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Occupational Therapists' Perceptions and Clinical Reasoning of Splints Used in Adults with Neurological Conditions

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OCCUPATIONAL THERAPISTS' PERCEPTIONS AND CLINICAL REASONING OF SPLINTS USED IN ADULTS WITH NERUOLOGICAL CONDITIONS

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ABSTRACT

Using splints for upper extremity functional improvement in neurologically impaired patients is a common practice among occupational therapists despite inadequate evidence to support this intervention. This mixed-method study aims to address the gap in research regarding occupational therapists' perceptions of current neurological splinting trends, perceived effectiveness of splinting, their rationale for splinting, and confidence in splinting. Semi-structured interviews were conducted with four occupational therapists across the United States. A 37-item online survey was then developed and administered to 129 occupational therapists who practice with neurologically impaired populations. Three themes were developed from the qualitative data: clinical reasoning guides decision-making and perceived effectiveness of splinting, contextual factors limit and support splinting implementation, and confidence levels for splinting varies within the individual. The quantitative data revealed that functional resting splints were most commonly prescribed to this population. The majority of participants considered splinting to be moderately effective. Interactive reasoning and conditional reasoning were utilized by therapists in addition to procedural reasoning in both decision making and evaluating the effectiveness of splinting. Participants reported moderate or less knowledge and confidence levels as well as limited university education and continuing education opportunities on neurological splinting. Evidence-based practice (EBP) on this specific intervention was rarely or even never conducted by most participants. Therapists may need access to education and training for both neurological splinting and EBP to positively impact patient outcomes.

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Introduction

As of 2011, about 100 million people in the United States were afflicted by at least one of the over 1,000 neurological conditions (Gooch, Pracht, & Borenstein, 2017). Stroke affects 6.8 million American adults (2.7%), and disproportionately affects the elderly and disadvantaged ethnic minority groups (American Heart Association, 2018). Over the span of six years, from 2007 to 2013, the rate of TBI related emergency department visits increased by 47% (CDC, 2018). In 2013, roughly 2.8 million traumatic brain injury (TBI) related emergency department visits, hospitalizations, and deaths occurred. Nearly 1 million American people are living with multiple sclerosis (MS), which is more than twice the previously reported number (National Multiple Sclerosis Society, 2018). The annual incidence of spinal cord injury (SCI) is about 54 cases per one million American people, or about 17,700 new SCI cases each year (National Spinal Cord Injury Statistical Center, 2018). Roughly 288,000 people are currently living with SCI in the United States. Due to the great number of people suffering from neurological conditions, exploring the efficiency and effectiveness of the specific techniques and interventions a practitioner employs play an important role in ensuring quality of care and obtaining optimal client outcomes.

Individuals with central nervous system dysfunctions tend to have primary impairments and activity limitations such as impaired muscle tone, impaired limb posture or positioning, pain, and loss of motor control (Bondoc & Harmeyer, 2013).

Thus, splinting is a common intervention that occupational therapists (OTs) often utilize to decrease spasticity, prevent or correct contracture, position to enhance biomechanical advantage, protect joint integrity, and reduce pain in adults with a neurological condition. The effectiveness of splinting for adults with neurological conditions has been a source of debate in the literature; however, splinting following a neurological condition is a common practice despite inadequate evidence to support this intervention (Adrienne & Manigandan, 2011; Bondoc & Harmeyer, 2013; Pidgeon, Ramirez & Schiller, 2015). Although studies from South Africa and Ireland have explored OTs' perceptions of the use of splints with neurologically impaired populations, there is currently no available literature that documents therapists' perceptions and their clinical reasoning process for prescribing splints in the United States.

Therefore, the problem this mixed method research study will be addressing is the gap in the research regarding OTs' perceptions of current neurological splinting trends in the United States including splinting effectiveness, their rationale for splinting, and therapists' perceived confidence for splinting with these populations. The results of this research could be used as background information on the effectiveness of current commonly used splints from practitioners' perspectives. Since the annual cost of medical treatment has been putting an enormous financial strain on the health care system (Gooch, Pracht, & Borenstein, 2017), examining the effectiveness of neurological splinting intervention may potentially reduce the costs of health care for this population. In addition, having a better understanding of

practitioners' clinical reasoning process and confidence levels for splinting could support continuing education and training to improve the efficiency of delivering skilled services and lead to optimal outcomes for patients with neurological conditions who receive occupational therapy services for splinting.

Literature Review

Neurological condition and upper extremity (UE) function. Neurological condition refers to damage to the brain, spine, and the nerves that connect them, such as stroke, TBI, MS or SCI, which can cause disruption of the upper motor neuron inhibitory pathways, and impact UE function (Botte, Nickel, & Akeson, 1988; Hughes et al., 2016). Since both the brain and body need to relearn how to function following neurological conditions, addressing issues related to the UE such as spasticity can maximize the benefit of rehabilitation for patients with TBI and stroke (Kimberley et al., 2010). About 71 % of people with mild stroke and only 41 % of moderate to severe stroke patients regain dexterity in hands which significantly affects their performance in activities of daily living (ADL; Hughes et al., 2016). Limitations in ADL and social activities due to reduced UE dexterity are also found as highly prevalent in mid to late stages of MS. Patients with cervical SCI and their caregivers always identify regaining arm/hand function as their main priorities during neurorehabilitation (Hughes et al., 2016).

Spasticity is the most common cause of limited UE function among populations with neurologic conditions since these disorders can disrupt normal function of spinal

reflex arcs controlling muscle tone (Bhimani, McAlpine, & Henly, 2012). The increased muscle tone and hyperactive reflexes may result in loss of joint motion, lead to contractures and pain, and cause abnormal posture and orthopedic deformities (Botte et al., 1988; Matsumoto-Miyazaki, Asano, Ikegame, Kawasaki, Nomura, & Shinoda, 2016). A longitudinal observational study has found that position-dependent spasticity presented early at the wrist among stroke patients even after they recovered UE function (Malhotra, Pandyan, Rosewilliam, Roffe, & Hermens, 2011). Contractures were found mainly developed in patients who did not recover UE function and the significant reduction in passive range of motion was observed prior to observing increase in joint stiffness.

Splinting. An orthosis or splint is defined as an externally applied device that is added to an individual's body to support, align, prevent, immobilize, or correct deformities, assist weak muscles, or improve function (Radomski & Latham, 2013). It applies stress to either side of a joint to redistribute the forces acting on that joint to control abnormal motion of one or more body segments around the joint, and to prevent undesirable movements and positions (Tyson & Kent, 2011). Using splints for the neurologically impaired hand is a common practice among OTs in treating central nervous system dysfunctions because of its ability to decrease spasticity, prevent or reduce contractures, position to enhance biomechanical advantage, protect joint integrity, and reduce pain (Bondoc & Harmeyer, 2013; Lannin & Ada, 2011).

Types of UE splints can be grouped into categories based on the features such as resting and functional as well as serial static, dynamic and static progressive. A

resting splint's primary function is to provide a prolonged low load stretch to the target muscles and tendons and immobilize the joint in proper alignment at rest (Kuipers et al., 2009). With the prolonged muscle stretch, the splint might reduce spasticity and prevent length associated changes such as contractures. The aim of a functional splint is to promote UE function in the presence of hypertonicity and weakness as they can result in compensation positioning of the arm or hand during active movements such as reaching and grasping (Kuipers et al., 2009). The serial static splints are usually molded to hold the joint(s) at the end of available passive range of motion (ROM) without an outrigger system, which can be used across all recovering stages for tissue repair (Glasgow, Tooth, & Fleming, 2008). The dynamic splints are comprised of both a stable static base and a mobilizing component that is usually made from elastic materials such as elastic bands, springs, coils or lycra. A wide variety of dynamic splints are utilized to improve the joint(s)' ROM by applying the mobilizing force (Glasgow et al., 2008). While the static progressive splints are similar to dynamic splints, the mobilizing component of the static progressive splint is constructed from rigid inelastic materials such as fishing line, cord, Velcro or screws. This type of splint is usually used for contractures that are more fixed and resistant to standard therapy techniques (Glasgow et al., 2008).

Effectiveness. Various studies have investigated the functional outcome of using splints with stroke survivors; however, not many studies have looked into other neurological disorders. The effectiveness of splinting for adults with neurological conditions, especially stroke, has been a source of debate in literature. Khatri, Logan,

Kay, and Lehner (2016) utilized an in-depth case study approach to evaluate eight stroke survivors' sensorimotor and functional outcomes following a splint. Their findings suggested that splinting practice is potentially effective for the rehabilitation of the upper extremity for stroke patients and can improve their quality of life outcomes. A randomized, single blinded study examined the impact of individualized resting hand splints for people with TBI (Copley, Kuipers, Fleming, & Rassafiani, 2013). The results from the ten participants with moderate hypertonicity and contracture indicated that the individualized resting splints had positive clinical effects for the maintenance of passive ROM, reducing muscle stiffness, and decreasing spasticity. Choi, Ma, and Song (2016) randomly allocated 15 participants to a control and an experimental group to research the effects of resting hand splints on hand pain and edema in stroke patients in the acute stage. Significant decreases were found in both pain and edema in the experimental group, so the study concluded that a resting hand splint contributes to improved UE function in stroke survivors.

However, another randomized controlled study on splinting for spasticity following stroke failed to demonstrate any statistically significant differences in spasticity or passive ROM for the use of both volar and dorsal splints (Basaran, Emre, Karadavut, Balbaloglu, & Bulmus, 2012). A pilot study compared the effect of using a dynamic wrist-hand orthosis versus manual-assisted therapy with patients with chronic stroke, but there was no significant between-group difference presented (Barry, Ross, & Woehrle, 2012). Suat, Engin, Nilgün, Yavuz, and Fatma's (2011) randomized controlled study with 19 chronic stroke patients investigated the

effectiveness of a hand splint with reflex inhibitory characteristics. Their results showed that such hand splints have no significant effect on balance and functional ambulation activities in chronic poststroke patients. A systematic review completed by Tyson and Kent (2011) suggested that splints were not effective in patients with stroke and other non-progressive brain lesions for UE function since neither ROM at the wrist, fingers, and thumb or pain were reduced. Moreover, Lannin and Herbert's (2003) systematic review of hand splinting for adults with stroke examined the results from 19 studies and they concluded that there was insufficient evidence to either support or refute the effectiveness of splinting for a variety of outcomes for stroke survivors.

Occupational therapists' perspective. Using a splint after a neurological condition such as MS, stroke, TBI, and SCI is a common practice for OTs despite inadequate evidence to support this intervention (Adrienne & Manigandan, 2011; Bondoc & Harmeyer, 2013; Pidgeon, Ramirez, & Schiller, 2015). The popularity of splints among rehabilitation therapists for clients with neurological conditions appears to support the clinical usefulness for these clients, although the lack of support through evidence remains (Bondoc & Harmeyer, 2013). According to AOTA (2018), rehabilitation related to UE impairments is a major focus of occupational therapy as such conditions can be seen in variety of settings including special hand clinics, general rehabilitation settings, and acute care hospitals. Neuromuscular pathology is one of the common conditions of the upper extremity that are treated by OTs, and orthosis design and fabrication for post-injury are usually included in their interventions (AOTA, 2018).

With the ongoing debate of the effectiveness of using splints with neurologically impaired adults, multiple studies outside of the United States have investigated OTs' perceptions on this particular topic. A study from South Africa has found that OTs often rely on their professional development and clinical reasoning skills when splinting adults with neurological conditions due to the absence of research evidence (Chazen & Franzsen, 2016). They suggested that therapists' skills for making splints and problem solving were achieved mainly through learning from other experienced colleagues and through clinical practice. Inexperienced therapists tended to use splints more often and inappropriately since they chose splints based on guidelines learned at the undergraduate level and used procedural clinical reasoning. The participants, South African occupational therapy practitioners, believed that the subjective experience of patients wearing the splint and the change in patients' ability to complete functional tasks should be considered to measure the effectiveness of neurological splints. Adrienne and Manigandan (2011) from Ireland distributed a cross-sectional survey to sixty-two OTs to examine the factors associated with therapists' hand splinting practice and their perceived splinting efficacy in inpatient settings. The study suggested that hand-splinting prescription was found to be a common practice following stroke among practitioners who perceive splints to be effective. The custom-made volar forearm based wrist-hand functional position splint is the preferred splint by therapists for treating patients with stroke but a universally accepted practice guideline is still lacking in terms of regulating therapy. In the United States, a study conducted by Skubik-Peplaski, Howell, Hunter, and Harrison (2015) investigated OTs'

perceptions of environmental influences on practice in a neurological rehabilitation setting. Their results indicated that the environment and therapists' habits influenced their clinical reasoning. However, there is currently no available literature that documents therapists' perceptions of splints used in practice and their clinical reasoning for patients with neurological conditions in the United States.

Clinical reasoning. Clinical reasoning is the term used to describe the process by which practitioners collect cues, process the information, develop an understanding of the client's problem or situation, plan and implement interventions, evaluate outcomes, and reflect on and learn from the process (Lauri et al., 2001). It plays an important role in occupational therapy because it not only relates to the biological world of disease but also to the human world of values, beliefs, and motives (Mattingly, 1991). Although clinical reasoning can be primarily associated with diagnosis, therapists often become involved in addressing a host of problems surrounding the illness and disability. The ultimate goal for occupational therapy is to not only treat the symptoms and deficits but also help patients to achieve a meaningful life while dealing with the imperfect body.

Fleming (1991) described three levels of clinical reasoning for occupational therapy clinicians, which are procedural reasoning, interactive reasoning, and conditional reasoning. Procedural reasoning emphasizes the procedural treatment of physical aspects of the individual's disability or functional limitations. With procedural reasoning, practitioners would consider neurologically impaired patients' physical

performance problems such as spasticity, contracture, ROM, and pain when they consider prescribing or making a splint for them. Secondly, interactive reasoning refers to the form of reasoning that therapists utilize when they want to understand the patient as an individual such as how the patient feels about the treatment at the moment or his or her special preferences (Fleming, 1991). This type of reasoning allows therapists to better understand the experience of the illness, injury, or disability from the patient's own point of view, which may determine if the treatment session is going well. The person' age, hand dominance, personality, and attitudes towards wearing a splint are all part of the interactive reasoning when therapists treat individuals with a variety of neurological conditions. Lastly, the conditional reasoning moves beyond specific concerns about the person and the physical issues, instead, it focuses on the whole condition including the family and the social contexts in which the patient lives (Fleming, 1991). Neurologically impaired patients, especially individuals with TBI, often experience cognitive deficits during the rehabilitation process. They typically rely on the family and caregivers to assist them with appropriately wearing splints according to the recommended schedule following the injury. Therefore, taking these factors into consideration when prescribing or making a splint for patients with neurological conditions is evidence that an OT employs conditional reasoning.

