the splints and their

satisfaction and levels of compliance. The small sample size of nine and no control group meant the study had poor internal validity and it was not really an RCT. Participants were not involved in any other therapy for the treatment of spasticity and were divided into three groups, one wearing the splint (finger spreader/abduction splint) for 22 hours per day, second group wearing it for 12 hours per day, third group wearing it for six hours per day over a four week period. Spasticity was measured by a torque motion analyser and expectations, satisfaction and compliance was measured by a questionnaire and a log. The study revealed no significant differences among the groups in reduction of spasticity and significant relationships between the expectations and compliance and satisfaction and compliance. (Langlois, Pederson et al. 1991) The study has been criticized to have poor generalisability due to small sample size, expectations of splints may have been influenced by researchers expectations due to non-blinding or a placebo effect which cannot be ruled out as there was no control group (AOTA 2003)

The later RCT by Lannin and Horsley in 2003 investigated the effect of splinting the hand on length of the wrist and finger flexor muscles in 28 stroke/TBI patients who were in the early stages of rehabilitation and had had onset in the last six months. In this study patients with no active wrist extension were selected and randomly divided into two groups, both of which received regular therapy including motor training and upper limb stretches. The experimental group wore a palmar resting splint for a maximum of 12 hours/night for four weeks and the control group wore no splint. The outcomes included the length of wrist and finger flexors measured by torque-controlled instrument and gonionmeter, MAS, upper limb pain and compliance. The results showed no detectable or important changes in wrist and finger extensibility and resulted in decreased functional use of the hand, no significant effects on pain although there was good compliance with splint use. (Lannin, Horsley et al. 2003).

A RCT in the form of a pilot study by Sheenan in 2006 found some clinically important results when splinting patients with neurological injury in terms of tone. This study aimed to examine the effect of resting splints on spasticity. The outcome measures were the amount of resistance and rate of change of resistance, calculated by means of a computerized torque apparatus, designed for the purpose of this study. The sample was small, consisting of 12 participants and the researcher acknowledged the need for a larger study to be executed. The researcher was

blinded to group allocation and participants were randomly allocated to one of two groups, one which wore the splint for the full six weeks and another which wore the splint for five weeks. The specific regimen was not presented. The results of the study reveal a very small positive, but not clinically worthwhile effect of splinting on the amount of resistance or hypertonicity and the rate of change of resistance or spasticity. Although it was found that the effect was greater for splinting over a longer period of time (at least five weeks). (Sheehan, Winzeler-Mercay et al. 2006)

The study with a much larger sample of 63 stroke patients, eight weeks post stroke, by Lannin, et al. in 2007 used randomization, blinding of assessment of outcomes and a six week follow up of the intervention. The main outcomes included extensibility, measured by a standardized torque instrument with proven test-retest reliability and the wrist angle measured from three lateral photographs. Other outcome measures were upper limb spasticity (Tardieu and MAS), self-reported disability and symptoms (DASH and pain scores).The participants were divided into three groups, one where they were fitted with a neutral wrist splint, one where they were fitted with a wrist extension splint (45^0 extension with fingers extension), and one where they were not fitted with a splint. All participants who had no active wrist extension continued to receive regular therapy, except stretches of the wrist and long flexors. Participants were to make use of these forearm based volar splints for up to 12 hours (overnight) for four weeks. The results showed overall high compliance (higher with neutral compared to extension splint). Limitations of the study included the inability to generalise results to a sub-acute or chronic stroke population and non-blinding of participants. The study had good internal validity and the outcomes used were objective. The authors concluded that the routine practice of splinting to prevent muscle contracture during acute rehabilitation after stroke should be discontinued. (Lannin, Cusick et al. 2007)

However, the study failed to specify the severity of ‘no active wrist extension’ and had no subgroup analysis and therefore may have excluded the benefit of splinting for those with more severe imbalanced muscle over activity or pain and therefore at high risk of contracture development. The study is also criticised for failing to examine or consider the many other reasons for splinting during neurological rehabilitation including joint protection, maintaining alignment, functional splinting or splinting for spasticity management in conjunction with active therapies. It was

argued that their conclusion on the ineffectiveness of splinting in preventing contractures was to be limited to patients at minimal risk of contracture (Marossezky, Gurka et al. 2008).

Basaran et al (2012) considered the effect of splinting on tone and mobility of the wrist in patients with sub-acute neurological injury in their 2012 study which reviewed the change in spasticity and wrist PROM. A smaller sample of 35 patients recruited on admission and a single-blinded, randomized design study was used. The patients wore the splints either (volar or dorsal) at night for up to 10 hours over a five week period. Three times during the day they did stretching and active functional grasp as part of conventional occupational therapy. Hmax:Mmax ratio and MAS were used as outcome measures along with wrist extension PROM. They however found splinting had little or no effect on this loss of range, upper limb function, spasticity and self-reported disability and symptoms. No statistically significant difference was found and the recommendation is that splinting integrated into treatment as splinting alone will produce no major clinical effect and they should not be seen as an alternative to other intervention. (Basaran, Emre et al. 2012)

More significant results when considering both tone, range of motion and pain in pre-test post-test studies did find statistically significant improvement in the hand of chronic stroke patients with neurological injury after splinting.

2.2.3.3 Level 3 evidence: Pretest-posttest design

Pizzi et al. involved 40 stroke subjects, four months or more post stroke with no functional use of the affected upper limb in a pre-test post-test study in 2005. A functional resting splint was applied for 90min/day for a month, which then increased to 110min/day for another month, which then increased to 150min/day for a further month. Outcomes include pain (measured by the visual analogue scale), spasticity (measured by MAS and Hmax/Mmax ratio), ROM (measured by a goniometer), spasms (measured by Penn spasm frequency score) and clonus. Results showed a statistically significant improvement in wrist extension PROM, with a greater improvement in chronic more than sub-acute patients. Spasticity of flexors improved significantly and pain and spasms were less. The limitation of this study was the lack of a control group. The author identified the need for more research, but suggested that splinting is to be used as an integral part of the rehab process for a non-

functional hand with very compliant patients with no tendon shortening (Pizzi, Carlucci et al. 2005).

Case studies and surveys which are a lower level of evidence have presented a variety of types and designs of splints including thumb splints, inflatable splints, dynamic splints and lycra splints. The evidence presented for these various splints used varying outcomes, subjects, wearing regimens and study designs.

2.2.3.4 Level 4 evidence: Single case study and case series and survey

Only one case study using a type of thermoplastic splinting material (the type of splints considered in this study) was found. Takami et al. reported a single subject case study (66 year-old with left hemiplegia), with no specified regime, no control, unknown treatment duration and unspecified time post stroke and no specified outcome measures in 1992. They used a wrist extensor splint with a 'shape memory alloy' which is able to mould to the desired shape, but slowly recover as it is heated by body temperature said to avoid the development of spasticity. The authors acknowledged that the study was not sufficient to prove the effectiveness of this splint or material (Takami et al. 1992).

The challenge with the literature is the difference in samples, splints, wearing schedules and outcome measures, therefore no conclusive conclusions can be made. However, the common notions which appear are that splinting the hand has no significant effect on spasticity and extensibility without an exercise programme or stretching and for those at low risk of contracture development in acute and sub-acute patients. Evidence for chronic patients is very limited. There is also a significant relationship between expectations of the client and compliance with the splint and satisfaction of the client and compliance with the splint.

The problem with all levels of evidence presented above is that it is based in research and does not consider the essential decision-making needs of practitioners (Tickle-Degnen & Bedell, 2003). Despite the confusion created by the literature, it is not likely that therapists would stop using splints in a clinical setting. Therapists argue that the effectiveness of splints is determined on an individual basis, and is usually combined with other therapeutic modalities such as Botox, stretching and functional activities. (Seneviratne 2007)

2.3.3.5 Level 5 evidence: Expert Opinion

The last level of evidence in the traditional pyramid is expert opinion. Recognition of the practitioner expertise and patient preferences in EBP must be expanded (Sackett, Strauss, Richardson, Rosenberg, & Haynes, 2000) especially in occupational therapy which requires dynamic interaction with patients. This can only be achieved by adding qualitative components to the research and including these results in the evidence by using the type of evidence pyramid suggested by Tomlin and Borgetto in 2011 which provides a new outlook on the levels of evidence in occupational therapy and considers evidence on four sides of a pyramid including descriptive, experimental, outcome and qualitative research at various levels. (Tomlin and Borgetto 2011)

They have indicated that by including qualitative research into EBP in the research pyramid, with a particular focus on outcomes in the real world of patient participation and clinical experience, using the expert opinion of therapists to obtain “thick description” of their lived experience in splinting for neurological injury would place the evidence at a higher level. (Tomlin and Borgetto 2011) than expert opinion in the single-hierarchy EBP model (Arbesman et al., 2008) can only be obtained from experienced or expert therapists who have clinical experience in the field (Schell and Schell 2007)

Due to the absence of conclusive quantitative evidence to provide EBP, Borgetto et al have suggested the use of qualitative research with a particular focus on outcomes in the real world of patient participation and clinical experience. (Borgetto et al., 2007). Qualitative information in the form of thick descriptions can be gained through the use of expert opinion of therapists with clinical experience in the field. (Schell and Schell 2007). Focus group discussions are effective in providing therapists with opportunities to discuss the shared and more important issues related to splinting following neurological injury (Kielhofner 2006) and could be useful to provide current practice guidelines.

2.3 Expert therapists and practice development

Schell and Schell describe an expert therapist as one that does not always need to make use of intensive cognitive process, abstract principles and strict protocols to

make decisions. Formal tools are useful to the novice therapists initially as they ensure that they focus on all aspects of the problem and they assist in identifying the most relevant problem to proceed to the execution of treatment, enabling the novice to learn this process more efficiently. (Benner 1984) Novice therapists are likely to follow guidelines developed by the he Association of Chartered Physiotherapists Interested in Neurology (ACPIN) for splinting following neurological injury.

These guidelines assist in the process of splint prescription if splinting is indicated and include; Consent being obtained from the patient/carer as well as the rehabilitation team involved, precautions being identified, clinical rationale being identified along with objective measures, treatment plan and goals, documentation of area to be splinted, reason for splinting, type of splint, range of movement, physical appearance, any other objective measures to monitor splint effectiveness, types of materials padding and strapping and wearing regimes, written description for patients and staff being provided, close monitoring of the splint and a date for reassessment being set (ACPIN 1998). As the therapist follows guidelines, gains experience, and implements theoretical knowledge, expected outcomes are challenged, refuted or confirmed by what occurs in the actual situation (Heidegger 1962, Gadamer 1970). The therapists can then build up a store of concrete experiences, which can be referred to immediately or that are perception changing and can be remembered and referred back to at another time. (Benner 1984). This will allow therapy to become more efficient and as these experiences continue the therapist will rely less on principles and strict protocols and be able to focus directly on the specific parts of the problem without time spent on a large range of irrelevant information and alternative solutions.

Practice development occurs in occupational therapists' practice setting as they gain experience as well. This development focuses on the enhancement and growth of personal, professional and/or organisational standards and quality of services by involving and focusing on the patients' specific needs. Practice development requires team-working, interdisciplinary collaboration, effective communication, internal and external partnerships and a willingness to learn and share with and from each other, (Mcsherry 2004) It also involves the promotion of improvements in quality of one's own care and self. (McSherry and Driscoll 2004) This is developed through critical reflection and introspection on clinical practice.

Professional knowledge is the knowledge which arises from within practice and is built up through professional education (propositional knowledge), actual practice (procedural knowledge) and professional and life experiences (personal knowledge) (Higgs and Titchen 2001b).

- Propositional knowledge- this is the knowledge developed through formal education, including undergraduate training and postgraduate courses. For a young inexperienced therapist the issue of splinting has been described as “an amorphous quicksand waiting to engulf the unwary therapist” (Coppard and Lohman 1996) as most undergraduate training does not focus on the specific skills required for splinting a hand following neurological injury. Graduates however should be equipped with foundation knowledge, clinical experience, and skills in clinical reasoning and problem solving which should enable them to work through a problem relating to splinting patients with neurological injuries (Higgs and Titchen 2001b).

  Occupational therapy for these patients differs from other professions as there is no gold standard protocol and therapy for all patients is conceived individually for the variety of problems they may present with. This poses challenges to novice occupational therapists as they require additional field-specific training and practice to develop clinical practice knowledge. (Ericsson and Smith 1991). This practice knowledge is embedded in clinical expertise and is central to the advancement of practice along with theoretical knowledge (Benner 1984). As new knowledge is gained in the field, professional educators should include this in undergraduate and postgraduate curricula, to allow therapists to practice from an evidence base and to enable therapists to make more informed decisions in a field full of uncertainty. (Higgs and Titchen 2001b).

- Procedural knowledge- is the knowledge learned through real clinical experiences. The learning of the newly-qualified therapist is based on four assumptions. Firstly it occurs during authentic practice, which is that therapists learn as they do. Secondly the transfer of learning is limited to similar situations and in neurological rehabilitation in occupational therapy this is a challenge due to the unique presentation of individual patients. Thirdly,

learning is a social phenomenon which requires the therapists to work in a team. Fourthly, learning relies largely on the use of propositional knowledge (Black and Schell 1995).

- Personal Knowledge is the knowledge that develops through life experiences and reflection on them. This requires therapists to make judgements on what theoretical knowledge they have as well as what they have used in practice. Expert therapists have a clearly defined purpose which should ultimately be linked to an improvement in function (Dutton 1995) however it is often challenging for them to identify how they came to a particular decision, as they may say that 'it just feels right' (Dutton 1995). They do understand that in order to make decisions they need to draw and reflect on information from various sources on various aspects (Unsworth 2001) they will then make use of knowledge and frames of reference as a foundation but understand more comprehensively that other problems may exist (Dutton 1995).

  Reflection is also a critical element used by expert therapists in the development of clinical practice knowledge (Jensen, Gwyer, Shepard, and Hack 2000,) and through reflection and self-appraisal, this knowledge becomes more explicit (Donaghy and Morss 2000). This allows them to perfect the dynamic transaction between personal, theoretical knowledge and the current clinical situation (Benner 1984).

The different levels of clinical reasoning and problem solving used by expert clinicians is reviewed in models presented by Fleming and Mattingly in 1994 and Schön in 1990 (Fleming and Mattingly 1994, Schön 1990). Analysing the different levels of clinical reasoning of expert therapists related to splinting following neurological injury will assist less experienced therapists in developing a pattern to follow in their own professional development.

2.4 Clinical reasoning

When occupational therapists decide on an appropriate course of action, clinical reasoning requires them to make judgments and improvise by altering general

practice guidelines to a specific therapy for the given patient.(Mattingly 1991). Clinical reasoning has also been described as a “decision tree process”(Wolf 1985) or a four-stage model of Medical Inquiry (Elstein, Shulman et al. 1978). This process focuses specifically on identifying the problem and the first stage or *cue acquisition*, is the gathering of cues relevant to a particular case.

A clinician is expected to draw on prior knowledge and experience to gather sufficient cues and determine the relevance and “weight” of each cue. The second stage or *hypothesis generation* is the formulation of a hypothesis based on the cues and possible relationships between cues. Some of the relationships that may exist are causal (the cue caused the condition), an association (the cue is secondary to the actual cause), situational (as a result of the patients response to the condition) and null (not related to the condition). The third stage or *cue interpretation* involves rechecking or testing of cues in light of the hypothesis and the final stage or *hypothesis evaluation*, occurs with the selection of a hypothesis based on the cues according to the new information gained (Elstein, Shulman et al. 1978).

There are a number of other models on clinical reasoning, Two will be further examined, firstly the Three-Track Mind which is specific to occupational therapy (Fleming and Mattingly 1994). Secondly, a model based on clinical problem solving and reflection of practice which involves Knowing-in-Action, Reflection-in-Action and Reflection-on-Action by Schon will be examined. (Schon 1990)

2.4.1 Three-Track Mind

Fleming and Mattingly in their study of clinical reasoning in 1994, found that occupational therapists made use of different ways of thinking for different purposes and for different aspects of a problem. The more experienced therapist can make use of previous knowledge and experience to recognize patterns seen in patients and then move quickly to goal setting and treatment planning.(Mattingly and Fleming 1994)

Three reasoning strategies were identified –

- Procedural reasoning

Procedural reasoning is aligned to the use of theoretical knowledge about the disease or disability and the treatment procedure to use to improve a functional

problem. It addresses problems of the physical body in a number of problem spaces, for example cognitive, emotional, cultural, neurological and structural. The task environment in which assessment and treatment occurs, is also considered allowing better treatment selection. Novice or inexperienced therapists may base their therapy at this level of clinical reasoning. (Mattingly and Fleming 1994).

- Interactive reasoning

Interactive reasoning occurs during face-to-face interactions with the Occupational Therapist and patient. This reasoning is used to better understand the patient as an individual. Occupational Therapy demands a high level of commitment by the patient and developing a good interpersonal relationship is important to enhance this. The clinical abilities required are interviewing skills and a therapeutic use of self which become more effective with experience. A therapist may explore how a patient feels about treatment, what the patient is like as a person and their experience of disability. This allows them to match treatment goals and strategies, build trust, relieve tension, evaluate treatment and show personal interest (Mattingly and Fleming 1994).