Chapter 2: Journal Article Manuscript

Introduction

As of 2011, about 100 million people in the United States were afflicted by at least one of the over 1,000 neurological conditions such as stroke, traumatic brain injury (TBI), multiple sclerosis (MS), and spinal cord injury (SCI; Gooch, Pracht, & Borenstein, 2017). Due to the great number of people suffering from neurological conditions, exploring the efficiency and effectiveness of the specific techniques and interventions a practitioner employs play an important role in ensuring quality of care and obtaining optimal client outcomes.

Individuals with central nervous system dysfunctions tend to have primary impairments and activity limitations such as impaired muscle tone, impaired limb posture or positioning, pain, and loss of motor control (Bondoc & Harmeyer, 2013). Thus, splinting following a neurological condition is a common practice although the effectiveness of this intervention is still a source of debate in literature (Adrienne & Manigandan, 2011; Bondoc & Harmeyer, 2013; Pidgeon, Ramirez, & Schiller, 2015). Although studies from South Africa and Ireland have explored OTs' perceptions of the use of splints with neurologically impaired populations, there is currently no available literature that documents therapists' perceptions and their clinical reasoning process for prescribing splints in the United States.

Therefore, the problem this mixed method research study will be addressing is the gap in the research regarding OTs' perceptions of current neurological splinting

trends in the United States including splinting effectiveness, their rationale for splinting, and therapists' perceived confidence for splinting with these populations.

Literature Review

Neurological condition refers to damage to the brain, spine, and the nerves that connect them, such as stroke, TBI, MS, or SCI, which can cause disruption of the upper motor neuron inhibitory pathways, and impact upper extremity (UE) function (Botte, Nickel, & Akeson, 1988; Hughes et al., 2016). Spasticity is the most common cause of limited UE function among populations with neurological conditions since these disorders can disrupt normal function of spinal reflex arcs controlling muscle tone (Bhimani, McAlpine, & Henly, 2012). The increased muscle tone and hyperactive reflexes may result in loss of joint motion, lead to contractures and pain, and cause abnormal posture and orthopedic deformities (Botte et al., 1988; Matsumoto-Miyazaki, Asano, Ikegame, Kawasaki, Nomura, & Shinoda, 2016). Since both the brain and body need to relearn how to function following neurological conditions, addressing issues related to the UE such as spasticity can maximize the benefit of rehabilitation for patients with TBI and stroke (Kimberley et al., 2010). Therefore, splints are used to apply stress to either side of a joint to redistribute the forces acting on that joint (Tyson & Kent, 2011). Splints are commonly used among OTs in treating the neurologically impaired UE because of the ability to decrease spasticity, prevent or reduce contractures, position to enhance biomechanical advantage, protect joint integrity, and reduce pain (Bondoc & Harmeyer, 2013; Lannin & Ada, 2011).

Various studies have investigated the functional outcome of using splints with stroke survivors; however, not many studies have looked into other neurological disorders. The effectiveness of splinting for adults with neurological conditions, especially stroke, has been a source of debate in literature. Khatri, Logan, Kay, and Lehner (2016) utilized an in-depth case study approach to evaluate eight stroke survivors' sensorimotor and functional outcomes following a splint. Their findings suggested that splinting practice is potentially effective for the rehabilitation of the upper extremity for stroke patients and can improve their quality of life outcomes. A randomized, single blinded study examined the impact of individualized resting hand splints for people with TBI (Copley, Kuipers, Fleming, & Rassafiani, 2013). The results from the ten participants with moderate hypertonicity and contracture indicated that the individualized resting splints had positive clinical effects for the maintenance of passive ROM, reducing muscle stiffness, and decreasing spasticity. Choi, Ma and Song (2016) randomly allocated 15 participants to a control and an experimental group to research the effects of resting hand splints on hand pain and edema in stroke patients in the acute stage. Significant decreases were found in both pain and edema in the experimental group, so the study concluded that a resting hand splint contributes to improved UE function in stroke survivors.

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Using a splint after a neurological condition such as MS, stroke, TBI, and SCI is a common practice for OTs despite inadequate evidence to support this intervention (Adrienne & Manigandan, 2011; Bondoc & Harmeyer, 2013; Pidgeon, Ramirez, & Schiller, 2015). The popularity of splints among rehabilitation therapists for clients with neurological conditions appears to support the clinical usefulness for these clients, although the lack of support through evidence remains (Bondoc & Harmeyer, 2013). With the ongoing debate of the effectiveness of using splints with neurologically impaired adults, multiple studies outside of the United States have investigated OTs' perceptions on this particular topic. A study from South Africa has found that OTs

often rely on their professional development and clinical reasoning skills when splinting adults with neurological conditions due to the absence of research evidence (Chazen & Franzsen, 2016). They suggested that therapists' skills for making splints and problem solving were achieved mainly through learning from other experienced colleagues and through clinical practice. Inexperienced therapists tended to use splints more often and inappropriately since they chose splints based on guidelines learned at the undergraduate level and used procedural clinical reasoning. The participants, South African occupational therapy practitioners, believed that the subjective experience of patients wearing the splint and the change in patients' ability to complete functional tasks should be considered to measure the effectiveness of neurological splints. Adrienne and Manigandan (2011) from Ireland distributed a cross-sectional survey to sixty-two OTs to examine the factors associated with therapists' hand splinting practice and their perceived splinting efficacy in inpatient settings. The study suggested that hand-splinting prescription was found to be a common practice following stroke among practitioners who perceive splints to be effective. The custom-made volar forearm based wrist-hand functional position splint is the preferred splint by therapists for treating patients with stroke but a universally accepted practice guideline is still lacking in terms of regulating therapy.

Clinical reasoning is the term used to describe the process by which practitioners collect cues, process the information, develop an understanding of the client's problem or situation, plan and implement interventions, evaluate outcomes, and reflect on and learn from the process (Lauri et al., 2001). It plays an important role

in OT because it not only relates to the biological world of disease but also to the human world of values, beliefs, and motives (Mattingly, 1991). Fleming (1991) described three levels of clinical reasoning for occupational therapy clinicians, which are procedural reasoning, interactive reasoning, and conditional reasoning. Procedural reasoning emphasizes the procedural treatment of physical aspects of the individual's disability or functional limitations. With procedural reasoning OTs would consider neurologically impaired patients' physical performance problems such as spasticity, contracture, ROM, and pain when they consider prescribing or making a splint for them. Secondly, interactive reasoning refers to the form of reasoning that therapists utilize when they want to understand the patient as an individual such as how the patient feels about the treatment at the moment or his or her special preferences (Fleming, 1991). This type of reasoning allows therapists to better understand the experience of the illness, injury, or disability from the patient's own point of view, which may determine if the treatment session is going well. The person' age, hand dominance, personality, and attitudes towards wearing a splint are all part of the interactive reasoning when therapists treat individuals with a variety of neurological conditions. Lastly, the conditional reasoning moves beyond specific concerns about the person and the physical issues; instead, it focuses on the whole condition including the family and the social contexts in which the patient lives (Fleming, 1991). Neurologically impaired patients, especially individuals with TBI, often experience cognitive deficits during the rehabilitation process. They typically rely on the family and caregivers to assist them with appropriately wearing splints according to the recommended

schedule following the injury. Therefore, taking these factors into consideration when prescribing or making a splint for patients with neurological conditions is evidence that an OT employs conditional reasoning.

Method

Approval for this study was granted by the Institutional Review Board (IRB) at Eastern Kentucky University in June 2018 through an expedited review process. All participants provided informed consent before participating in this study and all ethical procedures were followed throughout the research.

Research design. An exploratory sequential mixed-methods approach was used in this descriptive study. This approach is a design where the researcher first begins by exploring with qualitative data and analysis, and then builds an instrument to be tested in the later quantitative phase (Creswell, 2018). The purpose of this design is to explore with a sample first so that the later quantitative phase can be tailored to meet the needs of the larger group of participants. This mixed-methods design was chosen because it draws on the strengths of both qualitative and quantitative research and minimizes the limitations of both approaches (Creswell, 2018). By first collecting and analyzing qualitative data, the researcher can develop better contextualized measurement instruments to administer to a larger sample. The transcendental phenomenology methodology was conducted for the qualitative portion of this study. According to Moustakas (as cited in Creswell & Poth, 2018), transcendental phenomenology consists of identifying a phenomenon, bracketing out one's prior

experiences to reduce the impact of the investigator on the research process, and collecting information from several individuals who have experienced the phenomenon of interest. Phenomenology is the appropriate technique for the qualitative part of this study since it minimizes the interpretations of the researchers and focuses on the participants' perceptions and experience of prescribing or making splints for adults with neurological conditions (Creswell, 2018).

Recruitment. OTs working in an adult rehabilitation setting with at least one year of experience directly working with neurologically impaired individuals were included in this study. Additional inclusion criteria for the study included having prescribed a neurological splint to at least one client within the last year. Therapists who received professional education outside of the United States and/or practiced outside of the United States were excluded from the study due to the different learning background and clinical perspectives. Therapists who retired from clinical practice were also excluded because of their potential inability to provide up-to-date information regarding the current trends in splinting.

Purposive sampling was used to identify participants for both the qualitative and quantitative portion of the study. This approach allows the researcher to select individuals for the study who can purposefully inform an understanding of the research problems and central phenomenon being examined (Creswell, 2018). Specifically, sampling strategies were used in the qualitative portion to identify four OTs who have been directly working with neurologically impaired adults and have prescribed or made neurological splints for at least one client within the last year in

order to ensure the sample met inclusion criteria. The potential participants were referred to this study through occupational therapy researchers from Eastern Kentucky University. The principle investigator contacted four purposefully selected participants via email or phone call to explain the study in more details and to schedule an interview. Interviews were conducted either in person or over the phone based on the participant's preference. All participants provided written informed consent or verbal consent over the phone before the beginning of data collection. Participants were informed that participation was voluntary and could be discontinued at any time.

For the quantitative portion of the study, non-probability, convenience sampling strategies were used to recruit participants due to its advantage of saving time and money. A recruitment document was posted on a professional online community, American Occupational Therapy Association (AOTA) CommunOT, and was also emailed to three professional organizations including: the Kentucky Occupational Therapy Association (KOTA), the Ohio Occupational Therapy Association (OOTA), and the Occupational Therapy, Physical Therapy, and Athletic Trainers Board (OTPTAT) for Ohio. A month after the initial post, thirteen potential participants from AOTA CommunOT signed up for the study by providing their name and contact information so that they could be emailed a link to the survey, with one person indicating an interest in the qualitative portion of the study. At the same time, the principle investigator received a list of Ohio OTs' email contact information from OTPTAT. In order to increase recruitment rate, alterations were made to the research protocol, with IRB approval, to revise the recruitment letter for the OTPTAT electronic mailing

list to include a direct link to the survey rather than asking participants to sign up to receive the link. The principle investigator emailed the 6,135 OTs on the OTPTAT list via the revised recruitment email through Survey Monkey, and initially 64 of these therapists completed the survey. After a week of the initial recruitment, a reminder email was sent to the therapists who did not respond. The number of survey responses then increased to 144. A second reminder email was sent to the rest of the therapists who did not respond after another week and the number of survey response increased to 246. The practice setting was not identified on the mailing list, which did not allow narrowing of study recruitment based on a client population.

Data collection. A semi-structured phenomenological interview guide was developed by the principle investigator to explore therapists' perceptions and experience of prescribing or making neurological splints (See Appendix A). Prior to data collection, the interview guide was reviewed by a committee member and was administered to a local experienced hand therapist who did not meet all inclusion criteria for additional feedback. A preliminary questionnaire was also developed by the principle investigator based on a thorough review of the literature. It contained 37 question items and was divided into four sections: (a) demographics, (b) current trends in neurological splinting at your facility, (c) clinical decision-making process of prescribing neurological splints, and (4) resources that support your splint-making process. The primary faculty adviser and committee members, who are three experienced OTs, evaluated and validated the questionnaire.

For the first portion of the study, four participants were purposefully selected to participate in a private interview based on their specialty, years of experience, and location to enable the researcher to involve a wide range of clinical experience and geography among the participants. At the convenience of the participants, one face-to-face interview, three phone interviews and one follow-up face-to-face interview were conducted by the principle investigator. All interviews were completed at a quiet place with minimal background noises of participants' choosing, including their home, workplace, a coffee shop, and Eastern Kentucky University. The average interview time was approximately 30 minutes. All interviews were audio recorded and then transcribed verbatim. Results from the interviews were used to guide the quantitative portion of the study.

After each initial interview, participants obtained the preliminary questionnaire and were asked to provide feedback for the purpose of piloting. Three of four interview participants completed the questionnaire. Based on early thematic analysis of the qualitative portion of the study and the pilot survey results, revision of the preliminary questionnaire was then made to the research protocol, with IRB approval, to promote the validity and reliability of the survey. The revised questionnaire was distributed online through Survey Monkey, a web-based survey system, to all potential participants. Survey Monkey as an online survey tool allows researchers to create their own surveys quickly using custom templates and post them on Web sites or email them to participants to complete (Creswell, 2018). It can generate results and report

them back to the researcher as descriptive statistics or as graphed information which can also be downloaded into a spreadsheet.

Data analysis. The qualitative portion of this study followed Creswell and Poth's (2018) phenomenological thematic analysis procedures with the following steps: (a) organize and prepare data files, (b) read through text and take notes, (c) identify codes and reduce codes to categories and themes, (d) relate themes to develop interpretations, and (e) create a point of view. Data collection and analysis were concurrent, meaning that the primary investigator began analysis of interview transcripts while still continuing to collect data through additional or follow-up interviews. Following the recorded interviews, the transcripts were hand coded by the principle investigator to obtain an initial impression. The total recording time of the four initial interviews and one follow-up interview was 125 minutes, which were transcribed into 51 pages. After reading the transcripts multiple times, patterns across transcripts were used to identify initial codes and reoccurring categories. Both a priori and in vivo coding were utilized in this study. A priori coding refers to the use of codes that are determined ahead of time based on a preexisting theory (Creswell & Poth, 2018). For instance, a priori codes in this study were "procedural reasoning", "interactive reasoning", and "conditional reasoning". In vivo codes, names that are the exact words used by participants, also emerged and were used to describe therapists' confidence level, participation in continued education, and their evidence based practice (Creswell & Poth, 2018). Nine early themes were developed from 45 meaning

units that emerged from 102 significant statements, and then were narrowed into three overall themes.

The quantitative data of this study was analyzed through using the "Analyze Results, Questions Summaries, and Data Exports" feature from Survey Monkey. Descriptive statistics were utilized for data analysis to determine frequency and percentages for any closed-ended responses on the survey, while open-ended survey responses (i.e. specify "other" answer options) were collated from all participants.

Trustworthiness. Several methods were employed to ensure rigor and validity. The principle investigator maintained a reflexive journal during the interview guide development phase to examine sources of potential biases that may have arisen in the qualitative portion of the study. Reflexivity is considered as a core characteristic of qualitative research in order to clarify the bias the researcher brings to the study (Creswell, 2018). Prior to data collection, the principle investigator recorded preconceived areas of concern that could affect the research process in order to increase her awareness and ability to limit the impact on the results. Examples of recorded ideas included the belief that OTs would use multiple types of clinical reasoning when treating neurologically impaired adults and how her role as a graduate student may influence the honesty and authenticity of therapists' answers regarding practice.

Peer debriefing was utilized as findings of qualitative data were discussed with the primary faculty advisor to confirm decisions and ensure an accurate analysis. The primary faculty advisor reviewed and asked questions about the qualitative study

throughout the data analysis process so that the account will resonate with people other than the primary investigator. In addition, according to Creswell (2018), the utilization of member checking can determine the accuracy of the qualitative findings through taking parts of the polished product back to participants and determining whether these participants feel that they are accurate. The principle investigator contacted all four participants to inquire about emerging themes two months after initial or follow-up interview to ensure that results were reflective of participants' experiences. Two of the four participants participated in member checking and confirmed the themes and overall findings from the research, but did not provide any new or additional data for the study.

For the quantitative portion of the study, the preliminary survey was developed based on literature review and was also reviewed and evaluated by the primary faculty advisor and committee members prior to administration of the instrument. Content validity is one of the three traditional forms of validity, which examines if the items measure the context they were intended to measure (Creswell, 2018). The primary faculty advisor and committee members all have rich experiences in working with individuals with neurological conditions and have prescribed splints for this population in the past. Therefore, the content validity of the survey was established since they were able to provide comments to ensure that the question items measured the trend of splinting, therapists' clinical reasoning, and available resources for therapists.

The survey in this research was pilot tested on the three OTs who participated in the first qualitative portion of this study. Pilot testing is an important step to ensure

validity of the survey instrument and to improve questions, format, and scales (Creswell, 2018). All three participants were asked to provide feedback regarding the design of the survey such as any questions that were confusing or any additional items they felt should be added to the survey. Only one participant provided feedback about the design of the survey. This therapist suggested that "elbow extension splint" should be added as an additional answer option under the question of commonly prescribed splint type. This respondent also stated that it was unclear if the answer option "working environment" referred to the client's working environment or the therapist's working environment. The revision and clarification was made based on this feedback to further support survey validity.

Qualitative Results

For the qualitative portion of this study, more than 30 participants were contacted for participation; however, only four individuals agreed to be interviewed. Among these four participants who are identified via pseudonym throughout this section, one is male and three are females, with an average of 21 years of clinical experiences (See Table 1). Three of the four participants (Bob, Jennifer, and Susan) were interviewed over the phone, while Mary completed face-to-face initial and follow-up interviews.

Table 1. Description of Interview Participants

Pseudonym	**Gender**	**Years of Practice**	**Primary Practice Setting**	**Primary Practice Location**	**Certified Hand Therapist**
Bob	Male	30	Outpatient Rehabilitation	Oregon	Yes
Mary	Female	7	Inpatient Rehabilitation	Kentucky	No
Jennifer	Female	26	Outpatient Rehabilitation	Ohio	Yes
Susan	Female	21	Neuro-rehabilitation (inpatient and outpatient)	North Carolina	No

From the data analysis, three themes emerged, and theme 1 was further divided into three sub-themes (See Table 2). Quotations are presented verbatim throughout the results section to support themes, and may include grammatical and other errors based on participants' words and phrases.

Table 2. Qualitative Themes

Theme	**Sub-themes**
1) Clinical Reasoning Guides Decision Making and Perceived Effectiveness of Splinting	• Procedural reasoning is always considered first • Interactive reasoning varies per therapists' personal clinical choices • Conditional reasoning is important for cognitive deficits
2) Contextual Factors Limit and Support Splinting Implementation	
3) Confidence Levels for Splinting Varies within the Individual	

Theme 1: Clinical reasoning guides decision making and perceived effectiveness of splinting. In discussing the process of making clinical decisions for prescribing or making neurological splints, all participants utilized procedural, interactive, and conditional reasoning with a variation of personal clinical choices.

Procedural reasoning is always considered first. All participants expressed that clients' symptoms were the first factor that they considered and measured prior to splint prescription. This permitted the therapists to identify the primary procedural recovery goal of the client based on their existing physical limitations. Mary stated: "I will do an initial evaluation and I usually know then if they are going to need one. I will check out their tone, their mobility, their passive and active range of motion." Other commonly measured physical client factors during the initial assessment mentioned by other participants were edema, muscle strength, sensation, pain level, skin integrity and hygiene.

Participants expressed that the most commonly prescribed splints they make for their neurologically impaired clients were a resting hand, wrist cock-up, elbow extension, and a prefabricated splint with extra padding. The main reason of prescribing resting hand splints was to reduce hypertonicity and prevent contractures. Jennifer and Bob also revealed that they usually fabricate some types of a resting hand splint for clients to wear throughout the day or during sleep at night to support hygiene, comfort, and skin care.

In discussing the perception of the effectiveness of splinting in individuals with neurological conditions, all participants expressed that high muscle tone which leads

to severe spasticity and contracture negatively impacts the effectiveness of this intervention. Two participants specifically mentioned that they found splinting to be ineffective when the client scored a two or more on the Modified Ashworth Scale. Two participants suggested that when the client's tone is "out of control," the addition of multiple interventions such as Botox injections are necessary for obtaining an optimal outcome. Additionally, one participant added that seizure disorder also significantly impacts the results of splinting.

The objective measurements that were used by all participants to evaluate the effectiveness of the splint they created for their clients included range of motion assessment, Upper Extremity Functional Index, ADL measurements, Box and Blocks, Fugl-Meyer, and fine motor assessments. Specifically, the focus on function and range of motion were mentioned by all participants. One participant added that she would also consider hygiene in the affected hand when evaluating the effectiveness of splinting.

Interactive reasoning varies per therapists' personal clinical choices.

Participants discussed the importance of understanding the client as an individual and viewing the experience of illness from his or her standpoint. Such understanding included the client's motivation and desire to follow through and wear the splint, personality, their functional needs, and hand dominance. Bob revealed that: "Traditionally what I will do is I will put them into a volar resting splint just to get them used to wearing the splint, at a pretty comfortable position without much of a stretch on it, and then once they understand what it's for and what they're wearing then I will

either do a static progressive or serial splinting." The level of clients' understanding and acceptance of the intervention was perceived to play a significant role in therapists' clinical decision and successful use of splints. An individual's personality was also considered as stated by Jennifer: "We will make things like their favorite football team colors. We've made splints to match tuxedos and prom dresses, and all kinds of things. Here, in Ohio, many people are big buckeye fans and so we fabricated some block Os out of the splint materials and we will patch those up and attach them to the splinting materials."

Although all participants demonstrated the use of interactive reasoning in the process of prescribing splints, varied personal choices and experiences led to different clinical decisions. Three participants claimed that they would not fabricate a splint if their client refused to wear one. Jennifer stated: "The biggest thing is just asking the patient before I even make one, 'Are you going to wear this splint?' and if the answer is no and they understand the reasons why, sometimes I don't even make the splint. Why bother if they are not going to wear them?" She also further expressed her rationale in the following statement: "I have declined to make one. If it is not going to work out, I don't believe in wasting benefits and resources for something that without a doubt is not going to work". Bob and Susan also revealed the same opinion which was that they would not proceed with this intervention if the clients refused to wear splints after they explained the benefits. However, on the other hand, Mary believed that it still worth a try even if the client has low interest in wearing a splint: "Sometimes they [clients] do quit wearing when they go home and the contracture

develops. But that does not prevent me from making one. Because I want to show that I tried very hard and document that I tried to educate. But it does not stop me from doing what client needs."

Moreover, certain aspects of interactive reasoning such as the client's hand dominance and functional use of hands were shown to be influenced by the setting where the therapists worked. Three participants who work at an outpatient rehabilitation or in neuro-rehabilitation expressed the importance of taking functional use of hands into consideration while prescribing a splint. Jennifer stated: "For me personally I don't like to splint any patients if they have functional use of their extremities." As Bob described a successful story of using splints, he mentioned that he made clinical decisions on the type of splints with a purpose of giving the client "a lot more functions to be able to use the hand for feeding or bathing." Susan discussed that she would be "a little bit more aggressive" with splinting when it is the client's dominant hand to obtain optimal functional gain. An interesting point she brought up was that the client could be "very motivated to maximize the function in her dominant hand" so she always made sure that "the splint would not interfere with the active use of that extremity." However, Mary who works at an inpatient rehabilitation setting had a different view: "Usually at my level, they [clients] are going to be in the acute phase still, so even if it's dominant or non-dominant, they are not very functional where they are at yet. So I am not really taking that into consideration as much as I want them to use both hands eventually."

Three participants expressed that the client's cognition, motivation and ability of following the wearing recommendations also play an important role in the effectiveness of neurological splints. Jenifer stated: "Sometimes it's [splinting] very effective and sometimes it isn't. Is the patient throwing the splint off as soon as they get it on? I've had patients come into the clinic wearing the splint on the wrong hand, wearing it on the dorsal surface when it should be on the palm."

Interactive reasoning was reported to play a role in the evaluation process of the effectiveness of the splint in conjunction with procedural reasoning. When the results of objective measurements display no significant differences, two participants expressed that they would take the client's subjective perception into consideration as well to evaluate if the splint was effective. A subjective change on the client's report or an improvement on Visual Analogue Scale were reported to be used to measure clients' subjective perception. Bob stated: "I think sometimes even though there's no objective measurement improvement but the patient just feels comfortable resting in a splint that puts them at a better position, or unloads the spasticity, than it can still be a beneficial splint." Although a client's subjective feeling cannot be used as a formal measurement, it imposes significant influences on therapists' perceptions of the effectiveness of the splint.

Conditional reasoning is particularly important for cognitive deficits.

Participants discussed the importance of considering assistance from clients' caregivers or team/staff members especially when the client has cognitive deficits or limited sensation. With neurological conditions, clients' capability of correctly wearing

a splint and following the wearing schedule varies, so whether they have the support they need from their caregivers or nursing stuff were reported as a significant factor for participants to consider. Bob stated: “If they [clients] have some cognitive impairments or physical impairments to take on and off the splint or manage the wear time, I’ll factor in do they have a care team or significant other or family member to assist them with it?” He also revealed the following: “I have had a couple patients where, because of their situation and caregiver support, I chose not to splint them.” Jenifer expressed the same opinion: “If they [clients] need assistance from a family member, and that family isn’t reliable, or they’re not willing, then that obviously is a factor to consider as well. If the patient doesn’t have good sensation, then they rely on the family member to do skin check.” Mary reported that if the client does not have adequate support or assistance from caregivers or the nursing staff, she would most likely cast the client instead of splinting: “If I was really worried about the splint was too difficult to put on, I could educate the staff there that day but sometimes they carry over for nights, like next shift, or night shift, like they don’t have time to train everyone. So sometimes I might go ahead and make a cast that is easy to put on or they don’t have to worry about it.”

In addition, one participant mentioned that she would consider what the doctor wants when making her own clinical decision on splinting. Another participant expressed that insurance plays a role in the clinical decision making process as well. When Susan was asked to describe a typical process of prescribing a neurological splint

for a client, she stated: “I usually do these [neurological splints] if they need something more immediate or if insurance does not cover anything else.”

Conditional reasoning was also used when therapists evaluate the effectiveness of the splint they prescribed or made. Three participants indicated whether the client had adequate caregiver support was a factor that could not be ignored when considering how efficient and useful the neurological splint is for the client.

Theme 2: Contextual factors limit and support splinting implementation.

While each participant worked at different settings across the U.S., all participants reported that they were able to access their desired splinting materials at the clinic where they worked, which is part of the physical environment. Two participants indicated that being connected to or working at a hand therapy clinic contributed to adequate resources for making neurological splints. For one participant, she expressed that although for the most part the desired materials were accessible, she had to be assertive about ordering materials and it can be a little bit challenging sometimes.

Within the social environment, other professionals, colleagues and supervisors were viewed as great resources by participants. Bob stated: “I do [feel like I have enough support] because I have a good clinic and our supervisor manager really trusts our clinical judgement. So if I feel like I need additional time to make a splint, I can allot that for that patient.” Due to the nature of high muscle tone in clients with neurological conditions, two participants mentioned that the need of extra help during splinting could be challenging since it would take up to three people to fabricate a splint when the client was very spastic.

Moreover, educational resources play an important role in supporting clinical practitioners' competence of prescribing or making neurological splints which is related to the effectiveness. Participants overwhelmingly expressed the concern of limited continuing education opportunities on making splints for the population with neurological conditions. Two participants discussed the importance of attending continuing education courses that focus on developing therapists' neurological splinting skills rather than orthopedic based splints. One participant also mentioned that the high cost of these professional courses prevented her from obtaining continuing education on this specific intervention. As an experienced OT and certified hand therapist, Jennifer taught some of the splinting courses herself. She brought up another interesting point: "I also feel very strongly that it [the splinting course] should be a hands-on course. That is not something that you can really do online because you've got to make a splint, you've got to get your hands on the materials, you need to understand the different types of materials and what their focuses are." She believed that learning needs to occur in the physical environment instead of just the virtual context due to the hands-on nature of splinting processes.

Furthermore, peer-reviewed research articles are another significant learning resource that can support therapists' use of interventions in the clinic. Although participants were aware of the importance of searching for evidence using online databases within the virtual context, they expressed that they do not find themselves looking up literature online on a regular basis. Susan indicated that she would only read some of her co-worker's publications on spasticity. Jenifer stated: "I value

research, I understand research, but I'm not good at utilizing it." Similarly, Mary said the following: "If it's something specific, I would say [I search for evidence] only a couple times of a year because I see a lot of the same things often."

The other participant, Bob, who was a member of his professional organizations brought up an interesting point that although he does not actively seek out evidence in literature, he would regularly review splinting articles from these professional organization journals due to the convenience. Reading the research articles that were published in his professional organization journals permitted him to consider how the newest study results on splinting could be applied to his clinical practice.

Within the discussion of the frequency of searching for evidence, two participants mentioned the use of trial and error techniques during the implementation of this intervention in clients with neurological conditions. Mary stated: "I think I use a lot of trial and error and look up [evidence] when I am getting more error than the desired outcome." Additionally, two participants also expressed that they would search for information from non-research based sources in the virtual context including Google and YouTube, especially when they needed to fabricate a splint that they have never made before. Overall, inadequate searching for evidence, especially peer-reviewed studies, was demonstrated among all participants.