- Conditional reasoning

Conditional reasoning is builds on interactive reasoning and takes the whole condition into account, as well as determining what is meaningful to the patient and understanding the social and physical contexts in which a patient experiences their lives. This may not always be a conscious process on the part of the occupational therapist but it requires “tapping into” the patient’s perception of themselves to identify with the patient as they perceived themselves prior to the injury and imagine what the patient could potentially achieve in the future. Patient “buy in” to commit to engagement in occupational therapy to recreate meaning in their lives is part of what must be considered and achieved. Carefully calculated decisions for activity to use in therapy need to be made for the patient to have meaningful experiences and sometimes the treatment of a particular impairment is sacrificed to achieve the overall meaning of therapy. This high level of abstract reasoning is developed in expert therapists who are able to use past clinical experience to focus directly on the relevant problems from various sources and develop a comprehensive picture of the patient. (Mattingly and Fleming 1994).

2.4.2 Knowing-in-Action, Reflection-in-Action, Reflection-on-Action

Schön (1990) examines the way that occupational therapists and other practitioners approach and solve problems. He describes two levels of problem; A well-formed problem and a “messy confusing problem” (Schon 1990).

A well-formed problem can be solved by applying research-based theory and techniques which is gained by systematic, scientific knowledge. The practitioner, faced with this problem, will make use of Knowing-in-action, which is the knowledge translated into action. Practitioners are skilful at being able to select the most effective technical solution to achieve a desired outcome. These technical solutions are derived from a body of professional knowledge; facts, rules and procedures specific to a profession. In occupational therapy these facts, rules and procedures constitute the various frames of reference which provide a theoretical set of assumptions about phenomena and explain and predict behaviour. (Mosey 1981) A solution can be taken from this set of theoretical concepts which guide practice (Denton 1987) (framing) once the problem has been identified (naming)(Parham 1987)

Some of the frames of reference guiding the practice of occupational therapy are biomechanical, neurodevelopment and rehabilitation. (Dutton 1995) A therapist following these familiar frames of reference daily with patients who have well defined problems, As with Procedural reasoning the inexperienced or novice therapist may rely on this Knowing-in- Action initially but with experience it becomes the routine, spontaneous, unspoken behaviour, which is often difficult to describe, but easy to execute.

The reality of dealing with patients is that real world practice, however, does not always present as clearly defined problems, particularly in occupational therapy which requires a therapist to consider a each patient as an individual with many aspects. Having to deal with this “surprise” situation, requires a practitioner to reflect on their actions as each patients problems can be unique, uncertain and are not always solved merely by applying learned theories or techniques from a professional body of knowledge. An experienced or expert practitioner is more easily able to make use of Reflection-on-Action. This involves a reflection on what was done once it has been done and the action that needs to be taken to have a, direct effect on the

current situation. Reflection-In-Action, may also take place while the action is occurring so immediate action can be taken to adjust the situation at that time. (Schon 1990) Reflection is evident in a skilled experienced or expert clinician, as they are able to undertake a moment-by-moment appreciation of a process and adjust their responses based on past experience and use of conditional reasoning. Reflection-In-Action may also require immediate ethical reasoning where there is value conflict and as with all the highly developed reflective skills used by experienced therapists the problem solving and clinical reasoning become challenging to describe but indirectly shape their future action and allow them to develop even more expertise. (Schon 1990)

2.5 Summary

The purpose of splinting, identified in the early literature, is for biomechanical as well as neurophysiological reasons, however problems are identified in the early literature which is a result of lack of research, inadequate definitions and inadequate measurement devices (Rosenada and Ellwood 1961). More recent literature presented reveals insufficient, quality evidence to prove the effectiveness of splinting on muscle tone, improvements in motor function, reductions of contracture formation and joint ROM for patients following neurological injury. Other challenges with the recent literature are the differences in samples, splints, wearing schedules and outcome measures, therefore no conclusive conclusions can be made. Despite all the emphasis on classical experimental methodology like systematic reviews and, randomized controlled trials, conclusive outcomes are not possible from the available literature suggesting splinting may be more effective for specific groups of patients. The lack of focus on qualitative outcomes in prescribing splints for patients with neurological injury means the therapists' clinical experience of splinting and expert opinion to describe its effectiveness are not considered. It is essential in occupational therapy where patients are considered individually within the 'real world' if splinting for neurological injuries is to be effective and outcomes are to be achieved.. By understanding the clinical reasoning of expert therapists in the field one can gain access to evidence of greater value which provides a "thick description" of the lived experience of splinting patients following neurological injury.

CHAPTER 3 METHODOLOGY

3.1 Research Design

The aim of the study was to 'explore' and 'investigate' the development through practice and clinical reasoning experienced occupational therapists are using in practice with regard to splinting the hand following neurological injury. The researcher made use of an exploratory, descriptive, deductive qualitative methodology (Parahoo 1997). Descriptive qualitative research emphasises exploring the phenomenon under investigation, exploring the manner in which it is understood from the participants' perspective and any other factors relating to it (Parahoo 1997).The study therefore followed a qualitative methodology using focus groups to explore the various aspects of reflective practice involved in splinting the hand in adults following neurological injury. The study was descriptive as the process, meaning and experiences gained by expert occupational therapists in prescribing and using splints in adult patients with neurological injuries was considered. Case studies and prompts were used in focus groups to establish the process expert occupational therapists use in splinting the hands of adult patients with neurological injuries.

3.2 Sampling

Sampling is about deciding who will participate in the study and how they will best represent the greater population (Kielhofner 2006). The population for the purpose of this study was qualified experienced occupational therapists with at least five years of experience working with patients following neurological injury (Dreyfus and Dreyfus 1985).

Selection of suitable participants was based on identification of a population who had experience and knowledge in the field of splinting in adult neurological pathology. In a study which compared experienced and inexperienced therapists and their decisions to splint, experienced therapists were defined as having at least six years of experience (Neuhaus, Ascher et al. 1981). Based on this and in view of the limited number of experienced occupational therapists in this field, the researcher decided

that an experienced occupational therapist should have at least five years of experience, all of which should have been in the area of neuro-rehabilitation to ensure they have had sufficient education, experience and an opportunity for constructing a knowledge base in practice. They have "has an intuitive grasp of the situation and zero in on the accurate region of the problem without wasteful consideration of a large range of unfruitful possible problem situations" (Benner, 1982, p. 406), A study by Benner (1984) revealed that therapists who had been in practice for two to three years still apply or transfer knowledge from theory to practice and they can only be considered competent not experienced therapists (Benner 1984).

According to Schell and Schell (2007) a therapist needs at least two to three years of experience with emphasis on education, field-specific training and practice in a speciality area to be considered experienced (Ericsson and Smith 1991). Therefore in addition the researcher decided to include therapists who had a minimum of three years of experience in neuro-rehabilitation, but who had been qualified for at least seven years allowing them to develop knowledge within the profession. No requirement was set on the specific number of years of experience each therapist should have in the treatment of the neurologically impaired hand as well as splinting of patients with neurological injuries but only therapists with some experience were recruited. This allowed the researcher to better determine the occupational therapists' competence in neuro-splinting specifically.

A geographical boundary of the Gauteng area (which included specifically Johannesburg and Pretoria) was set to ensure ease of access of the participants to the focus groups.

3.2.1 Inclusion criteria

- Occupational therapists who had been qualified for at least seven years, with at least three of those years with neurological rehabilitation experience and some experience with hand therapy involving people with neurological injuries

  or

- Occupational therapists who had been qualified for five years, having clinical experience for all five years in neurological rehabilitation and some experience with hand therapy involving people with neurological injuries
- Occupational therapists willing to participate in a focus group

3.2.2 Exclusion criteria

- Occupational therapists living too far to travel to the focus groups
- Occupational therapists working in neuro-rehabilitation who have never splinted the hand of a patient with neurological injury

To ensure that participants met these criteria, the researcher made the criteria overt on the invitation email and verified them on attendance of the focus group by having them complete a demographic questionnaire. (Appendix A)

The researcher made use of purposive sampling where an invitation (Appendix B) was sent via email to the rehabilitation hospitals in the Gauteng area. Emails were also sent to members of the occupational therapy departments of the two universities (University of the Witwatersrand and University of Pretoria) in the Gauteng area. Emails were also sent to occupational therapists who are members of the South African Society of Hand Therapists (SASHT) as well as occupational therapists who had web pages related to the treatment of adult physical conditions. Snowball sampling was also utilised to reach a greater network of occupational therapists in the Johannesburg area.

3.2.3 Sample size

Focus groups typically consist of four to six people although they can have a maximum of twelve (Kielhofner 2006). It was anticipated that three groups would be run, consisting of five to six participants. Therefore a total of 15 to 18 participants were expected to participate.

Participants were invited to attend one group each and a total of three groups were run. According to Krueger and Casey (2000), three or four focus groups with a particular audience are usually sufficient to determine variability in thoughts and experiences and to gather the desired quality and depth of data and achieve data saturation. It was anticipated three groups would be adequate and that the

presenting information after this would not be completely new and original. If necessary a group was planned either with new members or the return of participants who had already taken part to ensure data saturation.

Participants were told on an information sheet (Appendix C) that they may be expected to participate in a second group, should data saturation not be achieved and to gain further clarity following the first three groups, alternatively a fourth group of new participants was to be held. Participants were divided into one of three focus groups based on which was more convenient for them to attend. Only three groups, each consisting of four to five participants were held, as data saturation was obtained with similar themes consistently being identified on the completion of these groups, with no new information arising.

3.3 Data collection method

Focus groups were chosen as the most appropriate method of data collection as they are a non-intimidating way to create multiple lines of communication. They offer a safe environment to share ideas and attitudes with other occupational therapists of similar backgrounds. (Morgan 1988, Wilkinson 1998). The groups were effective for use with experienced occupational therapists as they recognise that aspects of decision-making, particularly for occupational therapy-related decisions, can be multifaceted and gathering of data may be most effective in a space where various perspectives can be heard and considered at the same time. (Kielhofner 2006) The focus group discussions were efficient in collecting data from many people at one time and were also able to lead to the more important issues, which could also be identified by the shared views of the participants (Kielhofner 2006).

Focus groups are reported as valuable in helping with the dilemmas which are presented as lacking of consistency or homogeneity of inclusion criteria and outcomes of current evidence in the literature. These groups can provide thick, rich data as the interaction between group participants often decreases the amount of interaction members of the group have with the facilitator which gives more weight to the participants' opinions and decreases the influence the researcher has over the group. (Denzin and Lincoln 2000) The focus group is a "collectivistic" research method and focuses on the "multivocality of participants' attitudes, experiences, and beliefs" (Denzin and Lincoln 2000) pg836). The group therefore has the power.

There were three focus groups held in the Gauteng area, these included two in Johannesburg; at Rehab Matters a neurological rehabilitation outpatient therapy centre in Rivonia, and the Occupational Therapy department of the University of the Witwatersrand. A third group was held at a rehabilitation facility in Pretoria, Muelmed hospital. The groups took place at a time and place which were most convenient for the occupational therapy participants to ensure maximum recruitment.

The groups took place after work hours and last 90-120minutes. After three focus groups of five to six participants were completed, the researcher identified that no new ideas were being generated from the groups and the ideas were similar to those being generated from the other groups. Data saturation was assumed at that stage.

The rooms in the venues were allocated based on a request for a non-distracting room of adequate size to accommodate a number of six-seven people. The rooms were all set up with chairs placed in a circle. One of the rooms had the chairs around a table which was the only arrangement available for that venue. Participants were each given a pack which was a clipboard containing a consent form, information sheet, case reports for Mr T and Mrs P (Appendix D) and a pen. An attendance register was circulated to ensure participants would receive their appropriate CPU's as well as for them to check their email addresses for member checking to take place at a later stage. Consent forms were completed on arrival. Refreshments were set up on the side of the room for when participants arrived and during the break which was following the discussion of the first case study. Two Dictaphones were placed in the centre of the group to record the responses. All participants completed a demographic questionnaire (Appendix A) in order to determine the number of years of experience of individuals and the level of postgraduate experience in the group, this would be anonymous.

The focus groups were led by the researcher. An assistant attended the group to make notes on observations, emphasis and mood of the group during the discussion. The assistant was given a copy of the questions (Appendix E) to be asked to the group to assist should the researcher neglect to ask one.

The researcher welcomed the participants and explained the purpose of the group as well as set some boundaries for the group to ensure consistency across all three groups. The researcher made use of case reports (Appendix D) to remind the

participants of similar patients that they had treated in the past and to get them thinking about previous cases and similar cases that they may have seen in the past. The question guide was to prompt the discussion and serve as a guide to understand their problem solving. To understand the therapists' thinking and decision making they were required to make a decision (to splint or not splint) for each case report and then justify their choice. The questions were asked in such a way as to determine the factors impacting a therapist's decision to splint.

The researcher requested the participants to read the case study, then participants were to jot down the answer to question one and then present their answer and a discussion would ensue. This was to prevent any bias or influence from stronger members on others and allow all participants to have an equal chance to share. They were also asked to justify, the "why" allowed the researcher to explore their justifications and the type of factors influencing the decisions. The discussion was transcribed by the researcher in order for her to become more familiar with the data. This took longer than the anticipated four to six hours per one hour of recording (Krueger and Casey 2000).

3.4 Trustworthiness

A number of procedures were undertaken to ensure the research question was precisely explored and the findings accurately represented. (Agar 1986) This is described according to a model which identifies four aspects of trustworthiness (Guba 1981). The four aspects considered in this study described by Guba (1981) were

3.4.1 Credibility

In order to ensure an accurate representation of the subjective human experience of the participants member checking was utilised. (Krefting 1991) Following the transcription of the data, summaries were made and emailed to participants, they were then requested to review and state if they felt the information was accurately represented and transcribed based on what was discussed in the groups. They were also given an opportunity to give additional comments. Peer examination was also utilised as findings were discussed with the research supervisor as well as research

assistant. Transcripts were also double-checked to eliminate obvious transcription errors.

3.4.2 Transferability

This refers to the ability to generalize the findings to larger populations (Krefting 1991). Through the use of case studies and the question guide, participants were asked to describe their decisions based on typical everyday behaviour, this was to ensure the data that was reported was what is 'usually' done in practice. The use of purposeful and snowball sampling also ensured that a sample representative of the population of experienced occupational therapists working in neurological rehabilitation was used. Data saturation was achieved as experienced clinicians, as participants would provide rich, thick descriptions and the groups were closed once no new ideas were being generated, this was determined by the researcher who ran each of the groups.

3.4.3 Dependability

Consistency between groups was ensured through the use of a question guide and case studies. Peer examination was used to increase dependability of data.

3.4.4 Confirmability

To ensure freedom from bias (Guba 1981, Krefting 1991) a research assistant cross-checked the codes for intercoder agreement to ensure text would be coded the same regardless of researcher. A qualitative codebook was used to ensure no drift in the definition of codes and line-by-line coding was also used to prevent the researcher from imposing her own beliefs on the data. (Lofland and Lofland 1984, Denzin and Lincoln 2000)

3.5 Data measurement

3.5.1 Measurement techniques

Data collection within a focus group may demand that the researcher ask questions, and that these should be broad based when working with expert therapists allowing them freedom to discuss their experiences. (Strauss and Corbin 1990, Denzin and Lincoln 2000). Research questions are needed because data collection is a selective process it needs to be focused and are the best defence against overload. The

researcher therefore made use of a discussion guide and case reports during the groups. Specific questions and variations in the case study were used to prompt discussion about how a therapist makes a decision to splint or not splint. This also aided the researcher to consider aspects of clinical reasoning and professional development which was ensured by the consistency in how the questions were asked in all three groups (Krueger and Casey 2000).

3.5.2 Development of the case reports

This included a set of two case reports and a list of topics which were developed to guide the discussion and keep the group focused. The researcher made use of two case reports (Appendix D) to allow the participants a chance to make decisions, provide explanations and justify those decisions and then stimulate discussions around the key points of controversy or confusion from the literature. The use of case reports was decided as an appropriate method to elicit discussion, as clinical and professional reasoning is an active process and requires a clinical problem to solve. The case reports also allowed the researcher to investigate rationales underlying splinting decisions involving patients with stroke or TBI. The case reports were adapted from Turner, Foster and Johnson (Turner, Foster et al. 2002) and Neuhaus et al. (Neuhaus, Ascher et al. 1981) and were presented in a simple table format for ease of reading and to allow the participants to refer back for the details of the case. Age and gender were adapted to allow participants to consider these variables. Dates of cases were changed to recent dates and work and living settings made more appropriate to a South African context to make the cases more real and current. Cases were also presented similarly to each other for consistency.

3.5.3 Development of discussion guide

A critique of the current literature on splinting was used in order to understand current best evidence in addition to the practical use of splinting by an experienced therapist (who could, based on their experience, informs current best practice).The discussion guide (Appendix E) was developed to focus on splinting in the patient with a neurological condition was then developed. The purpose of the question guide was to help the researcher to better understand how the participants had developed as professionals and their decisions in relation to splinting of neurologically injured patients in practice. An understanding of their thinking, their

level of experience with the materials and knowledge base as well as the internal and external factors which may influence their decisions was needed in order to allow the inclusion of these concepts into the analysis.