Theme 3: Confidence levels for splinting varies within the individual. When discussing how confident the therapists are in creating customized neurological splints, the answers varied from participant to participant. The two participants who are not

certified hand therapists indicated limited confidence level in neurological splinting. Susan stated that: “[I am] not as confident as an orthopedic [OT].” She expressed that for her the hardest part was to ensure the client maintained and held the position during molding. She felt as though she had enough knowledge but lack of confidence in the actual making of the splint. For the other participant, Mary, she felt confident in her commonly made splints such as resting hand and elbow extension splints, however, she reported that she was not confident at all with dynamic splints.

Among the two certified hand therapists, both with over 25 years of clinical experience, Jenifer felt “very confident” while Bob rated his confidence level as “medium”. Bob stated: “Every patient is dramatically different, with neurological patients, so you really do come at each one with a totally different perspective.” He also said the following: “It’s more of a personality thing, I tend to just worry about if I’m doing a good job.”

In the discussion of what factors contribute to a therapist’s confidence level, the majority of participants expressed that the experiences of making splints imposed positive influences on their confidence level, as well as the reheatable nature, or memory, of the splinting materials. Two participants reported that being able to reheat and remold the splint led to less pressure, which improved their confidence in making splints for neurologically impaired clients. In contrast, Bob believed that his 30 years of experiences of creating neurological splints did not improve his confidence level: “I think success gives confidence, but I think because they’re so individualized, it’s hard to extrapolate ‘I did well on this, I’ll do well on this.’”

Susan also mentioned that the lack of research showing the effectiveness of splinting negatively affects her confidence level of making neurological splints: "Somewhat I don't really feel that research shows it's effective but I still feel like I need to do something to provide some intervention, especially if there's starting to be an issue with skin or range of motion." It appeared that therapists' confidence level in making neurological splints was highly subjective and could be influenced by hands-on experiences, personality, and amount of research evidence supporting this intervention.

Quantitative Results

Response rate. Figure 1 demonstrates the participation rate of the quantitative portion of the study. The survey was distributed to 6,135 OTs total as the researchers were unable to narrow participants based on practice setting and age group of patients served; the initial sample likely included a large number of individuals who would not be eligible to respond to the survey due to not providing occupational therapy services for patients with neurological conditions or due to not treating adults, who were the focus of this current study. Two hundred and forty-six participants entered the online survey, and 223 of them responded to at least some of the question items on the survey. This resulted in an overall response rate of 4% from the initial 6,135 therapists who were contacted, and a 91% response rate for those participants who entered the survey. Several participants stopped the survey after answering the first 13 demographic questions due to their inability to meet further

inclusion criteria for the study as later questions required participants to provide splints for patients with neurological conditions in addition to general occupational therapy services for this population. The percentage of survey respondents who currently provided splints for adult patients with neurological conditions was 58%. One hundred and twenty-nine participants (52%) completed further questions on the survey and one hundred and four participants (42%) completed the survey in full.

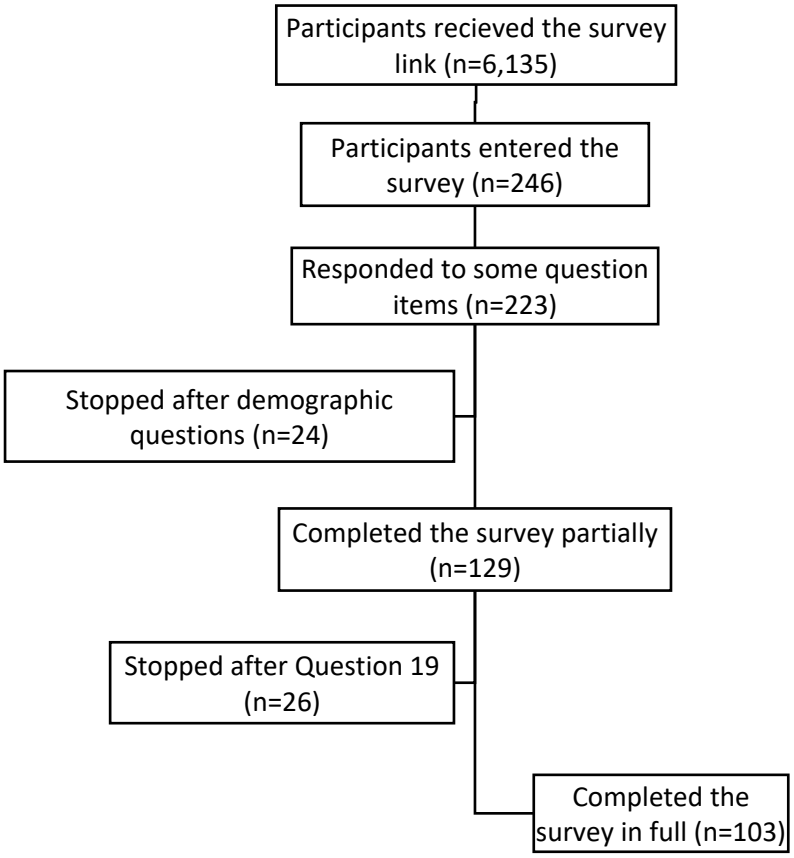

Figure 1. Flow of participants in the qualitative portion of the study

Participant demographics. Table 3 shows the distribution of the study participants' demographic information. The vast majority of participants were female

(n=222; 194, 87.39%). Most participants were 50 to 59 years old (n=222; 71, 31.98%), followed by 30 to 39 years old (51, 22.97%), 40 to 49 years old (46, 20.72%), and 20 to 29 years old (32, 14.41%). The majority of respondents had obtained a master's degree as their highest level of education (n=222; 114, 51.35%), followed by a bachelor's degree (89, 40.09%). One individual provided a unique response in the "other" category as being in the process of completing a doctorate degree. Since the recruitment mailing list was obtained from the OTPTAT Board, the vast majority of respondents reported Ohio (n=220; 188, 85.45%) as their primary state of practice. However, there were a few participants who were practicing in 18 other states across the U.S. such as Indiana (5, 2.27%), West Virginia (4, 1.82%), Pennsylvania (3, 1.36%), Connecticut (2, 0.91%), Florida (2, 0.91%), and Washington (1, 0.45%). Most therapists primarily practiced in a skilled nursing facility (n=222; 51, 22.97%) or in outpatient rehabilitation (49, 22.07%). Among 62 participants who selected "other", the reoccurring answer was home health which was indicated by 27 participants. The majority of respondents had been practicing as a registered OT for over 20 years (n=223; 104, 46.64%), followed by 6 to 10 years (28, 12.56%), 2 to 5 years (26, 11.66%), and 16 to 20 years (24, 10.76%). Only 20 (n=222; 20, 9.01%) participants were certified hand therapists and most of them had either been practicing as a hand therapist for over 20 years (n=20; 7, 35%) or 6 to 10 years (6, 30%).

Table 3. Descriptive Characteristics of Participants in the Study

Category	**n (%)**
Gender	
Male	28 (12.61%)
Female	194 (87.39%)
Age	
20-29	32 (14.41%)
30-39	51 (22.97%)
40-49	46 (20.72%)
50-59	71 (31.98%)
60-69	20 (9.01%)
70-79	2 (0.90%)
Level of education	
Bachelor's	88 (39.64%)
Master's	113 (50.90%)
Clinical doctorate	16 (7.21%)
Research doctorate	2 (0.90%)
Other	3 (1.35%)
Primary region of practice	
AZ	1 (0.45%)
CO	1 (0.45%)
CT	2 (0.91%)
DE	1 (0.46%)
FL	2 (0.91%)
GA	2 (0.91%)
IL	2 (0.91%)
IN	5 (2.27%)
KY	2 (0.91%)
ME	1 (0.45%)
MD	1 (0.45%)
MI	1 (0.45%)

Table 3 (continued)

Category	**n (%)**
Primary region of practice	
OH	188 (85.45%)
PA	3 (1.36%)
SC	1 (0.45%)
TN	1 (0.45%)
WA	1 (0.45%)
WV	4 (1.82%)
WI	1 (0.45%)
Primary setting	
Acute care	34 (15.32%)
Inpatient rehabilitation	26 (11.71%)
Outpatient rehabilitation	49 (22.07%)
Skilled nursing facility	51 (22.97%)
Neurorestorative	0 (0.00%)
Other	62 (27.93%)
Years of practicing as an occupational therapist	
<1 year	5 (2.24%)
1-<2 yr.	14 (6.28%)
2-5 yr.	26 (11.66%)
6-10 yr.	28 (12.56%)
11-15 yr.	22 (9.87%)
16-20 yr.	24 (10.76%)
>20 yr.	104 (46.64%)
Certified hand therapist	
Yes	20 (9.01%)
No	202 (90.99%)

Table 3 (continued)

Category	**n (%)**
Years of practicing as a certified hand therapist	
<1 year	4 (16.17%)
1-<2 yr.	0 (0.00%)
2-5 yr.	5 (20.83%)
6-10 yr.	6 (25.00%)
11-15 yr.	1 (4.17%)
16-20 yr.	1 (4.17%)
>20 yr.	7 (29.17%)

Table 4 displays participants' clinical experiences with the neurologically impaired population. The majority of respondents had over 20 years of experiences directly treating adult clients with neurological conditions (n=218; 70, 32.11%), followed by 6 to 10 years (36, 16.51%) and 11 to 15 years (32, 14.68%). Most of them reported that that they spent 1 to 5 hours per week working with this population (n=221; 74, 33.48%). A considerable number of participants prescribed or made neurological splints for less than 10% of their clients (n=220; 116, 52.73%), followed by 10% to 20% (45, 20.45%) and 21% to 30% (37, 16.82%).

Table 4. Participants' Experience with Neurological Conditions

Category	**n (%)**
Years of directly working with neurologically impaired adults	
<1 yr.	15 (6.88%)
1-<2 yr.	17 (7.80%)
2-5 yr.	29 (13.30%)
6-10 yr.	36 (16.51%)
11-15 yr.	32 (14.68%)
16-20 yr.	19 (8.72%)
>20 yr.	70 (32.11%)
Hours per week seeing clients with neurological conditions	
<1 hr.	44 (19.91%)
1-5 hr.	74 (33.48%)
6-10 hr.	34 (15.38%)
11-15 hr.	25 (11.31%)
16-20 hr.	16 (7.24%)
>20 hr.	28 (12.67%)
Percentage of clients receiving neurological splints	
<10%	116 (52.73%)
10%-20%	45 (20.45%)
21%-30%	37 (16.82%)
31%-40%	4 (1.82%)
41%-50%	6 (2.73%)
51%-60%	7 (3.18%)
61%-70%	1 (0.45%)
71%-80%	0 (0.0%)
>80%	4 (1.82%)

Current trends in splinting. This section of the survey includes questions that requested participants to rank their responses regarding their clinical experiences and professional opinions. The results of these ranking questions were calculated through the average ranking for each answer choice to determine which answer choice was most preferred overall. The answer choice with the largest average ranking was the most preferred choice. When W= weight of ranked position and X=response count for answer choice, the average ranking was calculated as the following: $(X_1W_1 + X_2W_2 + X_3W_3 \ldots + X_nW_n)/Total$. The participants' most preferred choice (which they ranked as #1) has the largest weight and their least preferred choice (which they rank in the last portion) has a weight of 1. Using Table 5 as an example, since the ranking question had 6 item choices, weights were assigned where the number 1 choice had a weight of 6 and the number 5 choice had a weight of 1. With a total of 123 respondents who ranked "Stroke" somewhere within their answer, the average ranking for "Stroke" (Weighted Average) was 5.52, which made it the most preferred answer choice among all six of them.

Table 5. Ranking Results of Common Diagnoses that Require Splints

	1	2	3	4	5	6	Total Responses	Weighted Average
Stroke	73.98% 91	15.45% 19	4.88% 6	2.44% 3	0.81% 1	2.44% 3	123	5.52
TBI	3.45% 4	39.66% 46	29.31% 34	15.52% 18	10.34% 12	1.72% 2	116	4.05
SCI	12.17% 14	17.39% 20	20.87% 24	32.17% 37	13.91% 16	3.48% 4	115	3.71
MS	0.88% 1	19.47% 22	24.78% 28	33.63% 38	14.16% 16	7.08% 8	113	3.38
ALS	3.51% 4	5.26% 6	10.53% 12	7.89% 9	53.51% 61	19.30% 22	114	2.38
Other	10.31% 10	6.19% 6	11.34% 11	7.22% 7	5.15% 5	59.79% 58	97	2.30

Note. 1 being most common and 6 being least common

Therefore, in the discussion of the most common diagnosis that required neurological splinting, stroke was ranked as the number 1 (n=123; weighted average=5.52), followed by TBI (n=116; weighted average =4.05) and SCI (n=115; weighted average=3.7; see Table 5). Among the 100 responses for the open-ended question item “other”, 23 participants (23%) responded with “N/A” or “none.” Some other commonly mentioned diagnoses that required splints were orthopedic conditions (16, 16%), dementia (14, 14%), nerve injury (12, 12%), arthritis (8, 8%), Cerebral Palsy (6, 6%), and Guillain Barre Syndrome (5, 5%).

Functional resting splint (n= 128; weighted average=6.74), wrist extension splint (n=119; weighted average=5.64), and elbow extension splint (n=108; weighted average=4.54) were reported by the respondents as the top three types of splints that

were most commonly prescribed or made, as demonstrated in Table 6. While the top three selected splints were all static splints, dynamic splints were ranked fourth following the wrist extension splint (n= 95; weighted average=3.66). There were 91 responses for the "other" category. Finger splints such as the thumb spica was the most commonly mentioned answer (28, 30.77%). 36 participants (39.56%) provided "none" as the answer for "other".

Table 6. Ranking Results of Common Types of Splints

	1	2	3	4	5	6	7	Total Responses	Weighted average
Functional Resting Splint	82.81% 106	13.28% 17	2.34% 3	0.00% 0	0.78% 1	0.00% 0	0.78% 1	128	6.74
Wrist Extension Splint	6.72% 8	61.34% 73	22.69% 27	7.56% 9	1.68% 2	0.00% 0	0.00% 0	119	5.64
Elbow Extension Splint	0.93% 1	20.37% 22	36.11% 39	25.00% 27	11.11% 12	4.63% 5	1.85% 2	108	4.54
Dynamic Splint	4.21% 4	5.26% 5	16.84% 16	23.16% 22	31.58% 30	14.74% 14	4.21% 4	95	3.66
Weight Bearing Splint	1.04% 1	3.13% 3	14.58% 14	27.08% 26	35.42% 34	14.58% 14	4.17% 4	96	3.47
Other	6.33% 5	5.06% 4	8.86% 7	11.39% 9	6.33% 5	2.53% 2	59.49 %47	79	2.48
Serpentine Splint	2.17% 2	0.00% 0	1.09% 1	5.43% 5	9.78% 9	57.61% 53	23.91 % 22	92	2.11

Note. 1 being most common and 7 being least common

Ninety-six participants (75.59%) reported that thermoplastic was their most commonly used splinting material, followed by Lycra or neoprene (39, 30.71%) and other (37, 29.13%; see Figure 2). Among 37 participants who selected "other", 25 participants (67.57%) specified that they commonly used prefabricated material. The rest of the responses included always use a vendor (3, 8.11%), polyform (1, 2.7%), multi-position and moldable (1, 2.7%), bendable splints from DME catalog (1, 2.7%), dynapro line (1, 2.7%), orthoplast (1, 2.7%), casting (1, 2.7%), and piano wire (1, 2.7%). There was one individual who selected "other" but did not provide a response to this question item.

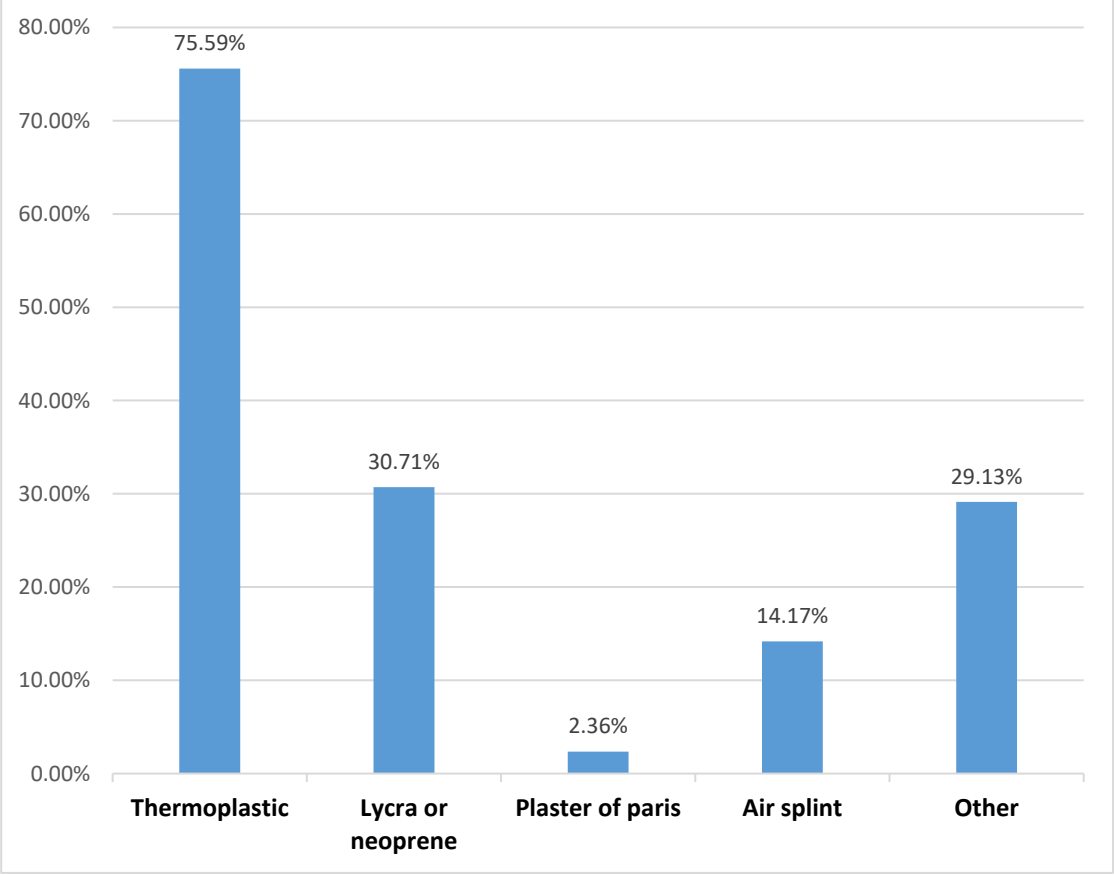

Figure 2. Commonly used splinting materials

Effectiveness of splinting. Participants most frequently perceived splinting as moderately effective in clients with neurological impairments (41, 39.42%; see Figure 3). Thirty-one therapists (29.81%) considered splinting as somewhat effective and 22 of them (21.15%) believed that splinting was effective. Only 10 respondents (9.62%) rated splinting as extremely effective.

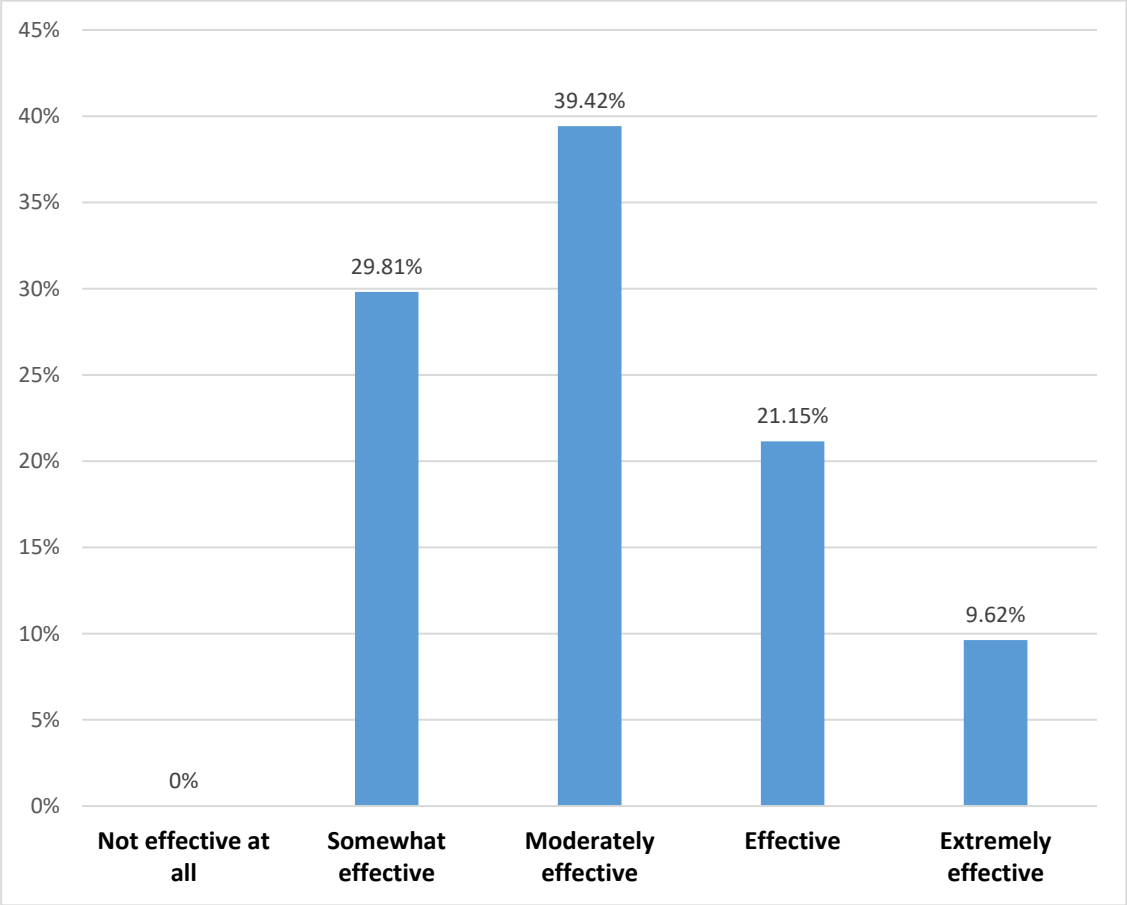

Figure 3. Effectiveness of splinting

When the participants were asked to rank the factors that impacted the effectiveness of neurological splints (See Table 7), clients' physical condition (n=103; weighted average=5.29) was selected as number one, followed by clients' personal traits such as participation and personal preference (n=102; weighted average=4.53),

caregivers' participation when the client has cognitive deficits (n=102; weighted average=4.05), therapists' splinting skill level (n=97; weighted average=3.23), type of splint (n=90; weighted average=3.10), and other factors (n=72; weighted average=1.18).

Table 7. Ranking Results of Factors that Affect Effectiveness of Splinting

	1	2	3	4	5	6	Total Responses	Weighted Average
Clients' Physical Condition	65.05% 67	13.59% 14	11.65% 12	5.83% 6	2.91% 3	0.97% 1	103	5.29
Clients' Personal Traits	20.59% 21	37.25% 38	24.51% 25	10.78% 11	5.88% 6	0.98% 1	102	4.53
Caregivers' Participation	5.88% 6	28.43% 29	38.24% 39	19.61% 20	7.84% 8	0.00% 0	102	4.05
Therapists' Splinting Skill Level	6.19% 6	8.25% 8	19.59% 19	38.14% 37	23.71% 23	4.12% 4	97	3.23
The Type of Splint	4.44% 4	16.67% 15	8.89% 8	25.56% 23	43.33% 39	1.11% 1	90	3.10
Other Factors	0.00% 0	1.39% 1	0.00% 0	1.39% 1	9.72% 7	87.50% 63	72	1.18

Note. 1 being most important and 6 being least important

A follow-up open-ended question asked participants to specify what types of splint they believed impact the effectiveness of this intervention. The majority of the responses indicated a specific kind of splint such as resting hand, saebostretch dynamic splint, and dynasplint (n=72; 27, 37.50%). Although most of them did not explain how the specific splint influences the outcomes, some participants expressed

opposite opinions in this open-ended question item. For example, one therapist claimed that “resting hand splints and hand roll/palm protectors are the most effective”; however, another two participants believed that resting hand splints were ineffective in tone management. The ease of application (7, 9.72%) and softness and moldability (4, 5.56%) of certain type of splints were also considered as important components by some of the participants.

Among the 69 participants who provided an open-ended answer for “other” factors that impact the effectiveness of splinting, 10 unique responses (14.49%) emerged such as insurance coverage (5, 7.25%) and conjunction interventions (1, 1.45%). One respondent mentioned that what other staff think about the particular splint plays a role too since “if the aids don’t like them [the splint], they tend to disappear” (1.45%).

Furthermore, in terms of evaluating the effectiveness of the splint, participants ranked functional outcome (n=101; weighted average=4.12), clients’ subjective feelings (n=102; weighted average=3.83), and objective measurements such as ROM assessment (n=101; weighted average=3.38) as the top three considerable factors (See Table 8). Hygiene was the fourth factor that participants consider (n=101; weighted average=2.61) when evaluating clients’ outcomes from wearing the splints they prescribed or made for them, followed by “other” (n=70; weighted average=1.11). Out of 60 participants who specified their choice of “other” important factors, 7 individuals provided unique answers (11.67%) for evaluating the effectiveness of the splint which were cosmesis (3, 5.00%), skin integrity (3, 5.00%), and cost (1, 1.67%).

Table 8. Ranking Results of Evaluation of Effectiveness of Splinting

	1	2	3	4	5	Total Responses	Weighted Average
Functional Outcome	52.48% 53	22.77% 23	10.89% 11	11.88% 12	1.98% 2	101	4.12
Clients' Subjective Feelings	25.49% 26	39.22% 40	28.43% 29	6.86% 7	0.00% 0	102	3.83
Objective Measurement	16.83% 17	27.72% 28	32.67% 33	21.78% 22	0.99% 1	101	3.38
Hygiene	5.94% 6	9.90% 10	25.74% 26	56.44% 57	1.98% 2	101	2.61
Other	0.00% 0	1.43% 1	2.86% 2	1.43% 1	94.29% 66	70	1.11

Note. 1 being most important and 5 being least important

Clinical reasoning. Among the 105 respondents who answered the question item regarding the frequency of taking the client's diagnosis such as stroke and TBI into consideration during clinical reasoning, the majority of them reported that they always considered the client's diagnosis (54, 51.43%) before deciding to prescribe or make a neurological splint for their clients (See Figure 4). 26 participants (24.76%) reported that they often considered the diagnosis and 18 participants (17.14%) sometimes took it into consideration. Interestingly there were 2 individuals (1.90%) who selected the answer option stating that they never considered a client's diagnosis when making their clinical decisions on neurological splinting.

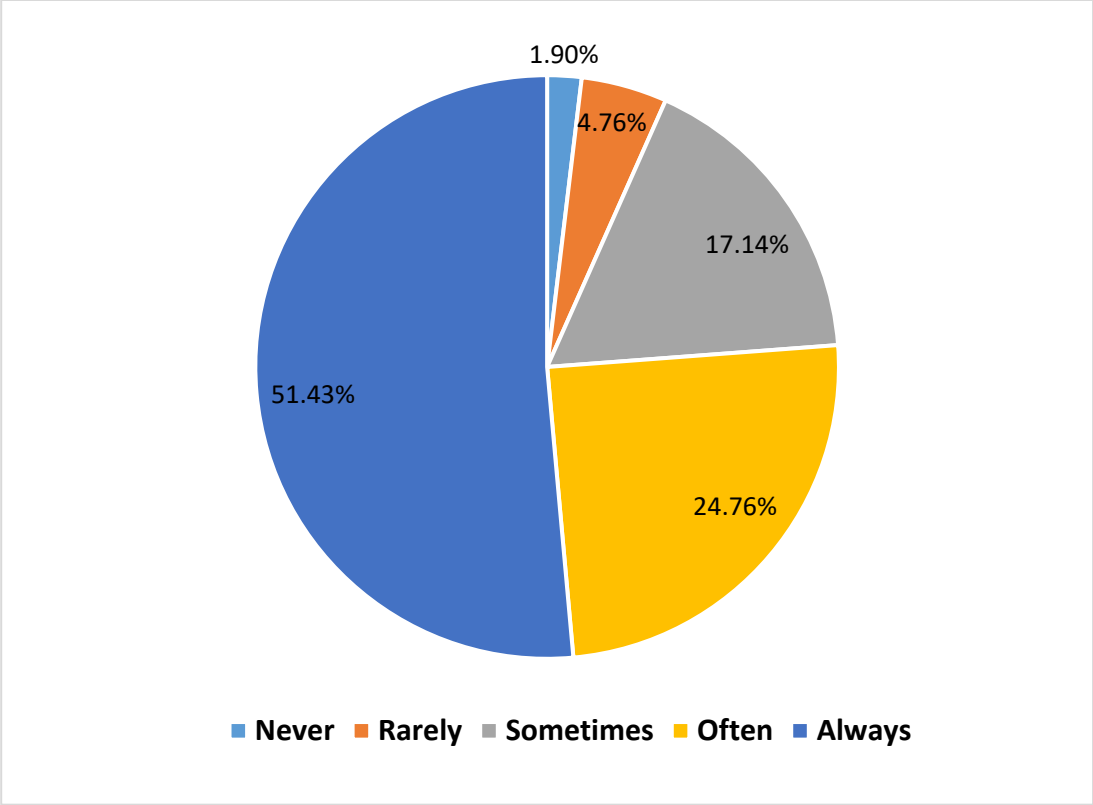

Figure 4. Frequency of considering clients' diagnosis for clinical reasoning

The vast majority of participants (n=105; 90, 85.71%) always considered clients' symptoms such as contracture and ROM when prescribing or making a neurological splint, followed by often (14, 13.33%) and sometimes (1, 0.95%; see Figure 5). Among variety of the symptoms, skin integrity was viewed as the most important symptom to consider by most participants (n=106; 31, 29.25%) when making splinting choices, followed by contracture (23, 21.70%) and spasticity (20, 18.87%; see Figure 6). While 10 participants provided responses to "other", 6 of them (60%) mentioned the importance of considering the client's functional or outcome potential.