Specific questions were asked related to the influence of formal education, models and literature on their decisions as well as interpreting the value of their experience when splinting under various conditions and determining that value by the number of times it is mentioned and the key words and emphasis used attributing value.

The initial question about splinting was open ended and related to their reasons for splinting the hand following neurological injury, this was to allow participants an opportunity to consider splinting and their experience without any preconceived notions and also to introduce the topic which would be discussed. The key questions were related to each case study about their decision to provide or not provide a splint. They were asked to justify each decision made in relation to this, to gain a greater understanding of their clinical reasoning. The types of materials, splints and regimens were also explored to understand their clinical reasoning and also the various factors which may influence their decision making. Following a discussion, specific follow-up questions or probes were prepared in advance in order to elicit information from the participants about other factors such as prognosis, time following onset, dominance, age, home environment, literature and precautions which have been raised in the literature but may not have been discussed earlier and which may in effect, influence their decision.

It is important to note that all questions were to encourage discussion and stimulation of discussion of the topics mentioned. The researcher remained flexible and was prepared to ask additional questions to explore the expert therapist's decision making.

Once all questions were asked and the group discussion was no longer highlighting or generating new ideas, the researcher concluded. To ensure that the researcher had accurately understood the main thoughts and ideas expressed by participants in the group, a typed summary was emailed to all participants for member checking, which allowed participants to verify information provided.

3.5.4 Pilot of discussion Guide

The discussion guide was reviewed and then refined based on comments by supervisors and colleagues, who did not meet the criteria for participation in the study but who worked in the field of adult neurological rehabilitation or who were not able to attend the groups. The questions were informally piloted by the researcher in two groups of occupational therapists from the researchers' work place who then provided feedback. The case reports were presented (Appendix D) and the discussion guide (Appendix E) was used, however only question one was queried. The therapists involved in the study were not part of the focus groups of the research, but this gave the researcher an opportunity to gain confidence. The participants provided assistance with adding to the questions to ensure that they were relevant and appropriate and guided the discussion. These include asking why they decided to splint or not splint and then asking if they would make the same decision under various circumstances such as if she was in the chronic phase or if she had an improved prognosis

3.6 Data Analysis

Each group was transcribed in a separate document and the dialogue summarized to identify the key points that were discussed. As the data was being studied, each "chunk" of information was assigned a label and highlighted in a different colour. These chunks of information were then assigned to priori themes and categories already determined based on Higgs and Titchen's Model of Practice Development (2001b) and a model of Clinical Reasoning presented by Mattingly, entitled The Three-track Mind (Mattingly and Fleming 1994). The groups of information were assigned to the sub-categories based on specific key words which represented that chunk of information. The chunks were summarized and presented as codes, as presented in table4.4Codes were presented on a single sheet for easy reference and to allow the researcher to more easily determine the relationships between codes (Miles and Huberman 1994). Analysis therefore took place in the same format to determine:

- The Expert clinical knowledge and experience

Information was grouped according to whether or not the key word/s (which represented the statement) linked with priori categories of how professional knowledge was gained whether it was through professional education (propositional knowledge), through actual practice (procedural knowledge) and through professional and life experiences and reflection on them (personal knowledge). (Higgs and Titchen 2001b)

- Individualized OT clinical reasoning process undertaken

Statements were analysed based on how the key words associated with how therapists execute clinical reasoning categories including; Procedural reasoning (the reasoning undertaken when planning treatment and dealing with disease and disability), Interactive reasoning (the reasoning employed when interacting on a personal level with the patient) and Conditional reasoning (which involves a more complex process where all factors are considered and the therapist is able to visualise the patient as he would potentially be in the future).(Mattingly and Fleming 1994)

The data analysis also involved comparing and contrasting quotes with reference to several key factors namely, frequency, specificity, emotion and extensiveness. Frequency is how often something is said. Specificity relates to detailed and specific accounts. Emotion is about what is said by participants with enthusiasm or emotion. Lastly, extensiveness relates to how many participants report the same information (Krueger and Casey 2000). These helpful factors enabled the researcher to identify data with increased weight and emphasis.

3.7 Ethical considerations

In the email invitation to participate in the focus groups, occupational therapists were made aware of the purpose of the group in an information sheet (Appendix C). They were asked to sign an informed consent (Appendix F) to participate in the study and also to sign that they agreed that the focus group be recorded for the purpose of data analysis. They also agreed that the information gathered from the focus group would be emailed to them for member checking. Email addresses were obtained prior to the group which allowed for member checking to be done at a later stage.

Demographic information would be collected prior to the group, this being anonymous.

The researcher had responsibility for all the data that was gathered. A master copy of the personal details of each participant was kept on the researcher's personal laptop protected by a password. The recordings and transcriptions of the focus groups were also kept in a secure location at the researcher's residence.

Each participant was allocated a code which was used during transcribing to ensure anonymity. Participants were referred to as "occupational therapists" or "participants" in the results and analysis of the data. Places of work or any personal information given in the group were not discussed in the results or discussion, however personal information, including what type of work (private practice, state hospital) was reordered and reported in the table of demographics (Appendix G)

The data and personal information will be kept secure until completion of the study and until the study has been submitted, marked and passed the necessary examination boards. Thereafter the data will be retained for an additional 5 years.

Ethical clearance certificate M10531 (Appendix H) was obtained from the University of the Witwatersrand Human Research Ethics Committee (Medical). Confidentiality will be maintained as the participant's names will not be recorded and they were informed that they may withdraw at any time. Feedback on the results was offered on request by forwarding on a summary of the study to the participants who requested it.

3.8 Summary

The researcher made use of an exploratory, descriptive, deductive qualitative methodology.(Parahoo 1997). The population included qualified, experienced occupational therapists with at least five years of experience specifically in neurological rehabilitation. The researcher made use of purposeful sampling and snowball sampling. Focus groups were chosen as the most appropriate method of data collection and the researcher made use of two case studies and a question guide with the questions so as to prompt a discussion and understand more fully the professional development and clinical reasoning utilised by the participants. Data

was analysed using priori themes and categories based on Higgs and Titchen Model of Practice Development (2001b), and Fleming's Three Track Model of Clinical Reasoning (1991). Informed consent was gained although confidentiality could not be ensured during the groups anonymity was ensured throughout the transcription and analysis process. The findings are reported in Chapter 4 and have been interpreted in Chapter 5 with reference to the available literature on the topic of splinting patients following neurological injury.

CHAPTER 4
FINDINGS

4.1 Introduction

Information on the study participants and the demographics of the groups will be presented. Thereafter, the findings of the study were analysed according to the priori themes and categories based on professional knowledge (Higgs and Titchen 2001b) and the professional knowledge is gained through the Model of Professional Education (propositional knowledge), through actual practice (procedural knowledge) and through professional and life experiences and reflection on them (personal knowledge) (Higgs and Titchen 2001b) and the Three Track Mind Model of Clinical Reasoning (Mattingly and Fleming 1994) using a within and across-group comparison. Interview data while being coded into subcategories according to these priori categories and themes were continually reviewed for additional emergent themes, and discordant data was separated for later consideration.

4.2 Demographics and professional experience of participants

A total of 14 qualified occupational therapists participated in the in the three focus groups. Since the number of therapists who met the inclusion criteria as described in Chapter 3, were limited, the criterion for experienced and expert occupational therapists was changed to those with at least four years of experience in neurorehabilitation. The sample was all female. The majority of the participants had qualified at the University of the Witwatersrand, followed by the Universitiy of Pretoria. Four of the participants had qualified at the other institutions.

Participants had an average of 10.2 years of neurological rehabilitation experience ranging from four to 25 years. Nine of the 14 participants had postgraduate degrees, six of these being in the field of neurology. The same number of participants had postgraduate Neurodevelopmental Therapy (NDT) training. All participants were working in the private sector and four had previous experience in the public sector specifically in neurological rehabilitation.

The groups were similar in terms of the number of years of experience working in the field of neurology. Participants in Group 3 had been qualified for significantly longer and those in Group 2 had more postgraduate training.

4.3 Development of themes

Following focus group transcription, directed content analysis was undertaken as each key point on the transcriptions was highlighted in a different colour and from there, codes were identified. Codes were presented on a single sheet for easy reference and to allow the researcher to more easily determine the relationships between codes (Miles and Huberman 1994). Codes were analysed into priori categories. using directed content analysis, These categories represented the subsections of the two priori themes based on Higgs and Titchen's Model of Practice Development (2001b) and Fleming's Three Track Model of Clinical Reasoning (1991)

- Theme 1: Practice development
- Theme 2: Clinical reasoning

Table 4.1 Themes, categories, Subcategories and codes developed

Priori Themes	Priori Categories	Subcategories	Codes
Practice development	Propositional Knowledge	Poor foundation of practical experience	• Undergraduate training • Postgraduate courses
		Research evidence for practice	• Keeping up to date • Controversy and lack of evidence
	Procedural Knowledge	Experience	• Working with colleagues • Working with the materials • Knowing the outcomes and goals
		Evaluation	• Reflection on successes and errors
		Effectiveness	• Measurement of improvement • Patient response
	Personal Knowledge	Individual growth	• Interpretation
		Listen to patients	• Adapted for preferences • Patient's goals
Clinical reasoning	Procedural reasoning	Client factors	• Range of motion • Muscle tone • Pain and others
		Performance skills	• Motor and praxis skills
	Interactive reasoning	Individual patient - internal performance components	• Personality • Age • Hand dominance
		Total patient – external performance components	• Family and caregivers • Education • Resources
	Conditional reasoning	The risks	• Treating the hand in isolation • Non-compliance or lack of resources
		Therapy comes first	• Preferred alternative treatment
		The whole picture	• Therapy more important initially • Combination of factors • Holistic approach

Each of these themes will now be further described, with accompanying transcriptions from the data to support the findings.

4.4 Theme 1: Practice Development

This theme was based on priori categories which propose that professional knowledge is built up through professional education (propositional knowledge), through actual practice (procedural knowledge) and through professional and life experiences and reflection on them (personal knowledge) (Higgs and Titchen 2001b).

4.4.1 Propositional knowledge

This is the knowledge taught at university, postgraduate courses and exposure to research. (Higgs and Titchen 2001b).

4.4.1.1 Poor foundation of practical experience

In **formal undergraduate education** at university it was apparent that the knowledge and understanding, consistent with the lower levels of Bloom's taxonomy of learning (Bloom, Engelhart et al. 1956), was gained around the basic principles and biomechanics that govern splinting. This acquisition of basic learning in the cognitive domain may or may not have been accompanied by psychomotor learning with the skill of splint making (Bloom, Engelhart et al. 1956) resulting in a deficit of both knowledge and skill. Some participants indicated that they had no experience in splinting the hand in neurological injuries at an undergraduate level.

- *"we had shocking lectures on splinting, I don't ever remember learning to make an anti-spasticity splint or even discussing splinting with neuro"*
- *"my lecturers did do splinting but nothing on neuro splinting"*
- *"… varsity you splint, but you splint on your buddy's hand and, no (OT: it's not spastic) and you don't learn a lot about, well we haven't actually gone to a neuro patient and splinted them in varsity, so although we learned it by the lecturer, it's still not, you don't get a good picture, you know in your mind, well I didn't.....*

This is because the learning about splinting at undergraduate level was directed specifically to musculoskeletal (biomechanical) conditions.

- *"The splinting lecturer shows the biomechanics and the principles of splinting and the design of it and getting that right, with the, and the theoretical condition*

- *"at university we made splints, we learned splints for more your biomechanical injury"*

Participants reported that during undergraduate training they were taught how to reflect and problem solve how to use splinting for neurological conditions by using the theoretical knowledge acquired and the basic techniques of splinting learned. A higher level of learning would then need to take place to ensure the application of theory to practice (Bloom, Engelhart et al. 1956).

- *[The neuro] lecturer helping with the reasons and the problem solving and the judgment, ya the justifying of the splint, so it's about the problem solving of it, not just 'this is how you make it and this is how your wear it' but the problem solving behind it"*
- *" in neuro you obviously learned the principles that govern treatment, so that you then have to problem solve and then say: What am I trying to achieve, what's my purpose?"*

A newly qualified, "younger" therapist based on her lack of actual experience, was seen to default to splinting when it was not necessary or not splinting when it was appropriate.

- *"I think scarily sometimes for a younger therapist, making a splint, feels like the only functional thing that they can do, they don't really know what to do with this patient or this arm and so by making a splint it looks …like we doing something and you can show the family, …"*

- *"or my problem is the … younger, inexperienced therapists who don't splint because they are intimidated by it and they don't splint quickly enough,*

Professional propositional learning about splinting of the hand in neurological patients may be gained through **postgraduate courses.** Participants indicate that

courses provided them with additional knowledge but more specifically the psychomotor skills of splinting.

- *"but I think there are lots of techniques that I have come across… since I've graduated. .., so things that I'm using now, things that I've learned from new courses, but to stay in touch with what's happening in the hand therapy world as well as in neuro"*

- *"I think just in terms of time and staying up to date it's difficult to keep, you know, neuro is such a big field to start with, but I think there are lots of hand courses that would be helpful as well to attend*

  "courses often so specialized and so complicated that you couldn't after having done one, even under supervision attempt to do it somewhere else again"

So in conclusion it appeared that the participants were not always clear on which of these courses they should attend and which would be useful in this particular field of practice, courses on hand therapy or intervention with neurological conditions.

4.4.1.2 Research Evidence for Practice

Some participants however felt there was value in **keeping up to date** and "*reading up*" on current evidence, sharing resources and *"going to… textbooks*". Exposure to research was mentioned as a contributor to propositional knowledge, and evidence for splinting neurological injury. However there was some difficulty with finding a consensus on information in the literature available and what therapists have discovered worked from their experience. No participants made mention of doing their own research on this particular topic. **Controversy** about results of research in the literature by (Lannin, Horsley et al. 2003) came up in the discussion as well as current splinting practice in the United Kingdom as described by one of the participants, both were met with much resistance and disagreement.

- *" there is no evidence that [splinting] decreases tone, it has no impact on tone in about 95% of people but there is that one or two that it does make a difference .....…"*

This puts the spotlight on the **lack of sound research evidence** in this field for best practice and even these experienced participants had no definite answers in relation to the propositional knowledge underlying splinting in neurological conditions as the results or phenomenon surrounding this splinting was frequently reflected in words of uncertainty, such as "*I don't know*", *"maybe"*, *"might*", *"hopefully*" as opposed to definite findings.

- *"I think it's the stretch on biceps, it's the weight against gravity, I don't know, it's…"*
- *"I don't know, I think there's some patients you just can see…"*
- *"within the splint(dorsal volar) they are able to experience more of a stretch of their fingers and that's maybe the comfort or the relief that they are feeling as opposed to really reducing tone"*
- *"You might actually have a trial of changing the wrist position to see"*
- *"A bit of both, I don't know, maybe my theory is a bit wrong, but for me I like to get the thumb out, that really helps"*
- *"… ya, maybe we must invent a splint"*
- *"because hopefully then you are going to get an overlap, hopefully there will be some regain of movement so then they can use the movement during the day… and then leave it on at night"*

4.4.2 Procedural knowledge

This refers to knowledge acquired through actual practice (Higgs and Titchen 2001b). Participants placed great emphasis on the value of their clinical experience where they appear to move to the analysis and synthesis aspects of learning in this field (Bloom, Engelhart et al. 1956).

4.4.2.1 Experience

Learning is described as a social activity, with each learner having their own unique experience(Daley and Mott 2000). Having this social experience, **working with colleagues,** was expressed as the most valuable contributor to professional

knowledge and skill of the participants. This was particularly relevant when working with colleagues with more experience.

Participants felt this is where they learnt to make and apply the splints for conditions in a supported way and where they gained confidence in using splinting for real cases. This included observing other occupational therapists making splints, making the splints together consolidating psychomotor skills and learning application of "techniques" that work in practice. Discussing specific cases with other occupational therapists brought in aspects of analysis of problems they faced.

- *"If I think back on what I've done over all the years and what I do now, it's very different…making the splint is quicker and easier* "
- *"and make mistakes together, then you don't feel alone in your mistakes, and making neuro splints is quite tough so it's sometimes nice to have 4 hands and especially when you are exploring and trying something new"*

In addition, they valued the experience in **working with the actual splinting materials** and becoming more familiar with techniques on how to use materials more effectively. This included learning "*how to handle the hand*" when splinting a patient following neurological injury.

From experience participants were able to identify what type of splinting they thought most effective, this was however based on what **the goals and outcomes** splinting were aiming to achieve and not always on the actual splint itself.

- *"I've seen successful and unsuccessful splinting and they don't always depend on the splint"*
- *"the material and type of splint to me is not so much the issue… the design of the splint wouldn't be so much as important as the position, but which design would best support the position that you wanted"*
- *"… decide what you want to work on with the splint"*

However the dorsal-volar (anti-spasticity) splint was frequently mentioned and it was said to be the most effective splint in achieving the following specific outcomes or goals, it was discussed as follows.(Table 4.2)

Table 4.2 Properties of dorsal-volar (anti-spasticity) splint evaluated as effective based on experience with the materials and achievement of specific outcomes or goals.