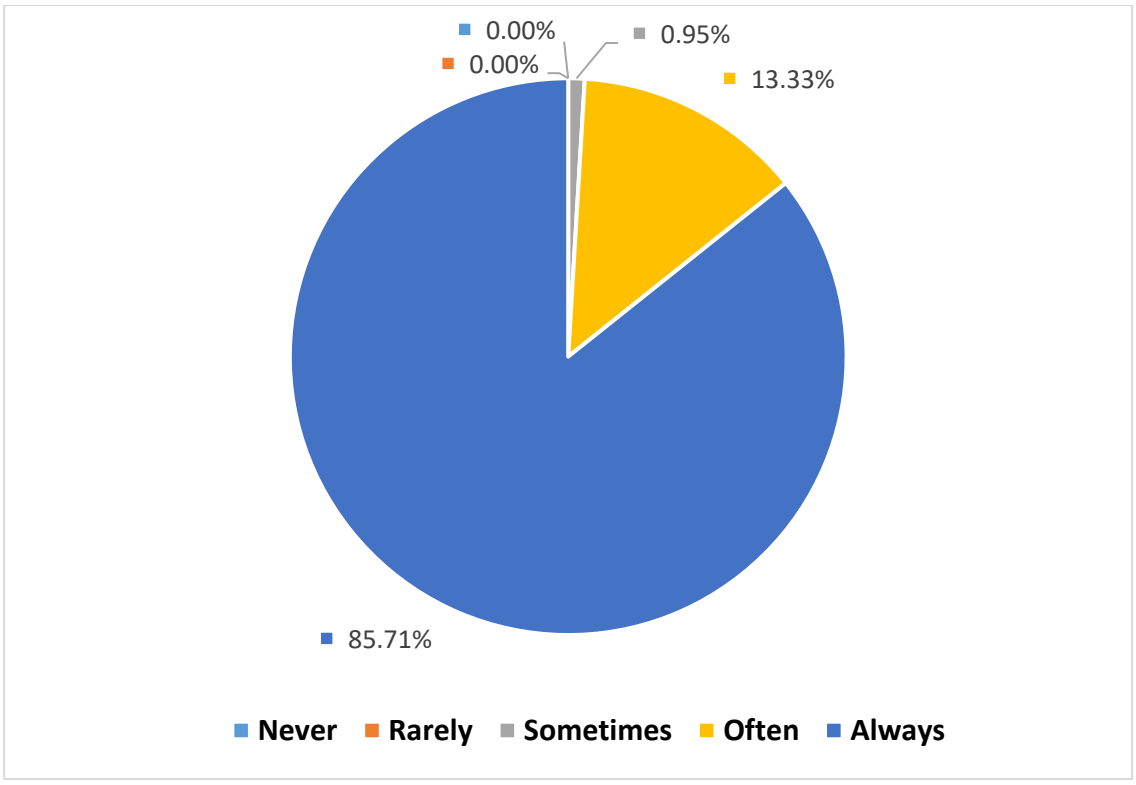

Figure 5. Frequency of considering clients' symptoms for clinical reasoning

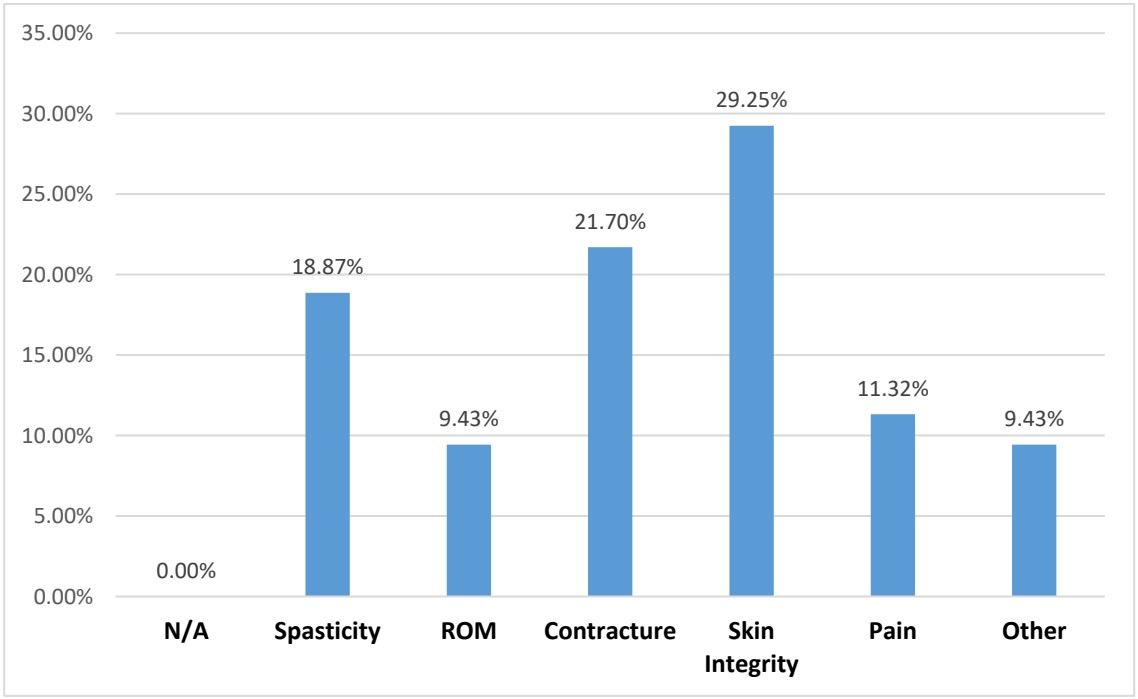

Figure 6. The most important symptom to consider during clinical reasoning

There were 58 participants (n=106, 54.72%) who reported that they always consider client factors such as the client's age, personal preference, and knowledge about the splint when making splinting choices, and 36 participants (33.96%) who selected "often" for this question item (See Figure 7). A small amount of respondents claimed that they never (2, 1.89%) or rarely (2, 1.89%) took client factors into consideration during their clinical decision process on neurological splinting. The client's cognition was selected by most therapists as the most important client factor to consider for splinting (n=104; 32, 30.77%), followed by clients' personal preference (29, 27.88%) and clients' knowledge about the splint such as wearing schedule and care (28, 26.92%; see Figure 8). Only 1 out of 9 (11.11%) participants who specified the "other" category offered a unique response, which was to consider the client's functional goals.

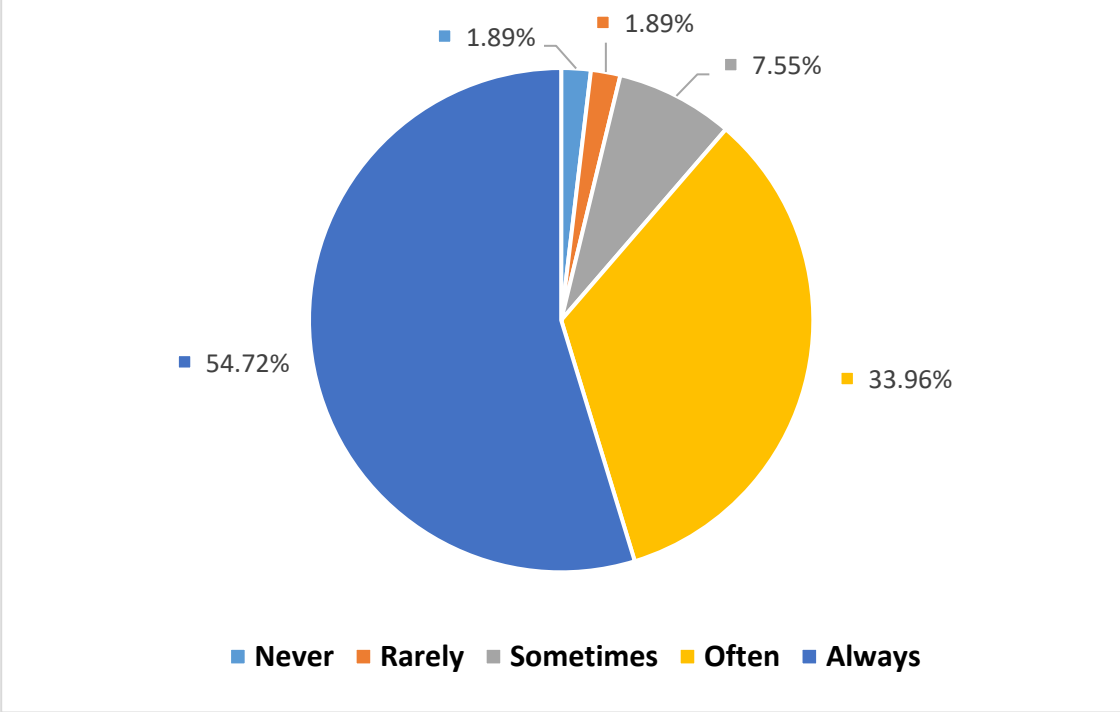

Figure 7. Frequency of considering client factors for clinical reasoning

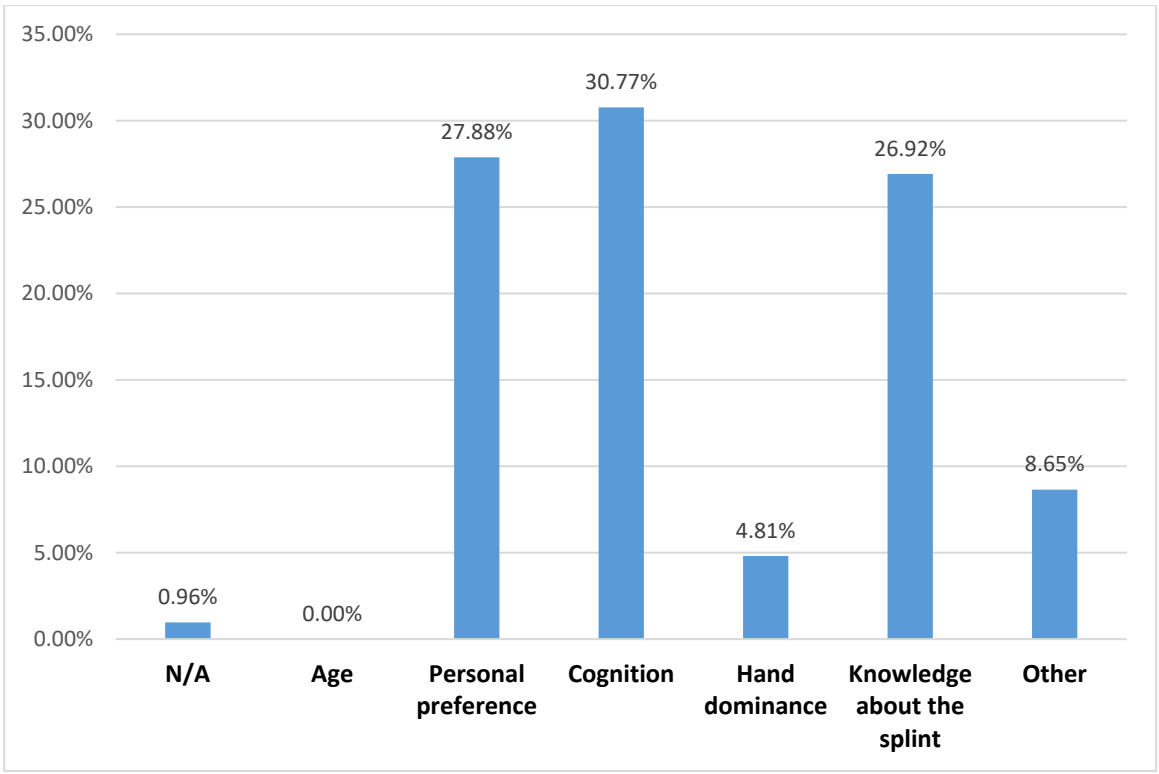

Figure 8. The most important client factor to consider during clinical reasoning

Contextual factors such as caregivers' support and home environment were always considered by the majority of the therapists when making splinting choices (n=105; 56, 53.33%; see Figure 9). Thirty-five respondents (33.33%) selected "often" in terms of taking this element into consideration. However, 2 respondents (1.90%) reported that they never considered clients' contextual factors during their practice. In addition, the vast majority of participants believed that the caregiver's attitude towards splinting when the client had cognitive deficits was the most important contextual factor when it came to neurological splinting (n=106; 81, 76.42%), followed by home environment (13, 12.26%) and other (10, 9.43%; see Figure 10). Among the 10 participants who selected "other", no response that was different from the provided options emerged. However, one person stated in this open-ended question

item that “I know that caregivers at the facility where I work will often not be consistent in applying the splint, but I make the splints anyway if I think they will benefit the client when they are used.”