Outcome or goals achieved	Ease of use	Disadvantage	Design requirements
Provides warmth and a good functional position	Easier to make	Can increase oedema if not fitted correctly	With thumb piece (neutral thumb)
No pressure in the palm	To address hygiene challenges	Thumb piece can make the splint difficult to put on	Dependent on the need for thumb piece based on the position tone in the thumb,
The splint provides a good stretch	Easiest for patient to keep on	The patient may be at risk of pressure areas on the thumb	Straps over forearm, wrist and over fingers
Improve the aesthetics of the hand by placing the hand in a good position	Easiest to get on /off the patient	A complex protocol for when to wear the splint affects compliance	The hand position depends on 'spasticity' (close as you can to functional position, not to the extreme of tone)
	The patient can apply using one hand		Some found this splint more comfortable with wrist in extension, some with finger extension and a thumb spacer
			Able to use, to address hygiene challenges, particularly in chronic patients

4.4.2.2 Evaluation

The process of reflection taught at an undergraduate level involves evaluation the splint, materials, wearing regimen and patient's response. This is an essential part of the learning process through actual clinical experience.

When evaluating other goals and outcomes of a splint in terms of its effectiveness the following points were mentioned; the need to spread the fingers therefore needing a flat pan or cone, offering neutral warmth, circular pressure and maintenance of the wrist in a good extension position which highlighted the usefulness of pre-made material splints (futura splints), as they are also unobtrusive. Finger extension and slight wrist flexion is more comfortably achieved by large foam

'resting splints' than thermoplastic splints, and aids compliance. Pressure in the palm was associated with clawing, which was found to be a problem associated with the Rood cone splint.

Comprehensive assessment was required in order to determine the need for and purpose of the splint and to allow the occupational therapist an opportunity to consider the wide range of factors that may influence their decision whether to splint or not. Participants followed protocols that emphasized careful initiation of the splint with close monitoring, prolonged wearing time, however, ensuring no pressure points and a tolerance for the splint. Using splints during the night when a patient is resting was also recommended.

- *"Leave the splint off in the day and combine with a stretching programme and allow for voluntary movement"*
- *"If the patient is unable to tolerate in the day then have the splint on intermittently in the day on for two to three hours then off for two to three hours"*
- *"Follow up every two to three weeks initially"*

Participants further describe the use of **reflection on their own and other's successes as well as "errors"**.

- *"…that you have made an absolute… where you should never have splinted or you should have splinted way earlier"*
- *"Patients arrive at your doorstep with a splint that you just about want to climb under the table, and go 'how could they!' You learn from that experience and go 'oh well, I wouldn't do this and I wouldn't do that' and know that you not going to try it again."*

Some participants did still admit to making use of "trial and error", particularly for TBI patients who *"never had a clear picture and are more difficult to predict than stroke".* Others admit their reluctance to splint based on the lack of evidence based practice.

- *..... I think we under splint more than over splint neuro patients, especially with all the controversy that goes around it"*

4.4.2.3 Effectiveness

If splinting was utilised, it was emphasised to proceed with caution and that follow up was essential. Any change, particularly **improvement, needs to be assessed or measured** because progress or deterioration would need to be determined and a decision of how to proceed would need to then be made. All participants agreed that the decisions about the way forward with splinting were dependent "*on how she progresses*".

Not only was splinting a decision not made in isolation, considering the goals one at a time and judging the effectiveness in terms of outcome measurements for each of these factors was a challenge. Many different ways were suggested for measuring outcomes including; non-standardised measurements of hand function (observation during various occupational performance tasks), assessments of muscle tone (using the Ashworth Scale, completed by the same person assessing each time to ensure reliability), evaluation of the condition of the skin, and range of motion (ROM) with a goniometer. One suggestion was to video a patient whilst playing a simple game, and use this for comparison at follow up appointments.

Participant's measure of progress was often influenced by the **patient's response to the splint**

- *"My patients generally they all tell me that it feels better once they have had a splint on for a while, they feel better, because now their hand is open longer, or … now the fingers can open easier, and I'm not quite sure if that is a decrease in tone…"*

The challenge of evaluation was expressed as the uncertainty with measurement of improvement using non-standardised assessments in order to make a decision on how to progress.

4.4.3 Personal knowledge

This refers to knowledge gained through professional and life experiences, and through critical, evaluative reflection upon them (Higgs and Titchen 1995). Participants appreciated personalized experience with individual patients. This process involved the patient in close consultation, listening to their needs and wants and observing what happens to the individual's hand when it is splinted.

4.4.3.1. Individual growth

Although protocols are discussed under professional knowledge it is clear that personal knowledge is related to **each therapist's interpretation** of these protocols from their own experience and practice. Each therapist develops their observation skills and how to interpret what they see allowing them to practice what they have learned and adapt the treatment.

- *"you'll see as well, the patient's body will tell you"*
- *"really seeing what splints do with a hand that just wants to climb out. That sort of experience has taught me a lot about splinting."*

One participant felt strongly that "*every splint you make is completely individual*", in terms of the therapist's clinical reasoning and the patient, therefore requiring you to "*mess around with it and see*".

4.4.3.2 Listen to patients

Participants valued highly the time spent with individual patients involved in occupational performance tasks and described the value of listening to the patient as a form of personal learning. This essential aspect makes occupational therapy client centred and allows the intervention to be **adapted to the individual patient's specific preferences.**

- "*I think it takes you a long time to listen to your patients, because you always think you know it all and sometimes if you really listen I think they have got quite good ideas"*

The **goals of the patients** play an important role in understanding the patient as a person. With chronic TBI to ensure compliance it was essential that the patient and therapist have a clear understanding of their goals and the patient requires a willingness to achieve those goals.

- *"you have to present it to the patient, if they are empowered enough then they have to make that decision, but some patients think that splints do a world of wonder and it's almost like a placebo effect and they tolerate it well and they do really well, others don't."*

In order to understand how the experienced therapists who participated in the group make decisions, it was important to first establish their level of expertise and gain an understanding of how they developed their professional knowledge This knowledge forms the foundation from which they would make decisions. In order to understand how, when faced with a clinical problem, they would make a decision with factors considered, their clinical reasoning is analysed.

4.5 Theme 2: Clinical reasoning

Clinical reasoning is used, in varying degrees, by all therapists but more completely by experienced and expert therapists in a clinical setting as it involves the application of general theory to a specific patient based on theoretical knowledge and practical experience (Dutton 1995)

Occupational therapists according to Mattingly and Fleming (1994) use Procedural reasoning (the reasoning undertaken when planning treatment and dealing with disease and disability), Interactive reasoning (the reasoning employed when interacting on a personal level with the patient) and Conditional reasoning (which involves a more complex process where all factors are considered and the therapist is able to visualise the patient as he would potentially be in the future).(Mattingly and Fleming 1994).

4.5.1 Procedural reasoning

Procedural reasoning (Mattingly and Fleming 1994) refers to the thought processes a therapist utilizes to approach a problem related to client factors or body functions and structure, related to concrete problems that can be identified and addressed. A number of client factors were considered and discussed in relation to splinting in neurological conditions. Again these were considered in the light of the goals, protocols and outcomes rather than the actual splint to be used.

4.5.1.1 Client Factors

Although participants agreed on which client's factors were the most important to address with splinting, there were still controversies and contradictions related to the

recommendations discussed. Changes in range of motion (ROM) and muscle tone were considered the most important client factors foe which splinting was required.

4.5.1.1.1 Range of Motion

The most common reason for splinting following neurological injury, throughout all stages of rehabilitation, was to influence the ROM in the joints and length of the tissues. A number of factors were identified as affecting the decision to splint for changes in ROM.

It was said that during the initial stages following stroke there was no need to splint if the passive range had been maintained. During the chronic phase after three to six months following a stroke, if passive range of motion was compromised due to increasing muscle tone there was a general consensus that splinting was considered to

> "***maintain the muscle length and the tendon length, maintain the ROM*** *so you don't start to lose it with all of this tone …coming in*".

However one respondent felt strongly that

> "*splinting isn't the greatest for myofascial tension, shortening and stiffness…*"

and that splinting was **putting the hand into an alternative stiff position**, a concept other participants felt that they had not all previously considered.

For TBI patients at any stage of rehabilitation all participants agreed participants recommended splinting to maintain and improve ROM unless there was active movement present in the hand. Hard splints were suggested for both TBI and stroke patients to **work out contractures** and these could be combined with serial splinting/casting, Botox or surgery. The splints were suggested to **maintain range** and to be used on a long term basis. Protocols included **long periods of wearing** in a comfortable position ensuring no pain, "*in barely a stretch from where he is*" frequent (daily) reassessments were recommended with a slow start and slow progression of adjusting the splint.

It was considered that movement that allowed the patients to actively participate in occupational performance activities should not be blocked by splinting "*if they've*

learned to do something in a functional position and you now try push them out of that position and then expect them to have some function then you are probably going to lose the function, so you'd have to decide whether, if he can still maintain the function with your better range, then obviously that's first prize but if you are going to lose the function just to get the range then rather lose the range and keep the function."

For patients in ICU, splinting was stressed for the purpose of **prevention of contractures** but it was important to ensure the splints were well padded.

> *"The severe shortness, the contractures that we see are because of positioning issues that could have changed. A lot of what we see here could probably have been prevented."*

The alternative to splinting in ICU was to focus on regular daily treatments by therapists and continually assess and monitor ROM. If the patient regressed and if **ROM was lost** then to seriously consider splinting but proceeding with caution.

4.5.1.1.2 Muscle Tone

There was no consensus on the decision to splint or not splint based on the influence of splinting on muscle tone. Participants found it more effective to

> "*work out the tone first and then look at the myofacial side later*".

However it was Important to consider "*tone and other impairments*" as what is seen may have been due to '*secondary changes*' (myofacial tension, stiffness and shortening)" and these factors could not be considered in isolation of each other.

For a patient (stroke or TBI) with a good prognosis and aspects of active movement splinting was to be **motivated by a clear underlying aim for normalisation of muscle tone**. However when aiming for normalisation of muscle tone one needs to be aware of the following;

- *"you can really cause a rebound in increasing tone if you go too far, and you can cause a lot of pain"*
- *"you have to go in increments, you actually have to do it really slowly… even if you can get the hand stretched that much, you can't splint them there"*

- *"…and then the other thing on that, that you don't think about as a neurotherapist is that obviously you are not only stretching the muscles and tendons, the nerves and the vessels go too, so if you've got a patient who has been in a position for a long time, you might actually compromise their circulation or you might be putting tension on the nerves if you go up too quickly [which] can cause problems."*

Participants recommended to splint the patient's hand in a "*mid position*" in a dorsal volar thermoplastic splint in a **prolonged position for 2-4 hours to inhibit tone** (to allow for a prolonged stretch, minimization of pressure points and neutral warmth) prior to therapy.

It was however suggested that there were other, more effective ways of reducing or maintaining muscle tone, these included:

- therapeutic techniques and training
- pressure garments
- teaching the patient neurotechniques
- teaching the patient to use the tone to get functional movement
- kinesotaping for cutaneous sensory input
- changing the position of the trunk and the head to influence tone
- treating the whole arm to improve functional movement

Also thermoplastic splints were not suggested as the most effective for reducing tone, but rather foam splints or soft splinting with thermoplastic inserts for neutral warmth

4.5.1.1.3 Pain

Pain was another client factor considered for the prescription of a splint which is done to reduce pain and discomfort and to manage pain for chronic patients. This is achieved by having the splint keep the hand in a good position,

"not going to go to the extreme of tone but try and get as close as you can to your functional position".

4.5.1.1.4 Other psychosocial and behavioural client factors

Other psychosocial and behavioural client factors such as; insight, levels of awareness in relation to the splint and its purpose, ability to take responsibility, aggression related to poor cognition and restlessness were also considered. A careful assessment of the patient's ability to learn new patterns of movement also played a role and if the patient is unable to learn and retain new patterns of movement then "*I wouldn't splint*". This also holds true for a patient with aggressive behaviour due to the risk of further injury on pressure areas and resistance to the wearing regimen. It was therefore strongly suggested that alternative therapy be considered.

- "*as soon as a patient has a say and an opinion especially if they are difficult to handle, if they don't understand why or what's going on and it's uncomfortable then it's really not effective. So your whole regimen of wearing, I think, needs to be very carefully thought out based on the history of the patient that you have either observed or obtained from somebody*."

Any of the factors listed above that affect the patient's understanding of the reason for splinting and compliance would indicate that the splinting programme maybe affected and needs to be closely monitored thus splinting should proceed with caution.

4.5.1.2 Performance Skills

4.5.1.2.1 Motor and Praxis skills

Although maintaining or improving ROM and muscle tone were noted as the most common reasons for splinting, the consensus continued with the notion that a splint was not to be recommended as soon as **active, voluntary movement** was present following TBI and stroke.

- *"When there is active movement, I try and mobilize the client and try and teach them to mobilize rather than splint them, well if there is active movement in the fingers, again I don't think they will include it. I won't, you have to assess how good is the movement, is it actually functional, can he grasp something like this , it depends what she's got…"*

- *"I definitely wouldn't splint for lengthening of muscles because I would end up reducing the active movement that has recovered so I would teach them to use active movement."*

It was strongly suggested that splinting has a negative effect on active movement and should be reduced as movement returns.

- "…*if there is (active) movement I would have been inclined to rather strengthen the wrist movement*."
- *"…he has enough movement just to facilitate and work on the function in the hand… with function… I wouldn't use something that immobilizes the fingers."*

Splinting was felt to have an impact on the active use of the hand and was more frequently suggested for patients with return of active movement- only if the splint assisted a motor skill such as improving grasp and lateral pinch or placing the wrist in an extended position to "*promote function of the hand*". The application of the splint however was not simple and involved a comprehensive functional assessment and application to a particular motor skill in a functional task.

- *"I would examine the hand and see what's lacking ... if she had difficulty with wrist extension, if you got her that and made her hand more functional by giving her that extension, plus working on it, you might actually achieve something, ... and whether you can compensate in another way or whether that splint can't just make that functional difference."*
- *"… if the wrist is particularly weak and the hand is strong, then obviously splint the wrist into an extended position and use that functional movement… it depends, where the movement is, what are the movements and how functional the movement is."*

4.5.2 Interactive reasoning

Interactive reasoning (Mattingly and Fleming 1994) is used when a therapist wants to understand the patient's disability or illness experience and understand the person better. The challenge in making a definite decision with regard to splinting is that there are a number of external and personal factors, unique to each patient. These

include family, caregivers, insight and resources, active movement, age and dominance. Each of these factors has an influence on the decision and all need to be known to the therapist, to allow an informed decision.

4.5.2.1 Individual patient

This means considering the whole patient and factoring in other **internal performance components. Personality** was strongly viewed as a more important determining factor in splinting. "*Every splint you make is completely individual*" and the decision to splint can often be influenced by the patient's personality. A positive experience with a splint may make the patient more compliant and thereby yield improved results, when a patient gives the feedback that she "*just loves it, too much"*, it will influence the decision as to whether or not a splint is provided.

- *"…some patients would want to try anything, so you would have to offer them all options and you would have to discuss it with them and say this is what I think I could offer you and this is why it might help, so whatever process you looking at for this functional hand the splinting becomes part of that process, or not."*

Participants identified some concerns that are associated with **age** which would influence their decision as to whether or not they provide a splint. There were five concerns mentioned about splinting elderly patients. It was felt that the risks associated with age were higher including; fragile skin, arthritis which may also compromise joints further, coexisting cognitive problems, response to therapy and poor tolerance of intensive splinting protocols. Change in life roles associated with neurological injury during this stage of life, lack of support systems, loss of independent living and the possible dependence of a patient on a carer for proper splint application were also concerns mentioned which are associated with increasing age.

There was disagreement about drawing attention to a compromised limb which some felt found in older patients was making them more compliant with splint usage. A number of participants felt irrespective of age patients may be self- conscious about wearing a splint, especially if they were younger as they may be influenced by what is socially acceptable or "*just not cool*".

A quarter of the participants suggested that more therapy should be used with a younger patient and splinting should be a "*last resort"*, as they had a better chance of recovery

- *"He's young, I've got a firm belief that therapy can still make a difference no matter how long after the incident, so for me I would still splint him, because he's young and you know I just feel you can try your best… and obviously combine it with intense therapy … if it was a 70 year old male I would maybe feel different, you know but your, (age) does make a difference for me"*

Hand dominance was not considered to be particularly important,

- *"if it can help, you'd use it, whether it's a dominant or not a dominant hand"*

One participant considered that if a patient were applying the splint independently, they may require the use of the dominant hand for application.

4.5.2.2 Total patient

The participants went on to consider **external performance components** especially for the Gauteng region, where the study took place, which impact the decision making process when deciding to splint. These components include the environment with physical and social features of the specific context (Kielhofner 2002).

Family and caregivers emerged as the most important of the external performance components for consideration when deciding to provide a splint. This was for both stroke and TBI patients at all stages of rehabilitation, but particularly if there are cognitive deficits. A splinting programme requires a good understanding and involvement of reliable carers or family and family education with the emphasis on insight of the family was stressed.

- *" His family set up, for me is a bigger determinant, because again, are they going to use the splint and use it correctly to achieve a change in function?"*
- *"…you actually need to work with the family."*

When the social environment was the staff in an old age home this was considered to pose particular problems to compliance and proper application due to challenges

with training of staff. This would deter some from splinting in these circumstances unless someone specific was responsible.

- *"I obviously need to decide if there is someone to put it on for the client because most of our clients don't have the capacity to put it on themselves."*
- *"I did highlight that really having his family on board, or staff in terms of his cognitive difficulties… they really need to have the support around him in that time."*

They felt however that sometimes even having family cooperation was not sufficient;

- *"It's one thing though to have the family on board and the patient still refuses, you are not going to get anywhere, the family can be as willing and as helpful as they want but you actually have to have the patient on board."*

Proper **education of carers** was considered essential and suggestions for this education included provision of a photo with proper application of the splint, training on warning signs for pressure areas and training on the specific programme for wearing. The caregivers understanding of what to do for the patient at home was unrelated to their socioeconomic status and circumstances but rather to their insight and ability to carry out a home exercise programme, this needed to be confirmed before they took the patient home

- *"So I usually educate, if we arrange a carer for the client to go home and care for the client, then I teach the carer to go home and put the splint on or if it's the spouse then I teach the spouse. I have issued splints where the client is going to a care facility, then I would go to the care facility who would teach the matron or someone in charge who would then teach the daily nurses."*
- *"insight is more important than poverty'*

Although it is very important to have the family involved, another aspect of this was discussed;

- *"… let's face it, this person has just had a stroke, the family are coming to terms with that. It mean she's got massive functional loss, I mean they haven't even accepted that maybe the movement's not going to come back so they are in a totally different space to where you are, we thinking long term implications because we know, whereas they are not there yet."*

This indicates that there should be a balance between understanding and following the needs and wants of the family and what the therapist knows is the best for the patient at that time.

In terms of **resources,** participants expressed the need to weigh up the cost of application and follow up against the outcomes achieved by splinting. Some felt that the splint needed to be used in conjunction with other therapies such as Botox and/or further surgery and they needed to determine if the patient could afford this, and more importantly the cost of on-going rehabilitation. Some described how goals could be reached through the use of "low tech" splints such as bottles or a soft ball to keep the hand comfortable and prevent the fingernails from coming into the palm.

4.5.3 Conditional reasoning

Conditional reasoning is a multidimensional process used by therapists when they consider the prognosis of the patient and its impact in a broader context. It is a deeper level of interpretation of the patient as a whole where the therapist imagines what the future of the client would be like and is able to revise the therapy to match the image (Unsworth 2001, Mendez and Neufeld 2003). What emerged in the discussions as part of this multidimensional process was to consider the value of ensuring the client is being treated as a whole, considering the timing, being aware of the numerous risks associated with splinting, looking at what the alternatives may be and a preference for them compared to splinting.

4.5.3.1 The risks

Identification of risks reiterates the importance of not **treating the hand in isolation**, and ensuring that one considers all the factors. It was strongly agreed that if splinting went ahead under any of the above mentioned conditions, at any stage of the rehabilitation process, it would require great caution and frequent monitoring of the skin, oedema, and muscle tone as well as monitoring the application and fit of the

splint and adjusting as necessary. In the initial stages this monitoring would need to be done on a daily basis.

Some of the risk factors include; a history of **non-compliance or lack of resources**, Cognitive and behavioural challenges, lack of proprioception, sensation, hemianopia and neglect, Patients with complex history such as a TBI including other deficits and Oedema.

- *"I think the biggest determinant, for me is cognitive"*
- *[Occupational Therapy treatment] can be* "*much more useful in alertness, stimulation, orientation, positioning, and preventing pressure sores."*

Participants felt that they had better control over the situation if patients were following up with regular out-patient therapy, they were then able to monitor the splint, or the hand (if no splint was issued). With every client factor considered when deciding to splint (as mentioned in procedural reasoning), there was always a suggestion given for a **preferred alternative treatment**. What was emphasised was the need to treat the upper limb as a whole and the patient as a whole.

- *"…so the splinting is not a standalone treatment it has to go together with functional use of what you are gaining from the splinting, to get your maximum output"*

One participant felt strongly that they would never give a splint unless accompanied with weekly therapy. Another said

- "*My focus of therapy would be on functional rehabilitation, getting the client transferring, getting the client more aware, so splinting at this stage, unless I… after a week of evaluation, see there is a severe deterioration which would limit that functional rehabilitation, it wouldn't be my primary treatment objective at this stage…"*

Particularly during the initial stages post neurological injury, it was expressed that **therapy was more important** during this time compared to splinting, but that it may be considered at a later stage.

The timing of the treatment also became an important factor in understanding the whole picture. The majority of participants expressed that splints should not be

issued as early as 10 days post stroke, they expressed that it was "*too early*" and that one should "*wait and re-evaluate later*", at that stage monitoring of range of movement would be sufficient.

- *"There is oedema, so that is always a red flag, there is decreased proprioception, sensation, neglect, subluxation and her depressed mood, and yes, I would deal with the oedema first and try and increase her neglect and level of awareness, how she is coping with having had the stroke and not anything extra Then later, absolutely (I would fit a splint) if she remains flaccid, and her oedema is under control… but a flaccid hand is quite a challenge."*

However patients, with increased tone, following TBI during initial stages were recommended splints. It was expressed that problems seen later could be prevented; however occupational therapy to address other functional or cognitive problems was seen as more valuable treatment during this time.

4.5.3.2 The whole picture

With a case which involved a **combination of other expounding factors**, including problems with cognition, proprioception and sensation, although a splint may be useful for wrist support with a flexed wrist, it was not considered to be the best option for treatment in that case.

- *"I said that I wouldn't splint the hand at this point, I said it was still quite early in my view and since she was maintaining range… I said her decreased sensation was a concern, in terms of safety, wearing the splint, that might lead to pressure are concerns, and because of her arm being subluxed as well, that could add extra weight and pressure on the arm, and if she has poor awareness of that side in terms of positioning in any way, she might not be aware of the splint and that could cause even bigger problems, and also some concerns about her cognitive and perceptual difficulties as well. I didn't know if there was anybody to help support her wearing it or anything like that so I don't know, I said that was a concern"*

- *"Honestly at 66, she'll now be 68, pensioner, if she came within 2 years and she was that contracted, I don't know how much you would do, because I*

don't think she would tolerate serial casting, I don't think they'd have money for Botox, so you would try and give them as much of a solution as you could and that might literally be just positioning or a splint in a position where there's a little bit of opening of the fingers so you are able to clean the hand and that would be all. So I think then you would definitely look at rehab potential, the finances, the support structure and what are her end goals."

The participants considered multiple factors which influenced their decisions, including physical, cognitive, perceptual and external factors. The participants then arrange the deficits into a hierarchy which then assists decision making.

This is a *"big problem solving process*" which can be correlated with what was mentioned about the need for an occupational therapist to have good observation skills, so a tailor-made solution can be determined for the individual. It requires experience and sometimes "*trial and error*" with each patient.

This is a **holistic approach** where individual assessment is important and consideration for the process to be managed as a whole. Particularly with patients following TBI, an individualized assessment was stressed as being essential when trying to address functional goals to *"…maximize the function he has".*

What was mentioned as a point for consideration, but only related to patients following two years post neurological injury, was the need to consider the patient goals. There was no mention of the individual's goals throughout any other stages of rehabilitation.

- "*…is it important to him to change, does he want to change? You might actually have a trial of changing the wrist position to see, does it impact, does it make things easier, does it make things worse, is he interested or not? So it is really his goals at this stage".*

4.6 Summary

The Model of Practice Development (Higgs and Titchen 2001b) presents the association between practice and knowledge. Participants report that although during undergraduate training they were taught about splinting, practical application to specific neurological conditions was lacking. Postgraduate courses were found to

provide valuable practical skills and a lack of sound research evidence has led to uncertainty on the reliance of the results of current evidence in practice.

Participants placed most value on Procedural knowledge, this included working with other colleagues with more experience, having actual experience with splints, reflection on protocols in their own and other therapists' experiences, having clear outcomes and goals. By gaining procedural knowledge participants were clearly able to identify what splints were most effective for them. Assessment of outcomes proved to be a challenge and so effectiveness was established by the individual's responses and by subjective experience, which has led to a therapist's personal interpretation of outcomes and protocols. What added to professional knowledge was the experience of working with individuals and adapting to their specific preferences and goals.

Fleming's three track model of clinical reasoning (Fleming 1991) was used to understand the application of general theory to specific clinical problems. Participants utilised Procedural reasoning to consider the physical, concrete problems to be addressed and ROM was identified as the most common reason for splinting, however, participants were unable to consider concrete problems in isolation. Participants utilised Interactive reasoning to understand the patients as individuals and understand the individual within the context of their environment. Participants then made use of Conditional reasoning to understand the multidimensional aspects of each case including the risks, benefits, alternatives to splinting and the value of therapy compared to splinting, essentially, the whole picture.

CHAPTER 5 DISCUSSION

5.1 Introduction

The aim of the study was to 'explore' and 'investigate' what experienced occupational therapists are using in practice with regard to splinting the hand following neurological injury. This is in an effort to assist less experienced therapists with their own professional development with regard to splinting the hand following neurological injury as their practice cannot be informed by current literature on the topic due to insufficient results (Lannin and Herbert 2003, Steultjens et al. 2003) and varying results and study designs presented in the history of splinting. Great value can be placed the clinical experience of the expert therapist in the field (Schell and Schell 2007).

The findings were gathered from focus groups of participants who had been qualified for an average of 14.6 years, with an average of 10.2 years of experience specifically in neurological rehabilitation and some experience in splinting patients with neurological injury. More than half the participants had postgraduate degrees, majority of them specifically in neurological rehabilitation, theoretically making the participants experts because of their number of years of experience (Neuhaus, Ascher et al. 1981) and their education and field-specific training and practice (Ericsson and Smith 1991) in neurological rehabilitation. They were thus able to provide thick, rich data on the subject of splinting patients with neurological conditions. This chapter will discuss the implications of the findings of the study.

The data was analysed into two main themes;

Firstly, clinical practice development: Which addressed how experienced professionals perceived their development in terms of their clinical practice and knowledge in relation to understanding and applying splinting techniques to patients with neurological conditions.

Secondly, clinical reasoning: Experienced professionals explained how they used clinical reasoning and what factors they consider when making clinical decisions in

relation to understanding and applying splinting techniques to patients with neurological conditions.

These prori themes are based on two existing models, the Practice Development Model (Higgs and Titchen 2001b) and the Three Track Model of Clinical Reasoning (Mattingly and Fleming 1994). This discussion will consider the categories and codes in the structure of these models.

5.2 Practice Development

The participants' perception of practice development in relation to learning how to use splints with neurological conditions related well to the Practice Development Model. The codes indicated that professional knowledge in this aspect is built up through professional education (propositional knowledge), actual practice (procedural knowledge) and professional and life experiences and reflection on them (personal knowledge) (Higgs and Titchen 2001b). Participants described that the greatest contributor to their development as professionals in this field was working with colleagues and their own clinical experience.

5.2.1 Propositional knowledge

Participants recognized that propositional knowledge is developed through undergraduate training, postgraduate courses, learning from experienced therapists and/or reading literature. Undergraduate professional education was not the sole contributor to professional development in splinting of the neurologically injured hand although this formed the foundation for practice. More important was the acknowledgement that skill was developed over time, particularly the skill of making splints and the skill of problem solving specific to this field of practice. In support of this, literature reports that therapists with less than five years of working experience use splints more frequently than those with more work experience (Reid 1992), a problem also identified by some of the participants in this study. It appeared that undergraduate training could only provide theory and not sufficient practical experience in this field and therefore it was suggested that inexperienced therapists probably chose splints based merely on trial and error and not on sound evidence. These inexperienced therapists seemed to rely on definite guidelines taught at undergraduate level and they attempted to apply their basic skills in practice using

procedural clinical reasoning so they not only used splints more frequently but the splints used were inappropriate.

Some participants however reported that lack of experience meant that some therapists were reluctant to splint even when it was appropriate because they lacked the confidence, skill and have a lack of theoretical knowledge as well inability to use reflective practice in application to these cases. However, having the occasion to splint provides the young therapist with the opportunity for application of theory to practice (Bloom, Engelhart et al. 1956) which is essential to their professional development. This identifies that undergraduate training alone is not sufficient for splinting the hand following neurological injury and those wishing to practice as expert therapists in this field are required to gain further knowledge and clinical experience specific to splinting and neurological rehabilitation.

The following guidelines are presented for professional development of propositional knowledge:

- Development of knowledge and clinical experience should take place under the supervision and mentorship of expert therapists during practical experience, while working with various materials and hands. Inexperienced therapists should be required to be involved performers and not detached observers relying on abstract principles (Dreyfus and Dreyfus 1985). Experience, along with mentorship was considered to support professional knowledge, where decision-making was informed by the “tried and tested” experience of more expert therapists. Thus working with colleagues, who had more experience, was expressed as the most valuable contributor to the development of propositional professional knowledge and skill of the participants. This supported the assumption of Ericsson and Smith, that field-specific training is required to develop clinical practice (Ericsson and Smith 1991) as clinical expertise along with theoretical knowledge is central to the advancement of practice (Benner 1984) and having a mentor to guide the practice will allow for enhanced learning.

- Staying up-to-date with changes in the field and gaining new knowledge through attending courses where skills were practiced and developed was considered very important. Courses which provided information on

neurological rehabilitation and splinting/hand therapy were both found valuable especially those that presented an intra-disciplinary approach and the development of skills related to splinting the neurologically injured patient. Therapists however are not always able to link the new propositional knowledge presented to actual practice and work environments (Daley and Mott 2000) and participants recognised that it is only experienced professionals who have learned to construct a knowledge base for themselves in the context of their practice as they can link concepts of new knowledge with their previous practice experiences (Daley and Mott 2000). Daley and Mott have suggested the use of reflective techniques such as concept maps (Novak 1998), reflective journals (Brookfield 1995), Venn diagrams (Novak 1998), critical incidents (Brookfield 1995), action learning (Brooks and Watkins 1994), and the creation of professional learning communities (Eraut 1994) as essential in this ability to more effectively create learning experiences. This should be done in the work environments (Daley and Mott 2000) thereby informing and improving clinical decision making.

- In order to develop as a professional; therapists were also encouraged to reflect on the latest technologies and procedures. Upon reflection however, participants in this study were concerned with the discrepancy between what they have seen and experienced in practice and what has been suggested in current research and literature. They were therefore resistant to some new concepts described in the literature and there appeared to be a lot of uncertainty surrounding the rationales for management and techniques described. The lack of certainty about new concepts in the literature may be attributed to the inconclusive outcomes as well as, to some extent, the significant amount of new scientific literature which has emerged on the basic concepts underlying neurological rehabilitation in the last 15 years (Singh 2012) and the difficulty of incorporating these into clinical practice even by experienced therapists. This indicates a need for stringent research to take place in current clinical settings.

Interestingly the participants did not mention of the value of postgraduate degrees as a contributor to professional knowledge although less than half the participants had postgraduate degrees in neurological rehabilitation. Neurological rehabilitation is a

field of practice which requires practical experience and possibly has the same challenges of a lack of specialist information and a lack of practical application of splinting in neurological conditions that is found in the undergraduate courses. In postgraduate courses however graduates should be equipped with foundation knowledge, clinical experience, and skills in clinical reasoning and problem solving which should enable them to work through a problem relating to splinting following neurological injury (Higgs and Titchen 2001b).

Participants, in the absence of definitive answers in the literature, appeared to be relying mostly on their personal experience for their practice development. Interestingly this correlates with what is being reported among therapists specialising in the field of neurology. This poses questions about the use of research on which their development is based and their use of this evidence based practice (Singh 2012). Some participants appeared to have the desire to splint more often, but because of a lack of evidence they were reluctant to do so.

5.2.2 Procedural knowledge

When discussing procedural knowledge great emphasis is placed on the value of clinical experience as well as the evaluation and effectiveness of splints. Participants felt clinical experience was essential in providing evidence and it was through clinical experience that they learned to apply their splinting skills to the hand with neurological injury. This experience results in procedural knowledge and learning developed according to the literature, on the basis of four assumptions (Black and Schell 1995);

- Firstly *learning occurs in the context of authentic practice:* It is by doing, that participants reported they learnt. It was while working with the actual splinting materials that they became more familiar with techniques on how to use materials more effectively. Whether they began with a trial and error approach, or applied specific knowledge, they eventually learned “how to handle the hand”. Through their practice with a hand following neurological injury they identified the ‘dorsal-volar’ splint as being most effective because of the ease of application, this is also described in early literature (Snook 1979).

- *The transfer of learning is limited to similar situations*. Skills were further developed as they used the knowledge gained from courses in practice. The problem of courses not being useful for application to clinical practice because it was too complex and diverse was raised in terms of the expertise the occupational therapist has. Graded courses need to be offered according to the level of practice and the propositional and procedural knowledge therapists have.