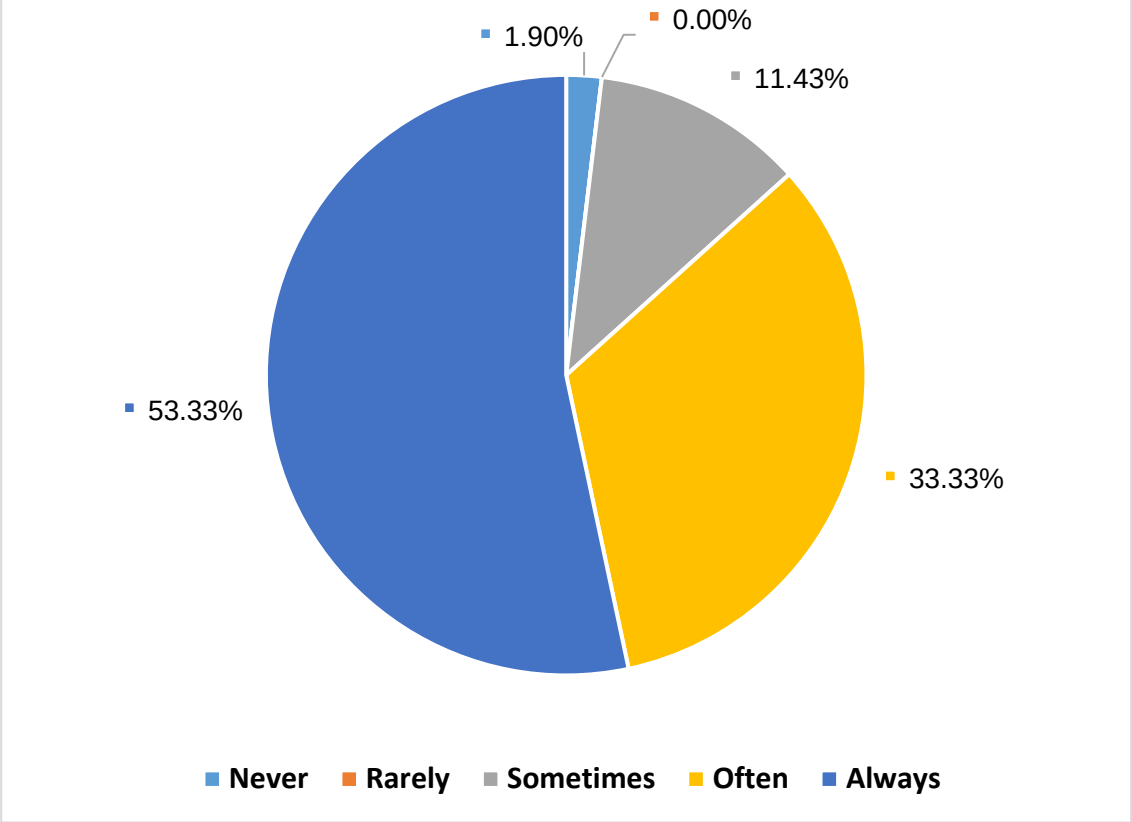

Figure 9. Frequency of considering contextual factors for clinical reasoning

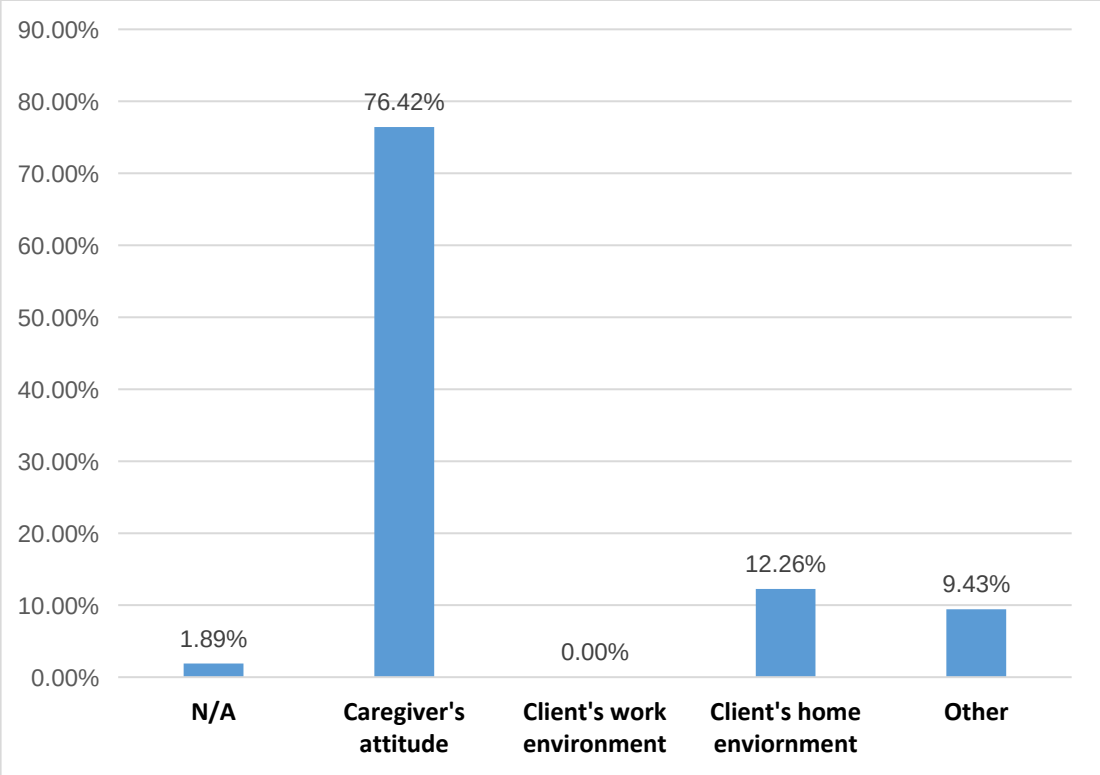

Figure 10. The most important contextual factor to consider during clinical reasoning

Therapists' competence. Participants most frequently reported that they were moderately knowledgeable in splint fabrication (n=103; 44, 42.72%), followed by knowledgeable (24, 23.30%) and somewhat knowledgeable (23, 22.33%; see Figure 11). Moreover, among 104 therapists, most of them reported that they were moderately confident in creating custom-made neurological splints (40, 38.46%; see Figure 12). Twenty-two participants (21.15%) believed that they were somewhat confident in their neurological splinting skills and another 22 participants (21.15%) rated themselves as confident. While 11 therapists (10.58%) felt they were extremely confident on this item, there were 9 participants (8.65%) who reported that they were not confident at all in creating neurological splints for their clients.

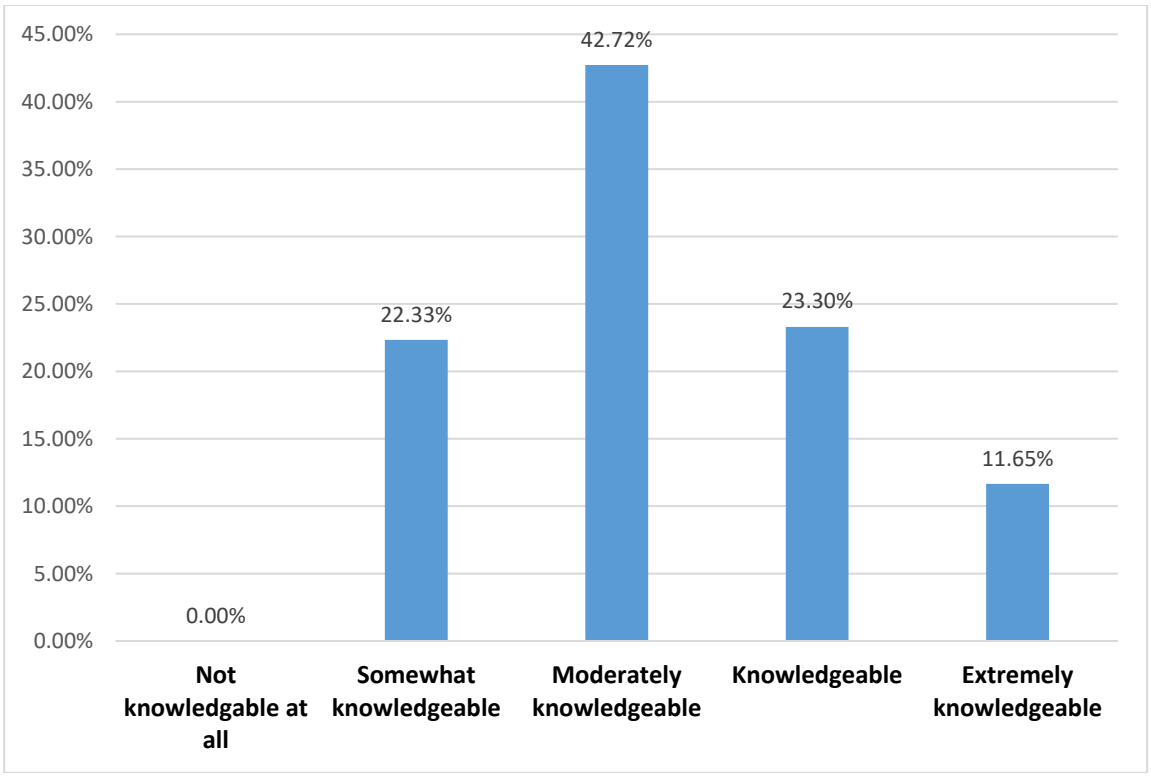

Figure 11. Knowledge level in splint fabrication

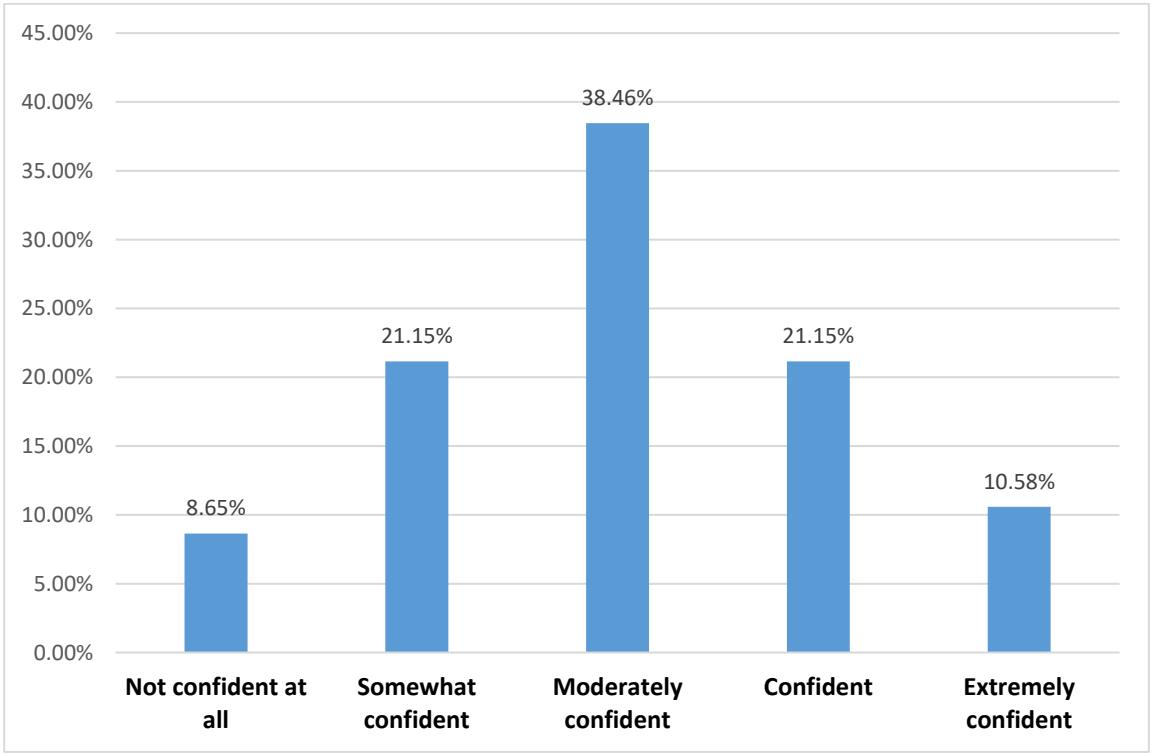

Figure 12. Confidence level in creating custom-made neurological splint

Resources. Most therapists reported that the desired splint materials were extremely accessible (n= 104; 25, 24.5%), somewhat accessible (25, 24.5%) and accessible (19, 18.27%) at their facilities (See Figure 13). While the number of participants who selected each option for this item question was not dramatically uneven, 18 respondents (17.31%) reported that the desired splint materials were not accessible at all at the facility where they worked.

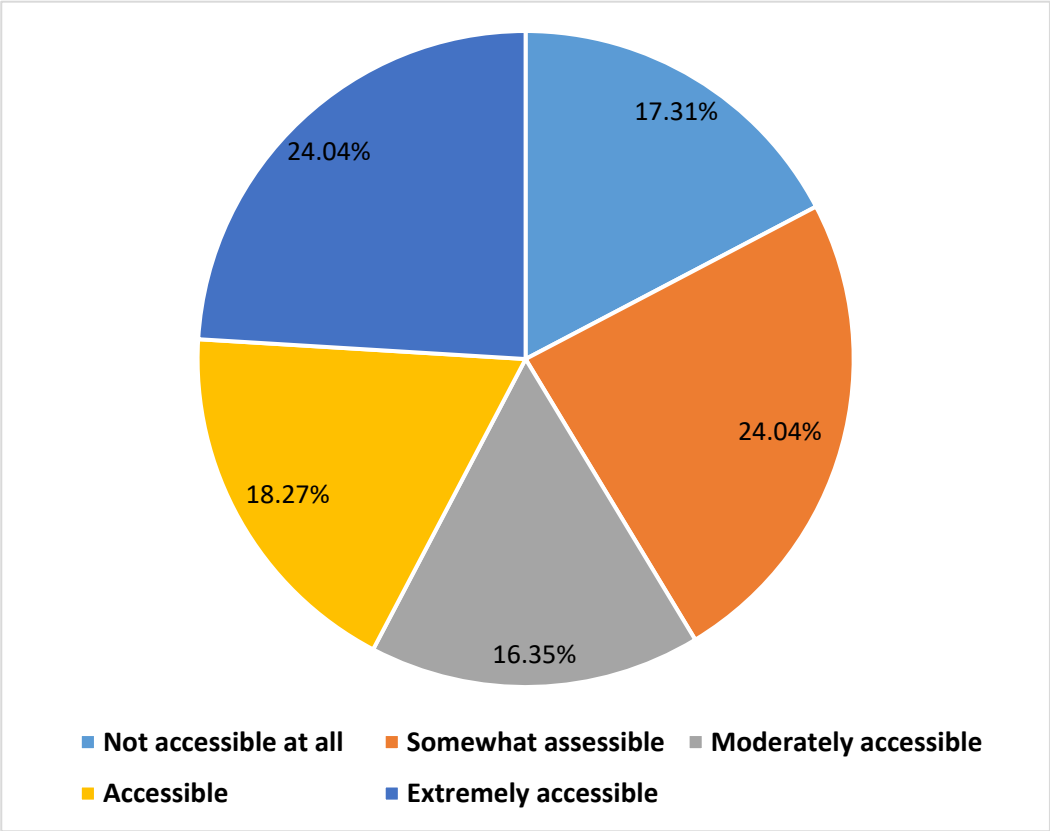

Figure 13. Accessibility of desired splinting materials

University education was voted as the top primary source of splint fabrication knowledge (n=104; 60, 57.69%), followed by attending splint courses (48, 46.15%) and joint sessions with colleagues (41, 39.42%; see Figure 14). There were also 36

participants (34.62%) who obtained fabrication knowledge through independent learning such as reading or watching online videos. Thirty-three participants (31.73%) reported that they utilized a trial and error approach. Four out of 10 participants (40%) who selected “other” mentioned the importance of practice. Three individuals (30%) also pointed out that working at a hand therapy clinic was considered as their primary source of splinting knowledge.