  The challenge of transference of learning in the field of neurological rehabilitation was considered to exist in that each case consists of a patient with a unique presentation which will require decision making specific to that individual. Therefore this type of rehabilitation is highly individualised and requires therapists to adopt a 'problem solving model' (Hagedorn 1992) which involves a process more than a set of structured theories. This requires a conscious effort to avoid assumptions and view the patient holistically and objectively prior to determining the treatment. Some participants admitted that they have made use of a trial and error approach in the absence of research and experience and only those who had had repeated success on a variety of different situations, were able to build up a repertoire of experience to which they could refer. This may be why participants really valued working with mentors who had already developed their own repertoires of tried and tested treatments and who could guide learning without trial and error.

- The third assumption is that *learning is a social activity:* This includes observing other occupational therapists making splints and making the splints together to consolidate psychomotor skills. This echoes the role of socialising less experienced therapists, using discussion and collaboration, into the profession as well as further supporting the value of mentorship in the development of professional knowledge.

- The fourth assumption is that *learning relies on the use of prior knowledge:* This assumption confirms the importance of propositional knowledge as a foundation in the development of professional knowledge. The therapist cannot develop clinical expertise if they cannot make use of knowledge and frames of reference as a foundation. Development in practice then demands

that they understand more comprehensively other problems which may exist due to actual clinical experience (Dutton 1995).

Although different approaches in gaining procedural knowledge in their professional development were reported by the participants, these approaches had allowed them to gain experience and they appeared to have developed some of their own underlying guidelines along the way. Despite the literature suggesting which splints should be used, based on experience they formulated their own guidelines. This may relate to what Mattingly (1994) described as a store of patterns that form a qualitative interpretation of cues based on clinical experience (Mattingly and Fleming 1994, Dutton 1995). These included

- ensuring a comprehensive assessment,
- setting specific goals of the splint,
- careful consideration about the design of the splint, the position it places the hand in,
- consideration of the materials used for the splint,
- carefully considering the splinting regimen and
- the ease of use of the splint.

Participants also evaluated when splints should be issued and the wearing regime. They felt strongly that splints should not be given at the first assessment and the wearing schedule needed to be as simple as possible. They agreed with Katalinic, Harvey and Herbert that splinting should be combined with a passive stretching programme (Katalinic, Harvey and Herbert. 2011). However even these expert clinicians admitted they were still developing their practice skills and that they constantly evaluated the outcome with each patient reflecting on results and admitted to still using “trial and error” in some cases.

Participants felt that as they developed procedural knowledge they were better able to evaluate the effectiveness of their interventions. All the participants agreed that to determine the purpose of the splint, a comprehensive assessment was required using specific outcomes. These outcomes included non-standardised measurements of hand function (observation during various occupational performance tasks),

assessments of muscle tone (using the Ashworth Scale, completed by the same person assessing each time to ensure reliability), evaluation of the condition of the skin, and ROM with a goniometer. None of these measures appear in the literature and many of the outcomes used in the literature are not practical for clinical use and a lack of consensus on outcome measures used clinically and in the research raises some concerns about the use of evidence based practice clinically.

The participants felt that the forms of assessment they used clinically with a patient following neurological rehabilitation were not always practical or reliable. This places great value on the non standardised professional evaluations used by the therapist and the subjective experience of the patient when wearing the splint. The patient's experience was reported as one of the main outcomes that should be utilized and was considered important in informing the participants' decision making. This is confirmed by research which shows a significant relationship between expectations, satisfaction and compliance of splint use (Langlois, Pederson and Mackinnon 1991).

5.2.3 Personal knowledge

Personal knowledge was used to deal with the challenges of insufficient quality literature available on the topic to inform best practice, and as participants developed they felt they were required to determine their own best practice. Mayston (2000) emphasizes the importance of having a good knowledge of current literature but explains that tried and tested therapies should not be discarded (Mayston 2000). Participants felt that the use of personal knowledge allowed them to develop interpretation skills so they could decide when to discard or not discard methods suggested in the literature. This interpretation was contributed to by valuable personal experience with individual patients, close consultation, listening to the patients needs and wants and observing the individual closely. As they worked closely with individuals they developed essential skills (Schon 1990) such as observation and listening and based on their personal knowledge and experience they are able to individually interpret the relevant information in order to make a decision.

Participants emphasized that every situation is unique to each individual. The approach to take is client centred and intervention should be adapted to the individual patient's situation, specific preferences and goals. Patients should be

required to actively participate in goal setting with occupational therapists as this allows them to set specific targets which can be broken down into achievable components and increases the likelihood of them meeting their own needs. Setting these goals is essential because the brain is goal/function oriented, not movement oriented (Edmans 2010) which is also the core of Occupational Therapy.

5.3 Clinical Reasoning

Clinical reasoning is the ability to apply a general theory to a specific patient (Dutton 1995) which involves the analysis of the theoretical knowledge and the application of appropriate techniques for a particular patient, based largely on practical clinical experience (Dutton 1995). Most expert therapists find it difficult to describe the complexities of a decision (Dreyfus and Dreyfus 1979) and therefore procedural, interactive and conditional (Mattingly 1991, Dutton 1995) aspects considered in this study were coded to better understand the clinical reasoning of the expert participants.

Procedural reasoning is used when selecting assessments and treatments and considering the disease and disability. Interactive reasoning is employed in order to understand the patient as an individual and Conditional reasoning considers all factors, particularly the patient's condition and impact of this on their broader social and temporal context (Mattingly and Fleming 1994). Each type of reasoning has its place with regard to splinting the hand following neurological injury; however some aspects were more important than others. A significant challenge noted was the difficulty for participants to describe general principles as the various deficits discussed are unique to each individual and a specific intervention is required for each of them.

5.3.1 Procedural Reasoning

Procedural reasoning (Mattingly and Fleming 1994) refers to the thought processes a therapist utilizes to approach deficits related to body functions, performance skills and other concrete problems that can be identified and addressed. A number of these deficits were considered and discussed in relation to splinting in neurological conditions in this study. The management of most of these deficits has also been addressed in the research literature; however a number of challenges are presented

in the literature. These include a lack of homogeneity of the participants in the studies and poor objective measures of outcomes, thus making comparisons of the studies reported in the literature a problem.

5.3.1.1 Range of Motion

The current level 1 research evidence (systematic reviews) on the outcomes for splinting in neurological conditions reveals that there is insufficient evidence to prove the effectiveness of splinting for reductions of contracture formation and improvement or maintenance of joint ROM for patients following neurological injury (Lannin, Horsley et al. 2003, Steultjens, Dekker et al. 2003, Teasell, Foley et al. 2003, Katalinic, Harvey and Herbert. 2011). In this study, participants reported this as their most common reason for splinting. However it was only suggested if the passive ROM was compromised and if there was no active movement present. There was also a consensus amongst participants that splinting should be used to maintain the muscle length, tendon length and ROM in the presence of increased muscle tone. Splinting with hard thermoplastic material was also recommended to work out contractures in a long wearing, 'low stretch' position protocol with frequent assessment and adjustment. Research studies on the effectiveness of this intervention are not of a sufficient level of evidence (Teasel, Foley et al. 2003) to provide a conclusive endorsement for the use of splinting in practice. There is also insufficient evidence to prove the effectiveness of the use of splints in combination with a stretching program.

It appears that the challenge in determining the effectiveness of splints for the hand with neurological injury and for any of the goals to be achieved in splinting, which are not supported by research evidence, is in the lack of objective outcome measurements and study design, rather than in the actual use of the splint for that purpose. The uniqueness of each patient result in a lack of homogeneity in the population being studied which makes it very difficult to complete satisfactory, large sample studies. When considering an aspect like ROM for instance, if a muscle, resting in a shortened position results in a loss of sarcomeres and muscle stiffness (Williams and Goldspink 1978, Williams and Goldspink 1984), then logic would indicate that a splint could prevent this shortening thereby achieving the goal of maintaining length, which is what was confirmed by current best practice based on

the participants' clinical experience. However as participants indicated all management is complex as each patient presents with a different mix of deficits which have to be considered, including changes in muscle tone.

5.3.1.2 Muscle Tone

Participants felt that splinting could be used to affect muscle tone although again current level 1 research evidence (systematic reviews) on the outcomes for splinting shows insufficient evidence to prove the effectiveness of splinting on muscle tone (Lannin, Horsley et al. 2003, Steultjens, Dekker et al. 2003, Teasell, Foley et al. 2003, Katalinic, Harvey and Herbert 2011). Effectiveness of splinting for treatment of muscle tone described by the participants was based on the design of the splint and its ability to provide "*neutral temperature, circumferential pressure and better alignment*". It was felt that these aspects could be better provided by materials other than thermoplastic such as foam and soft splints which provide better inhibitory effects based on their ability to provide circumferential contact and neutral warmth (Wallen and O'Flaherty 1991). Since the effectiveness of a splint may be dependent on an individualized, custom-made splint specific to an individual patient's position and muscle tone, this lack of homogeneity amongst patients again supports the difficulty of comparing outcomes of splinting in research.

There were clear guidelines from the participants on the use of splints for stroke patients in the acute stages, mildly impaired stroke and TBI patients, provided there were clear aims, related to the improvement of range or motor control to be achieved. However, participants could not reach a consensus about the use and effectiveness of splinting for more severely impaired stroke patients in the sub-acute stage as there was a disagreement, with some describing the importance of addressing the tone (spasticity) directly. This approach was based on the early theory that a sustained stretch supplied by the splint at sub maximum passive range reduces spasticity because it alters the threshold response to the stretch of the muscle spindle and Golgi tendon organ in the antagonistic and agonist muscles (Wilton 1997).

5.3.1.3 Motor control

There is no clinical evidence to support the assumption of improved motor control as a result of inhibition of spasticity (Nathan 1969, McLellan 1977), which would make the need to use splinting to influence spasticity redundant. The participants described the importance of first addressing the myofascial changes (secondary changes) although as yet there are no well-documented guidelines or support for this approach in the literature. A large number of contraindications and disadvantages were discussed in relation to splinting the hand with muscle tone changes with risks mentioned including; pain, rebound of the muscle and the effect on other tissues. There was however consensus amongst participants that there are other, more effective ways of reducing or maintaining muscle tone including; therapeutic techniques and training, pressure garments, neurotechniques, the use of tone to get functional movement, kinesotaping, positioning of the trunk and the head to influence tone as well as treating the whole arm to improve functional movement.

All the participants agreed that splinting in the presence of active, voluntary movement of the affected limb following TBI or stroke should be strongly discouraged. Most important to the participants was that splints were not to interfere with active movement and functional use of the hand. This correlates with a reported study by Teasell et al which revealed that splinting does not improve motor function in patients with neurological conditions (Teasell et al. 2003) and therefore should not be utilized for that purpose. Participants placed greater value on the use of therapy to encourage or improve active use of the components of movement in the upper limb, rather than placing the affected limb in a splint to achieve goals such as an increase in ROM. This is supported by Carr and Shepherd in the motor relearning approach where they propose that soft tissue length should preferably be maintained by active means (Carr and Shepherd 2007). Participants were all aware that using a splint to lengthen soft tissue and increase ROM would result in placing the hand in a static position, which could contribute to learned non-use and further muscle weakness. They would rather sacrifice range for function, although it was acknowledged that in some circumstances function may be gained by improving range.

Participants agreed that splinting can be used in some cases to improve active movement or hand function and reduce pain in the hand of patients with neurological conditions. It was suggested that this be achieved when addressing the treatment of a task-specific pinch or grasp.

The application of a splint is not simple and should involve a comprehensive functional assessment and specific application to the particular motor skill in a functional task. Again, each aspect is individual to the patient, their deficits and the task required.

5.3.1.4 Pain management

Splints for the purpose of pain management was advocated only for chronic patients in the absence of active movement, where by keeping the hand "*as close as you can get to a functional position"* participants felt that secondary changes related to pain could be managed with splinting resulting in a reduction in pain.

The reality is that participants in this study were actually unable to separate procedural reasoning and consider the concrete problems related to body functions and performance skills in isolation. Although they were able to identify what they felt was the effectiveness of splints in achieving specific outcomes, this was based on evidence from their clinical experience in achieving these outcomes. The participants when reviewing the use of splinting for patients with neurological conditions used a combination of procedural and interactive reasoning and interactive and conditional reasoning, as is expected from expert therapists (Mattingly and Fleming 1994). They were unable to consider the procedural aspects in isolation from the whole patient and their context although the coding was presented separately for convenience. This is because most patients with neurological conditions present with a wide variety of individual deficits making the need to use more than procedural reasoning in order to provide effective treatment.

5.3.2 Interactive reasoning

Interactive reasoning is used to better understand the patient as an individual within the context of their own environment and occurs during face-to-face interactions with the patient, applying interviewing skills and a therapeutic use of self, both of which are said to become more effective with experience (Schon 1990). In the lack of

current literature on the topic of splinting the hand in neurological conditions it is the experience of the participants which reveals a number of factors including the patient's psychosocial deficits and personality that would influence their decision about whether to splint or not and determine the type of splint given.

Participants reported that patients with neurological conditions frequently present with psychosocial deficits in addition to physical deficits, these should be considered when decisions about splinting are made as they may interfere with the patient's ability to manage the splint. The patient may have perceptual deficits impairing their ability to understand how to apply the splint or they may have cognitive deficits impairing their ability to follow a detailed protocol or understand the reason for application of the splint. There are also a number of other reasons why a patient would not be able to administer a splint independently. They may not have the physical capacity, due to loss of effective movement of a limb and poor coordination of the non-affected limb. All of which would indicate that the patient may require assistance to apply the splint.

Participants recognised that having someone to assist with managing the splint then bring in an additional dynamic which a therapist would need to consider. This included the environment, family caregivers and resources which needed to be reviewed when making a decision to splint. This also applied to the patient's personality which should be considered when deciding to splint since the patient group affected by stroke is remarkably diverse (Edmans 2010). The participants described that as they developed as professionals, they learnt to listen to their patients and then attempted to match splinting treatment goals and strategies to the patient's personality as well as their personal experience with the splint and perception of it (Mattingly and Fleming 1994). They felt that the patient needed to be willing to co-operate to ensure that the goals of the splint were achieved, this could be done through the use of a patient-centred approach (Hagedorn 1992).

Participants explained that being an effective occupational therapist in South Africa where there are people of different races, language groups, cultural backgrounds and traditions required a clear understanding of the patient, not only within his family environment, but also against the larger background of his culture. When using interactive reasoning not only culture but age need to be considered (Crouch and

Alers 1997) as intense rehabilitation can be more effective than splinting for younger patients, although splinting could be used in combination with this intense therapy, it should not be used as a replacement. Splinting to improve ROM or function is also preferably used with younger patients because of the problems associated with increased age such as fragile skin, arthritis which may also compromise joints further, coexisting cognitive problems, response to therapy and poor tolerance of intensive splinting protocols. This is consistent with current literature which suggests that greater functional outcomes will be achieved in a younger patient with a good initial functional status and that the risks are greater for an aged population (Bagg, Pombo and Hopman 2002). Other concerns mentioned which were associated with splinting with increased age were; change in life roles associated with neurological injury during a later stage of life, lack of support systems, loss of independent living and the possible dependence of a patient on a carer for proper splint application.

When discussing other factors that influence the decision to splint in neurological conditions, participants were expected to weigh up the cost of splint application and follow up against the outcomes achieved by splinting. This may also be specific to a South African context where in some environments resources are limited. Some felt that the splint needed to be used in conjunction with other therapies such as Botox and/or further surgery and they needed to determine if the patient could afford this and more importantly the cost of on-going rehabilitation. Some described how goals could be reached through the use of “low tech” splints such as bottles or a soft ball to keep the hand comfortable and prevent the fingernails from coming into the palm. The cost factor was felt to have been affected by the patient’s access to resources rather than the location of where the therapy was presented.

The findings about the resources could not be applied in either the private or public sector as although the total number of years of experience of the participants working in the private sector was greater, participants were not expected to specify where they had gained the experience. Therefore their opinions could not be linked to the location in which patients were treated and it is therefore difficult to infer that the answers given were specific to a more or less affluent population. Participants explain that “*Insight is more important than poverty*” so regardless of the financial situation and education of the patients with neurological conditions or their carers who will deal with the splint application, all that is required is a clear understanding

and a protocol to ensure compliance. By making use of interactive reasoning the participants were able to determine that it was more important to focus on education at the correct level with the patient or carers irrespective of where they lived. If this was done effectively they would be more inclined to use the splint and the associated protocol. It was clear that by using Interactive reasoning, participants were able to balance all the factors that need to be considered against the circumstances and the needs and wants of the family thus doing what is best for the patient at that time.

5.3.3 Conditional reasoning

The participants were aware that the family and caregivers play an essential role for both stroke and TBI patients at all stages of rehabilitation, but particularly if there are cognitive deficits. Thus a splinting protocol or programme requires a good understanding of and involvement of reliable carers or family and family education with the emphasis on insight of the family. Working with the family ensures that the goals of splinting are achieved, particularly if the patient is not able to execute it themselves. This demonstrates that the participants' conditional reasoning was built on their interactive reasoning. They discussed taking the whole condition into account, as well as determining what is meaningful to the patient and understanding the social and physical contexts in which a patient experiences their lives in a broader context. Literature indicates this is where the culmination of years of experience and education contribute to a greater understanding of all the factors which may influence a patient. Experienced clinicians have a greater capacity to provide a human perspective into their understanding of the patient (Robertson 1996). By examining the conditional reasoning of the participants in this study, what emerged was the factors relating to splinting that were crucial to consider when making decisions in relation to the whole patient and their context including; when splints should be applied, the risks involved, cognitive and behavioural challenges, complex presentations as well as the alternatives to splinting.

The literature available does little to provide guidelines for the timing of splint application with splints reported in studies being issued within six months post stroke (Lannin, Horsley et al. 2003), or within and over a year after stroke (Langlois, Pederson et al. 1991). Some studies do not even specify when the splints are issued

(Zislis 1964, Rose and Shah 1987, Bowen and Germsnos 1988, Takami et al. 1992). Participants indicated that this lack of consensus on timing required therapists to make their own decisions about when was the best time to issue a splint. They felt that splints should not be issued during the acute stages (as early as 10 days) post stroke as during this stage ROM could be monitored through regular therapy with splinting being evaluated at a later stage. The same consideration was not applied to the initial stages post TBI as it was recommended that patients with increased tone should be fitted with splints to prevent problems that may result at a later stage.

By understanding what risks are involved with the prescription of splints, the level of experience of the participants was apparent. Owing to the lack of clearly defined protocols for splinting the hand in neurological conditions and the number of factors that influence the decisions that need to be made when prescribing a splint, the participants were aware there may be risks related to splinting the hand with a neurological injury. Identification of these risks reiterates the importance of not treating the hand in isolation, and ensuring that one considers all the factors. Aspects covered by the participants included the requirement of frequent monitoring of the skin, oedema, muscle tone as well as monitoring the application and fit of the splint and adjusting as necessary. In the initial stages this monitoring would need to be done on a daily basis. It was strongly agreed that if splinting went ahead under any of the above-mentioned conditions or factors, at any stage of the rehabilitation process, it would require great caution. The risks were discussed as follows:

- They felt that oedema, in combination with non-use and poor positioning of the upper limb, as was frequently seen in neurological conditions, would be further exacerbated by the use of a splint. The risks might be reduced and splinting might be appropriate if the patient's hand remains flaccid and the oedema controlled, however the goal for applying the splint would need to be clear. Participants were particularly aware, probably because of their expertise and ability, to use conditional reasoning of risks that are not routinely reported in the literature. The inability of therapists to monitor splints continuously in the South African context where follow up was not always certain, made the participants feel that there was severe risk in fitting a splint on a oedematous hand even though some textbooks describe the use of splints to treat oedema directly (Gillen and Burkhardt 1998, Edmans 2010)

.Alternative techniques to splinting could be more effective for the treatment of oedema which include; positioning, pressure garments, elevation, MEM, massage as well as improving shoulder and elbow control.

- Use of the splint in the presence of loss of proprioception and sensation, hemianopia and unilateral neglect may be worsened by the application of a splint. The impact of splinting or a splinting protocol on poor awareness of the hand (sensory and perceptual) is not addressed in evidence based research and this factor was not mentioned as part of inclusion or exclusion criteria in any of the reported research on splinting the hand with neurological injury. Interestingly there was also no mention of the use of a splint to protect the hand in these circumstances although preferable alternatives to splinting for protection of the hand were described by participants and included positioning to protect the hand, massaging, stretches, positioning in a gutter arm rest placed on a chair, stockinet and strapping and the use of textures to improve awareness for the holistic treatment of the arm.

- Other risk factors participants felt were important to consider when splinting in neurological conditions included shoulder subluxation, patients or caregivers with a history of non-compliance and those with a lack of resources. Participants felt that they had better control over the situation, and that if patients could be followed up with regular out-patient therapy, then they would be able to monitor the splint, or the hand (if no splint was issued) and this would moderate some of the risks they learnt to recognise in this field of practice.

- Participants felt strongly that splints should not be issued to patients with cognitive deficits, aggression, poor ability to communicate, low levels of consciousness and poor insight. These opinions are not supported in the literature where the only mention of the patient's cognitive abilities in relation to splinting is their ability to provide informed consent (Sheehan, Winzeler-Mercay and Mudie 2006, Lannin, Cusick et al. 2007).

The confused patient requires the therapist to do all she can to combat sensory deprivation, and this should be achieved through participation and engaging with the environment (Crouch and Alers 1997) rather than through the use of a splint.

Behavioural and cognitive components can be severely disabling to the patient and therefore occupational therapy should address these elements specifically rather than splinting as participants felt this would be a more effective use of valuable therapy time. This reflected an additional challenge in the South African rehabilitation scene where time and resources are limited so that therapy time and equipment need to be prioritized. Other cases where therapy rather than splinting should be considered were with patients with a complex history including orthopaedic deficits and pressure sores and particularly with those who are non-compliance with splinting programmes.

Participants did note that in some instances, with low levels of consciousness, when there is a risk of loss of ROM in the neurologically injured hand, that it would be preferable to splint to gain length or that in some instances splinting may be used to assist with orientation if combined with a programme to improve this aspect. These scenarios were reported more as an exception than the norm and the decision for the use of a splint under these circumstances would need to be evaluated on a case-by-case basis.

Thus because the participants were drawing from years of experience and knowledge it was clear that as expert therapists they were able to consider the 'big picture' and suggest treatments which were most effective in achieving the desired goals when managing the hand after neurological injury. The purpose of the study is to investigate the use of splinting in practice, therefore the questions focused on the decisions related to splinting, however, under most circumstances participants felt that using a splint was not the most effective means of treatment. The emphasis was on holistic treatment of the upper limb. They emphasised that splinting should not be seen as a 'stand-alone treatment' but rather part of a holistic therapy programme with the focus on functional rehabilitation.

When discussing the cases, the participants considered multiple factors which influenced their decisions. The participants arranged the deficits into a hierarchy which assisted them in making a decision. The process was not purely based on Procedural reasoning, rather but included the use of this type of clinical reasoning with Interactive and Conditional reasoning simultaneously. This high level of abstract reasoning is said to be developed by expert therapists who are able to use past

clinical experience to focus directly on the relevant problems from various sources and develop a comprehensive picture of the patient (Mattingly and Fleming 1994). It was evident this was not a conscious process on the part of the participants in this study (Benner 1984) and they were able to "tap into" and identify themselves with the patient as they were prior to the injury and imagine what they could potentially achieve in the future. (Mattingly and Fleming 1994). The participants made mention of individualized assessment and consideration of the patient's goals and this would indicate that therapy was driven by the patient as well as the therapist as she fed off of the patent's cues.

The participants could identify the factors required to determine if splinting forms a part of helping the patient achieve the outcomes that contribute to what the patient wants to achieve. This is consistent with Benner's study which revealed that expert therapists were guided more by the patient's perceptions, and did not rely on rules or guidelines but therapists had an intuitive grasp on a situation (Benner 1984). They do things because 'it just feels right' (Dutton 1995). These essential skills, developed through experience and personal interactions with patients, allowed the participants to fine tune their treatment specific to each individual. This was described by participants as a *"big problem solving process*".

5.4 Limitations of the Study

The greatest challenge of this research and challenge for participants was the difficulty in describing decisions made in general for individuals who present with unique deficits, each requiring specific individual decisions. The purpose of this study was however to explore the reasoning skills utilised throughout this process and not the specific treatments used for a specific condition. Other challenges included finding suitable and sufficient participants with experience for the focus groups, who were willing to attend groups as requested. Inclusion criteria should have been for therapists with at least five years of experience in specifically treatment of the neuro hand and specifically involving splinting it. The focus groups which took place, were outside the setting where social interaction typically occurs, therefore the range of behavioural information gathered was fewer, limited to verbal communication, body language and self-report data. In addition the necessary presence of a facilitator made it difficult to discern how authentic the social interaction in the focus groups

really was (Denzin and Lincoln 2000). The combination of more experienced and less experienced therapists may have made those who were less experienced reluctant to share. Triangulation may have overcome these problems and improved the credibility of the data.

With the lack of experience in research, the researcher was required to make use of tools to assist her in gathering and analysing data, a discussion guide was developed and used; this may have added bias as it was developed based on a review of literature. In order to ensure ease of analysis of data, priori themes were also used, however a true exploratory methodology may have required a description and analysis of individual experiences and not a generalization of responses to specific models (Krefting 1991). The discussion guide also had questions that were too directive which may have prevented the participants from thinking freely about the initial question posed.

Another limitation was that there was a long period of time between when the focus groups were held and when the summaries were emailed for member checking due to the length of time it took the researcher to transcribe which may result in the participants having forgotten the details of what was discussed in the groups. The peer examination used was also not done by an objective party as this was done by the research supervisor and research assistant which may indicate bias.

The group of participants was also found to be very homogenous as most of the participants trained at the same university and they were mostly all in private practice. What may have added to the transferability of the data would have been a more heterogeneous group of participants. In addition because the study was qualitative in nature it makes the results less generalizable. Specificity to South African context could have been further explored by asking participants to specify the various contexts in South Africa where each decision could be/ has been implemented and having a more heterogeneous group involving occupational therapists from various settings. Focus groups could have also had more participants to have provided a richer discussion and greater competence of the participants in the focus groups could have been determined by gaining a history of specific experience and training thereby providing richer data.

CHAPTER 6
CONCLUSION

6.1 Conclusion

The aim of the study was to ‘explore’ and ‘investigate’ what experienced occupational therapists are using in practice with regard to splinting the hand following neurological injury. The group studied were experts because of the number of years of experience and their education and field specific training.

This group of experienced therapists described their development as professionals based on The Model of Practice Development (Higgs and Titchen 2001b) in terms of propositional, procedural and personal knowledge with the greatest value placed on procedural knowledge, their actual experience with patients and splinting materials.

Propositional knowledge specific to splinting following neurological injury is built up through undergraduate training. This forms the foundation for practice, however it is not the sole contributor to professional development and the skill is developed over time. Undergraduate training is not sufficient and often splints are fitted based on trial and error. Inexperienced therapists required the opportunity to practice, this practice however should take place under supervision of mentors with experience and knowledge in the field or while working with other colleges.

Propositional knowledge was also developed as therapists stayed up to date with changes in the field presented in courses. The more valuable courses were those that present an intra-disciplinary approach, developed splinting skills on the neurologically injured and encouraged linking of new knowledge with previous experiences. Current literature is not adequate to inform current practices as there are discrepancies between what is seen in practice and what the literature states. There have also been significant changes in the field of Neurorehabilitation in the last decade. This results in therapists relying on personal experience for practice development which poses questions about the use of research of which their knowledge is developed and about their use of evidence based practice.

Clinical experience (procedural knowledge) was essential in providing an opportunity to learn and provide evidence. Learning occurred under the following circumstances:

- When working with the actual splinting materials on a hand affected by neurological injury.
- As therapists practice on similar patients with similar presentations under similar circumstances, however problem solving is an essential skill required as all patients are unique.
- Learning is a social activity and there is benefit from working with mentors and colleagues.
- Learning relies on propositional knowledge.

Through experience participants developed their own guidelines including;

- Ensuring a comprehensive assessment.
- Setting specific goals of the splint.
- Careful consideration about the
    - design of the splint
    - position of the hand
    - materials used for the splint
    - splinting regimen
    - ease of use of the splint

Participants found the dorsal volar splint to be most effective. Despite these guidelines some situations still required trial and error.

Making use of assessments also helped to determine effectiveness of interventions although the patient's subjective experience was most valuable. Therapists were to use personal interpretation in order to determine what was valuable for their specific patient; this could be done as they worked closely with them and determined their needs. Participants emphasize that every situation is unique to each individual. The

approach to take is client centred and intervention should be adapted to each individual's situation, specific preferences and goals, with patients as active participants.

The key to understanding occupational therapists decision-making in a clinical setting in this field is in understanding their clinical reasoning. Fleming's Three Track Model of Clinical Reasoning (Fleming 1991) was used to understand the application of general theory to specific clinical problems.

Procedural reasoning takes into account the concrete deficits. There is insufficient literature to support or refute most of these aspects. Lack of homogeneity of populations also results in difficulty in comparing results or having sufficient sample sizes. The participants determined that splinting could be used for the following:

- To improve joint ROM, this is the most common reason for splinting particularly if passive ROM was compromised and no active movement present.
- To maintain muscle length with increased tone and to work out contractures.
- To affect muscle tone through neutral temperature, circumferential pressure and improved alignment although this could be better achieved through other materials or means.
- In some cases to improve active movement or hand function and reduce pain when working on a task-specific specific pinch or grasp. However, splinting in the presence of active, voluntary movement following neurological injury was strongly discouraged as it may interfere with functional hand use.
- Pain management for chronic patients.

Participants were unable to separate procedural and interactive reasoning because neurologically injured patients present with a wide variety of deficits. Interactive reasoning is that which considers the patient as an individual. This is not informed by literature, rather the participants experience with individuals specific to a South African context. The therapists is required to carefully consider the patient's psychosocial deficits, personality, environment, resources, culture, age, caregiver and family dynamics as these may influence the patient's ability to manage the splint

or protocol. In addition, participants were expected to weigh up the cost of splint application and follow up against the outcomes achieved by splinting. Education at the appropriate level is an important factor, however insight into the condition and reason for splint was said to be more important than poverty. It was clear that by using Interactive reasoning, participants were able to balance all the factors that need to be considered against the circumstances and the needs and wants of the family thus doing what is best for the patient at that time.

Conditional reasoning was used in every circumstance as participants found themselves unable to consider deficits in isolation, rather they found themselves considering the whole condition and the social and physical contexts in which a patient experiences their lives in a broader context. Some of these factors include:

- Timing. There was a lack of consensus on timing required therapists to make their own decisions about when was the best time to issue a splint. They felt that splints should not be issued during the acute stages (as early as 10 days) post stroke as during this stage ROM could be monitored through regular therapy with splinting being evaluated at a later stage.

- Risks. Oedema, poor skin condition, poor awareness of the limb, muscle tone, shoulder subluxation, patients or caregivers with a history of non-compliance and those with a lack of resources. Identification of these risks reiterates the importance of not treating the hand in isolation, and ensuring that one considers all the factors.

- Behaviour and cognition. Occupational therapy, to address these deficits specifically, rather than splinting would be a more effective use of valuable therapy time.

It was strongly agreed that if splinting went ahead under any of the above-mentioned conditions or factors, at any stage of the rehabilitation process, it would require great caution. It was also suggested to rather consider making use of alternative techniques to directly address the above deficits rather than splinting.

The participants were drawing from years of experience and knowledge and it was clear that as expert therapists they were able to consider the ‘big picture’ and suggest treatments which were most effective in achieving the desired goals when

managing the hand after neurological injury. The purpose of the study is to investigate the use of splinting in practice, therefore the questions focused on the decisions related to splinting, however, under most circumstances participants felt that using a splint was not the most effective means of treatment. The emphasis was on holistic treatment of the upper limb. They emphasised that splinting should not be seen as a 'stand-alone treatment' but rather part of a holistic therapy programme with the focus on functional rehabilitation.

6.2 Recommendations

With the lack of practical experience specific to splinting the hand following neurological injury gained at an undergraduate level, it is recommended that inexperienced therapists devote time to working with mentors, who are able to inform their decisions and discuss practical challenges that appear clinically with these patients. It is clear that there is no set protocol that can be developed for this type of splinting, only suggestions and defined goals and outcomes.

Occupational therapists with an interest in this field are expected to work in the field and gain actual experience with the patients and the splinting materials. It is also recommended that they attend appropriate postgraduate courses and CPD activities which focus on splinting and neurology, separately as well as combined and encourage clinical reasoning and splint prescription on a case-by-case basis.

Therapists are to make use of the following guidelines when determining if a splint is appropriate

- Complete a comprehensive assessment.
- Set specific goals for the splint.
- Carefully consider the
    - design of the splint
    - position of the hand
    - materials used for the splint
    - splinting regimen

- ease of use of the splint

When deciding whether or not it is appropriate to splint it may be worthwhile for therapists to make use of checklists which ensure they consider all aspects in the case, as patients following neurological injury often present with a wide variety of deficits. This cannot be done without having a good understanding of each patient as an individual including their external environment. It is recommended that splinting be used with great caution and proceed under the direction of an experienced Occupational Therapist and be utilised in combination with therapy.

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Appendix A

Demographic questionnaire

• **Basic qualification**	B.Sc. (OT)	B. (OT)	Other	
• **Year of Undergraduate qualification**				
• **University where graduated**				
• **Postgraduate qualification**	Yes	No		
If yes specify				
• **Short Neuro Courses**	Yes	No		
If yes specify (run by whom, length)				
• **Number of years of experience in Neurorehabilitation**				
Employment history				
Place of employment	**Number of years at place of employment**		**Access to splinting materials and equipment at place of employment**	
Private practice- general OT			Yes	No
Private practice- adult neuro only			Yes	No
Rehabilitation hospital (private)			Yes	No
Rehabilitation hospital (state)			Yes	No
State hospital- general OT			Yes	No
State hospital- neuro only			Yes	No
Other (specify)_____			Yes	No

Appendix B

Invitation to Focus group

There is a lack of conclusive, objective research guiding the prescription of thermoplastic splints for adult patients following neurological injury.