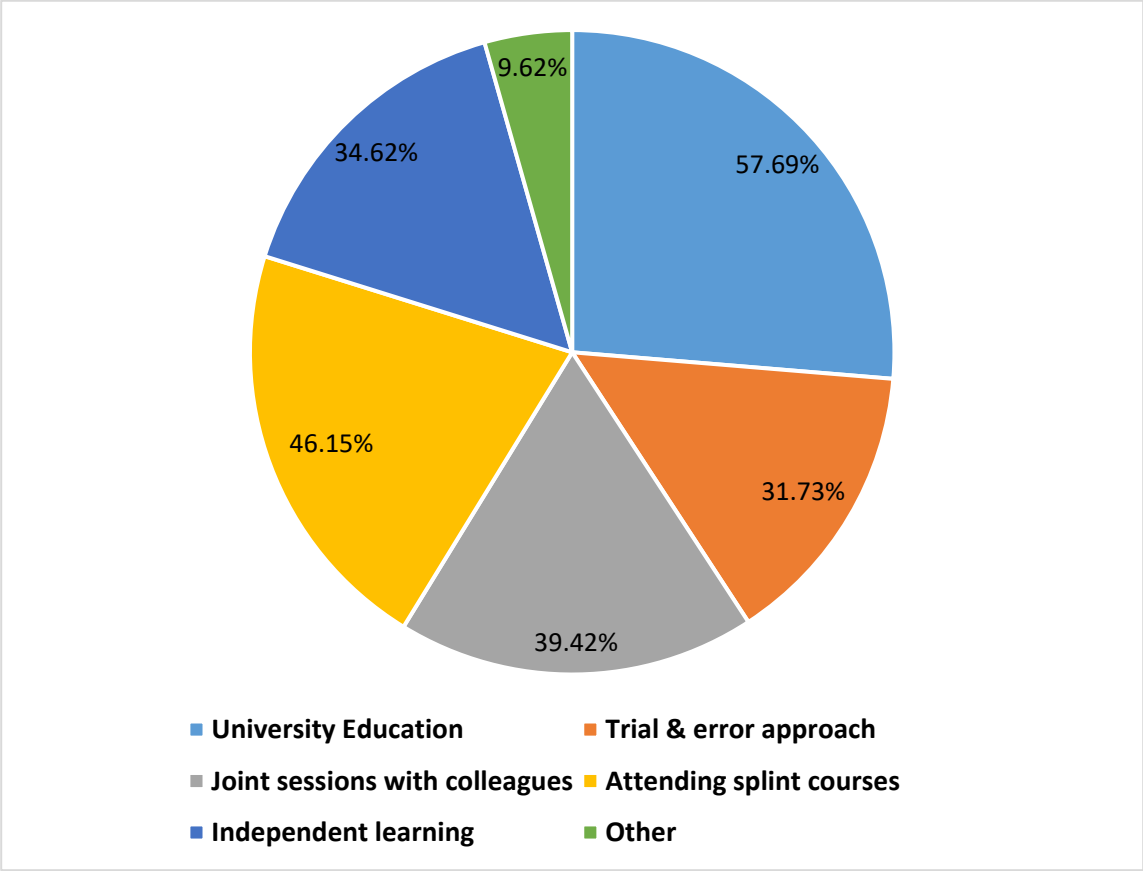

Figure 14. Primary source(s) of splint fabrication knowledge

When the participants were asked to rate the opportunities for them to learn splinting skills with the neurologically impaired population at the university where they completed their occupational therapy education, most of them selected some

opportunity (n=104; 42, 40.38%) and very little opportunity (34, 32.69%; see Figure 15). While 11 participants (10.58%) thought there was no opportunity for them at all at their university, only 3 participants (2.88%) responded that they had maximum opportunity at school. The next question item invited the respondents (n=103) to also rate the opportunity for them to learn splinting skills from more experienced therapists (See Figure 16). Most participants selected some opportunity (38, 36.89%), followed by a lot of opportunity (26, 25.24%) and very little opportunity (16, 15.53%).

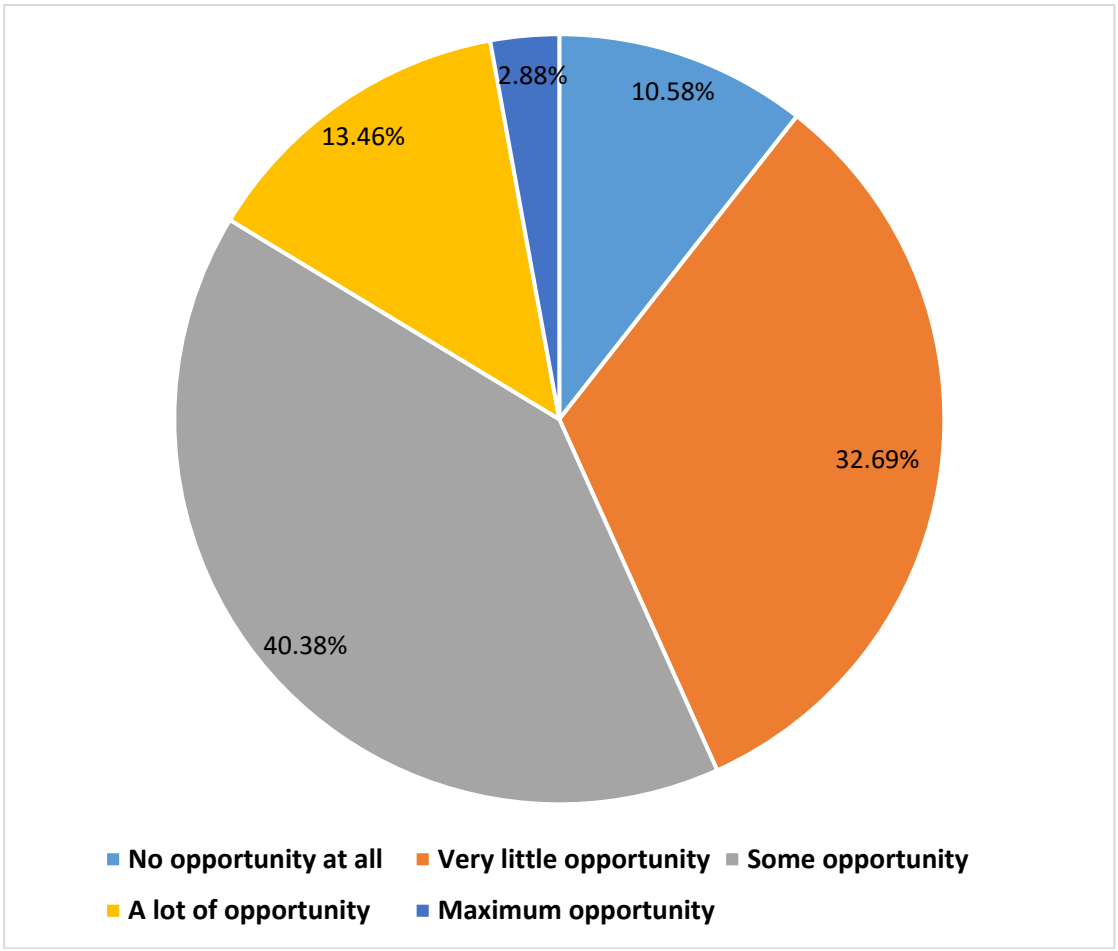

Figure 15. Opportunity of learning splinting skills at university

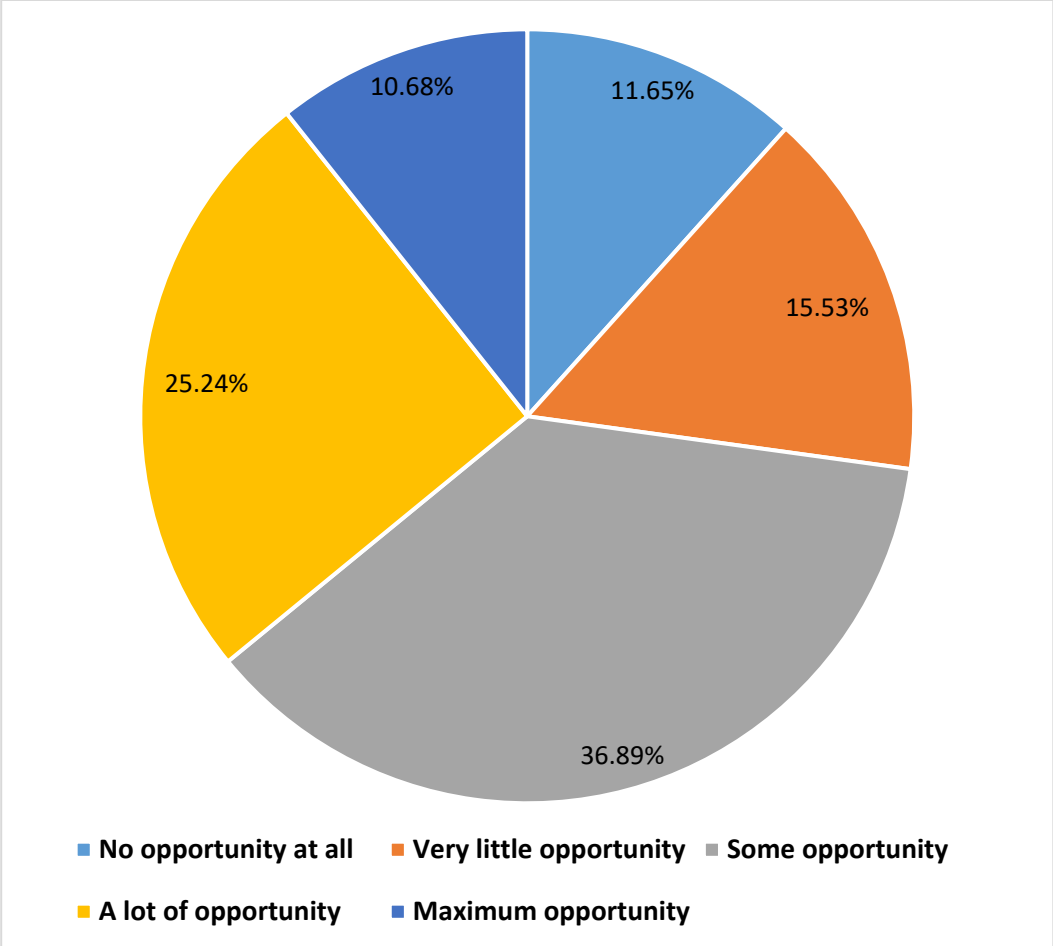

Figure 16. Opportunity of learning splinting skills from more experienced therapists

The vast majority of therapists reported that they had access to some continuing education opportunities for learning about making neurological splints (n=104; 52, 50%; see Figure 17). Nineteen participants (18.27%) believed that there was very little opportunity for continuing education on neurological splinting but another 19 participants (18.27%) felt as though there was a lot of opportunity.

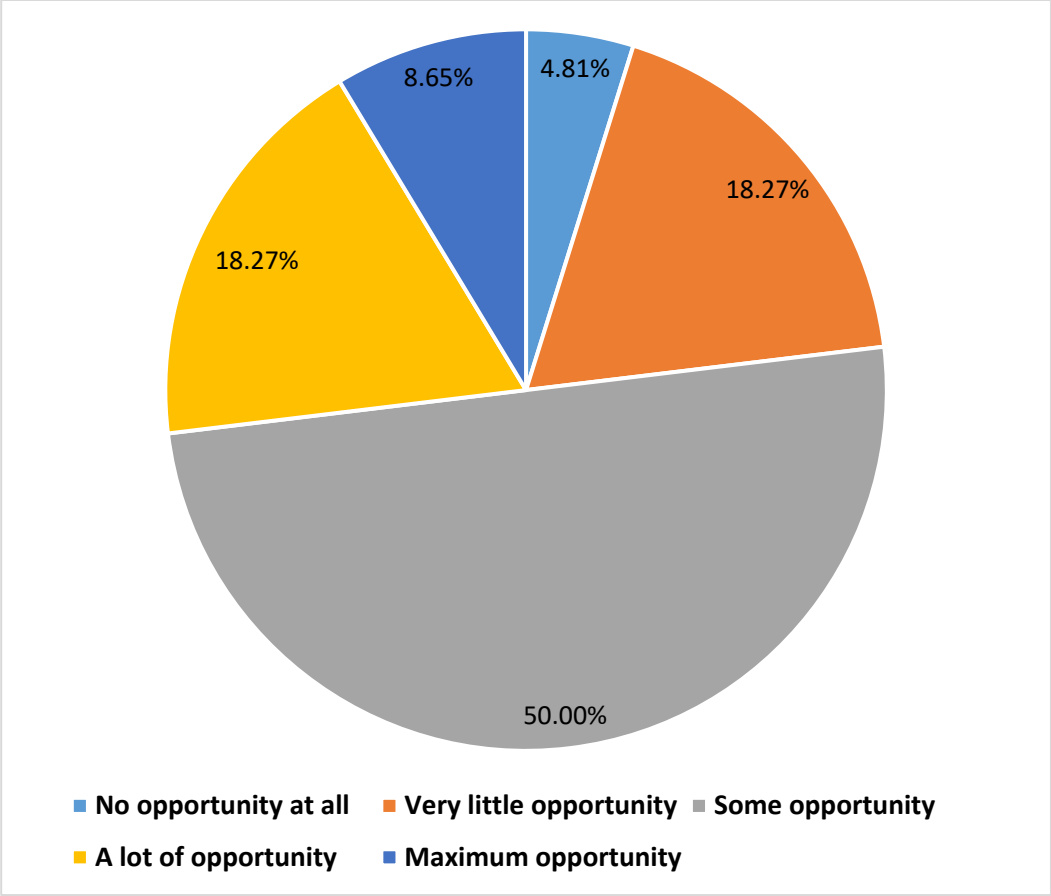

Figure 17. Accessibility of continuing education opportunities on neurological splinting

Search for evidence. Out of 104 respondents, 67 of them (64.42%) were a member of their professional organization. Among the variety of different professional organizations, most therapists belonged to American Occupational Therapy Association (47, 61.04%), followed by Ohio Occupational Therapy Association (38, 49.35%) and American Society of Hand Therapists (9, 11.69%; see Figure 18). Some other professional organizations that were mentioned in the open-ended "other" item were Kentucky Occupational Therapy Association (2, 2.6%), Neuro-developmental Treatment Association (2, 2.6%), American Burn Association (1, 1.3%), Academy of

Spinal Cord Injury Professionals (1, 1.3%), and Kinesio Taping Association International (1, 1.3%).