So what are Occupational therapists doing?

Occupational therapists appear to be relying on their **clinical experience** as current best evidence in the prescription of thermoplastic splints.

I am an Occupational therapist doing my Masters through Wits University, as part of my research I want to know what YOU as the EXPERTS are doing!

I need you to be a part of my research, to help me "**Understand the Expert Occupational Therapists' Professional Reasoning in Splinting the Adult Patient with Neurological Injuries"**

If you have been

- Qualified for 7 years, with at least 3 of those years with neuro experience and hand therapy involving people with neurological injuries

Or

- Qualified for 5 years with all 5 of those years with neuro experience and hand therapy involving people with neurological injuries

I would like to invite you to attend ONE of three 2hour focus groups that are being held to investigate this topic.

Venue	Address	Date	Time
Rehabilitation Matters	1 De La Rey Road, Rivonia, Johannesburg	Thursday 17March 2011	15:30-17:30
Wits University Occupational Therapy department	First Floor Khanya Block (old Conacher Building) Wits Education Campus	Tuesday 22March 2011	15:30-17:30
Muelmed Hospital	577 Pretorius Street Arcadia Pretoria	Tuesday 29March 2011	15:30-17:30

2 CPD’s applied for

Tea and biscuits will be served

Please RSVP directly to me ASAP at leechazen@gmail.com or 084 665 5590

Please forward this message on to your colleagues to allow all the opportunity to participate.

Warm regards

Lee-Anne Chazen

Appendix C

Information Sheet

Good day

I am Lee-Anne Chazen, an Occupational Therapist currently doing research for a Masters degree in Occupational Therapy at the University of the Witwatersrand. I would appreciate your participation in this research which aims to understand the expert occupational therapists' professional reasoning used in the decision to provide adult patients with neurological injuries, thermoplastic splints.

Reason for the study

The literature available on splinting the hand following neurological injury appears to be scarce and controversial. Thermoplastic splints are however used clinically, which has led me to question what influences the professional reasoning an occupational therapist (OT) in South Africa uses in the prescription of thermoplastic splints for the hand following neurological injury. I feel a clearer understanding of what more experienced therapists consider and have found to be effective in practice, when making the decision to splint, will provide valuable information which may aid less experienced therapists as well as inform evidence based practice with regard to splinting and neurorehabilitation.

What is expected from participants of the study?

I am inviting you to participate in a focus group in the study as you have been

- Qualified for at least 7 years, with at least 3 of those years with neuro experience and hand therapy involving people with neurological injuries

Or

- Qualified for 5 years with all 5 of those years with neuro experience and hand therapy involving people with neurological injuries

Demographic data related to qualifications, years of experience and place of employment will be collected and recorded when you attend the focus groups.

I will be presenting various case studies and will pose some questions to the focus group. I am requesting that you meet at a designated location for approximately 2 hours to discuss the case study and your various clinical experiences related to the case studies. I also request your permission to record the discussion which I will later transcribe for data analysis.

You may be asked to return for a follow up group should data saturation not be achieved in the first group.

Once the data has been analysed you will be sent an email and I am also requesting that you complete a member check of the results 2-3 weeks after the focus group.

Benefits of the study

You will be provided the opportunity to consider the reasons for splinting a hand following neurological injury, a topic which for some time has created confusion, this is an opportunity for you to contribute your expert knowledge and experience to allow us to contribute to evidence based practice in this field.

Can participants withdraw?

You may withdraw from the study at any time without having to give a reason. Remember that the study is completely voluntary and not taking part in it, or withdrawing from it, carries no penalty of any sort.

Confidentiality

Although confidentiality cannot be maintained between participants during the group, the recording tape will be destroyed once the research is complete in accordance with data storage protocols. Tapes will be stored by the researcher in a safely locked cupboard until they are destroyed/ deleted. You will be required to provide a name and email address to allow for member checking and validation of the information later and this information will be kept in a separate file by the researcher who will be the only person who has access to it. All emails will be sent directly to you from the researcher and you are requested to return it to her.

Feedback

You will be provided with feedback via email for member checking.

Should you have any queries; more information can be obtained from me, Lee-Anne Chazen on 084 665 5590. If you are happy to participate in the study, please read and sign the attached consent form.

Thank you

Lee-Anne Chazen

Appendix D

Case Reports

NB: This should be based on your knowledge and actual clinical experience as a qualified therapist working in the field of neurorehabilitation.
Case study Mr T
Adapted from a case study from (Turner, Foster, and Johnson 2002)
Age:19
Sex: Male
Occupation: Student, part time waitron at a nearby restaurant
Home situation: Lives with his mother, uncle and younger sister in a complex
Diagnosis: TBI, GCS on admission was 5 and he spent 20 days in ICU where he had a tracheostomy and PEG inserted. He sustained a left humerus fracture. After 1 month of being in the ward he was transferred to a rehabilitation facility.
Dominance: right
Onset: 01/03/2007
Seen for OT: Following transfer to rehabilitation unit (1month and 20days following onset)
Right Upper extremity: Severely impaired wrist and elbow Passive ROM (elbow and wrist flexion contractures), Mildly impaired shoulder, forearm and finger Passive ROM. Some active shoulder, elbow and finger movement present.
Right hand: Unable to perform 9 hole peg test, poor lateral pinch, unable to perform palmer pinch independently, mass grasp and limited finger extension
Left upper extremity: ROM within normal limits. Muscle strength within functional limits. Severe ataxia
Psychological and Cognitive evaluation: He has reduced cognitive ability with poor orientation and poor memory skills. He has severe dysarthria and has difficulty communicating his needs. He is inappropriate, aggressive and restless.
ADL evaluation: Mr T is currently dependent in all -, transfers and feeding.

Following set up he is able to bring a cloth to wipe his face and bring food to his mouth with his right hand with moderate facilitation.

NB: This should be based on your knowledge and actual clinical experience as a qualified therapist working in the field of neurorehabilitation.
Case study Mrs P
Adapted from the case study given by Neuhaus (Neuhaus, Ascher et al. 1981)
Age:66
Sex: Female
Occupation: Pensioner
Home situation: Before admission lived with her husband on a flat on the 3rd floor
Diagnosis: Right CVA due to haemorrhage, with left hemiparesis
Dominance: Right
Onset: 6/12/2009
Initially seen in OT: 16/12/2009 (10 days later)
Left Upper extremity: PROM within normal limits, with exception of moderate limitations in shoulder flexion (0-120deg). Flaccid muscle tone throughout. No active motion present. Moderate subluxation of shoulder. Slight pain on passive motion.
Left hand: Redness and moderate pitting oedema noted
Right upper extremity: ROM and strength within normal limits.
Sensory evaluation: Absence of proprioception and light touch sensation on left upper extremity
Perceptual evaluation: Left hemianopia and unilateral neglect
Psychological and cognitive response: Oriented to person, place and time will respond appropriately when addressed; distractible and will not complete a task if left unsupervised; appears depressed.
ADL evaluation: Completely dependent in self-care and transfers due to poor sitting balance, perceptual impairment and apparent anxiety.

Appendix E

Discussion guide

Welcome and provision of information sheets and signing of consent forms

Introduction to the researcher

Introduction to the research
- Purpose of the research

Explain how the focus group will run
- read 1st case study, then ask questions and discuss
- break for tea
- read 2nd case study, then ask questions and discuss
- Rules of the group
    - talk one at a time
    - talk loudly so that the recording device can record correctly
    - allow everyone equal opportunity to share
    - reemphasise that this is confidential within the group
    - EMPHASIZE that answers to their questions need to be based on their own personal experience.

Initial question
When you decide to make a splint for the hand following neurological injury, what would be your reasons you would splint?

Read the 1st case study

Questions on Mrs P
1. (1st jot down answers then we will discuss one by one) In this case, at the time of the initial evaluation in OT, would you provide a splint for the left hand? Discuss reason for splinting TYPE of splint (hard/soft) and other possible alternatives Wearing regimen? How would you measure if your splint is being effective/ ineffective/detrimental?
2. If, after 6weeks from onset, Mrs P still has no active motion in her left hand, has moderate to severely increased muscle tone in the fingers, would you recommend a splint? Discuss reason for splinting TYPE of splint (hard/soft) and other possible alternatives Wearing regimen? How would you measure if your splint is being effective/ ineffective/detrimental? (1st jot answers then discuss)
3. Would you consider recommending a splint after 2 years from onset?
4. If it was his dominant or non-dominant hand would it make a difference to your decision?
5. Does her age affect your decision?
6. How might her caregivers and home environment influence your decision to provide or not provide a splint? (government vs. private)
7. Would you ever issue a splint based on hospital procedures or purely Doctors orders?
8. Under which conditions would you never consider splinting her hand? (some examples may include oedema, spasticity, loss of ROM, loss of sensation, cognition and perceptual deficits)
9. What literature has influenced you with regard to splint prescription and which model of Neurphisological Rehabilitation –i.e Rood, Bobath, Carr and Shepherd, guides your practice?
10. How is what you were taught at university or on courses, influenced your decision to splint?
11. If this patient had a better prognosis, were younger (working as a legal secretary), with full PROM but mild to moderately increased tone of the shoulder

flexors and finger flexors with the upper limb in a stage 4 Brunnstrom (arm forward horizontal, isolating some movements pronation/supination). Hand with mass flexion and extension and lateral pinch. If sensation was intact, with only mild cognitive difficulties and no perceptual difficulties. If Mrs P was independent in most self- care tasks using mostly 1-handed techniques and she also had the possibility of returning to driving and work. - How might this change your decision to provide a splint? What type of splint (design and material) and what wearing regime might you follow? How would you evaluate its effectiveness? (1st jot down answer then discuss)

Read 2nd case study

Questions on Mr T
1. In this case, at the time he was admitted for rehabilitation, would you provide a splint for the right hand? (first jot down the answers, tell us your answers you wrote and then we will discuss) Discuss reason for splinting TYPE of splint (hard/soft) and other possible alternatives Wearing regimen? How would you measure if your splint is being effective/ ineffective/detrimental?
2. If you were able to treat Mr T while in ICU, 14days following onset and there was moderate to severe flexor tone on the right, and some active movement (not functional) would you provide him with a splint? (first jot down the answers, tell us your answers you wrote and then we will discuss) Discuss reason for splinting TYPE of splint (hard/soft) and other possible alternatives Wearing regimen? How would you measure if your splint is being effective/ ineffective/detrimental?
3. If, after 2 years from onset, Mr T had severe wrist and finger flexion contractures and had some functional movement of the right upper limb (raise arm to put in shirt, mass grasp to brush hair and teeth and hold spoon to eat with min assistance) would you recommend a splint? (first jot down the answers, tell us your answers you wrote and then we will discuss)

Discuss reason for splinting TYPE of splint (hard/soft) and other possible alternatives Wearing regimen? How would you measure if your splint is being effective/ ineffective/detrimental?
4. Would the amount of active functional movement he has change your decision?
5. If it was his dominant or non- dominant hand would it make a difference to your decision?
6. How might his caregivers and home environment influence your decision to provide or not provide a splint?
7. Would this patient being in a private or government setting change your decision?
8. Under which conditions would you never consider splinting this patient? (some examples may include oedema, spasticity, loss of ROM, loss of sensation, cognition and perceptual deficits)
9. Would you ever issue a splint based on hospital procedures or purely Doctors orders?
10. Is it literature, a model of neuro rehabilitation (i.e Rood, Bobath, Carr and Shepherd) or experience which informs your decision with regard to splint prescription.
11. How is what you were taught at university or on courses, influenced your decision to splint?
12. If this patient had a more improved prognosis, with almost full Passive ROM mild flexor tone and improved voluntary control of muscles. If Mr T was independent in most self- care tasks and had good cognition and a possibility of returning to his studies. (first jot down the answers, tell us your answers you wrote and then we will discuss) How might this change your decision to provide a splint? Discuss reason for splinting TYPE of splint (hard/soft) and other possible alternatives Wearing regimen? How would you measure if your splint is being effective/ ineffective/detrimental?

Appendix F

Consent form

I agree to participate in the study entitled "Understanding the Occupational Therapists' use of Splinting the Affected Hand of Adult Patients with Neurological Injuries".

I have read the information sheet for the above research and understand that I will participate in a focus group involving a discussion on splinting the hand following neurological injury. I understand that information will be confidential and that I may withdraw from the study at any time. I agree that the information on the group may be sent to me for validation.

Name_____Signature_____

Date_____

I hereby give permission to participate in the focus group and I understand that my voice will be recorded and the tape will be destroyed when the research is complete.

Name_____Signature_____

Date_____

Appendix G

Table of demographics

Participant no	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Basic qualification	B.Sc.(OT)	B.Sc.(OT)	B.(OT)	B.Sc.(OT)	B.(OT)	B Sc.(OT)	B Sc.(OT)
Year of undergrad qualification	1990	2003	1997	1999	1997	1999	2002
Number of years qualified*	21	8	14	12	14	12	9
Place of qualification	Wits	Wits	UOFS	UCT	UDW	Wits	Wits
Postgraduate qualifications	Adv. Dip OT (Neurosc)				Dip hand therapy	Adv dip (Neuro)	MSc OT (neurosciences)
	Dip voc rehabilitation					Dip voc rehabilitation	
	Dip hand therapy						
Short Neuro courses	Too many to mention	Managemnt of neuro UL- A Singh 1day w/s	NDT	Basic NDT	Neuro hand and splinting (M Lotter)	NDT basic, adult	yes
			Adv NDT	splinting for spasticity			
Number of years experience in Neurorehabilitation	Aprox. 18 years	Aprox. 4years	Aprox. 11 years	9 years	11 years	10 years	7, 5 years
Private practice- general OT		4 years (paeds)					
Private practice- adult neuro only	14-15 years (and hands)		9 years	4 years (UK)	11 years (and hands)	6 years	
Rehabilitation hospital (private)		3 years	2 years	2 years		5 years	
Rehabilitation hospital (state)							
State hospital- general OT	2 years	1 years		2 years (uk)			1,5 years
State hospital- neuro only	2 years			2 years (uk)			
Other (specify)_____							6 years (lecturer)

_____							
Access to splinting material	Yes	Yes	yes	Yes	yes	yes	yes
Participant no	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Basic qualification	B Sc(OT)	B Sc(OT)	B Sc(OT)	B (OT)	B (OT)	B (OT)	B (OT)
Year of undergrad qualification	2002/2003	1989	2001	1996	1970	2001	2003
Number of years qualified*	8 or 9	22	10	15	41	10	8
Place of qualification	York College	Wits	Wits	UP	Pta college of Occ therapy	UP	UP
Postgraduate qualifications	Dip hand therapy	Adv dip (Neuro)	MSc OT (neurosciences)	Dip Voc rehabilitation	B Hons		
		Dip hand therapy			M Occ ther		
					PhD		
Short Neuro courses	NDT (adult neuro)	Numerous	Basic NDT	Introductory bobath	NDT-basic	NDT-basic	NDT
				x3 courses in UK	NDT-adv		many 1 day courses
					Carr and Shep		
Number of years experience in Neurorehabilitation	apr 8 years	apr 15 years	9,5 years	apr 5 years	25 years	5 years	5 years
Private practice- general OT		14 years		5 years			
Private practice- adult neuro only	2 years	14 years					
Rehabilitation hospital (private)	4 years					4 years	5 years
Rehabilitation hospital (state)				4 years (UK)	x		
State hospital- general OT		5 years	5,5 years (general and neuro)		x	3 years	1 year
State hospital- neuro only					x		
Other (specify)_____ _____			4 years (lecturer)	6 years (mode, insurer)	x (lecturer)		1 year (UK, various)
Access to splinting material	yes	Yes	yes	yes		yes	yes

Summary of demographics							
Average number of years' experience	14.6						
range (number of years' experience)	8-41						
Average number of years' experience in neuro	10.2						
range (number of years' experience in neuro)	4-25						
Number of people with post grad	9.0						
Number of people with post grad neuro	6.0						
Number of people on NDT	9.0	not accurate					

Appendix H

Ethics

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

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Mrs Lee-Anne Chazen

CLEARANCE CERTIFICATE	**M10531**
PROJECT	Understanding the Occupational Therapists' use of Splinting the Affected Hand of Adult Patients with Neurological
INVESTIGATORS	Mrs Lee-Anne Chazen.
DEPARTMENT	Department of Occupational Therapy
DATE CONSIDERED	28/05/2010
DECISION OF THE COMMITTEE*	Approved unconditionally

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

DATE 15/12/2010 **CHAIRPERSON** .....
(Professor PE Cleaton-Jones)

*Guidelines for written 'informed consent' attached where applicable
cc: Supervisor : Mrs D Franszen

DECLARATION OF INVESTIGATOR(S)

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

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES...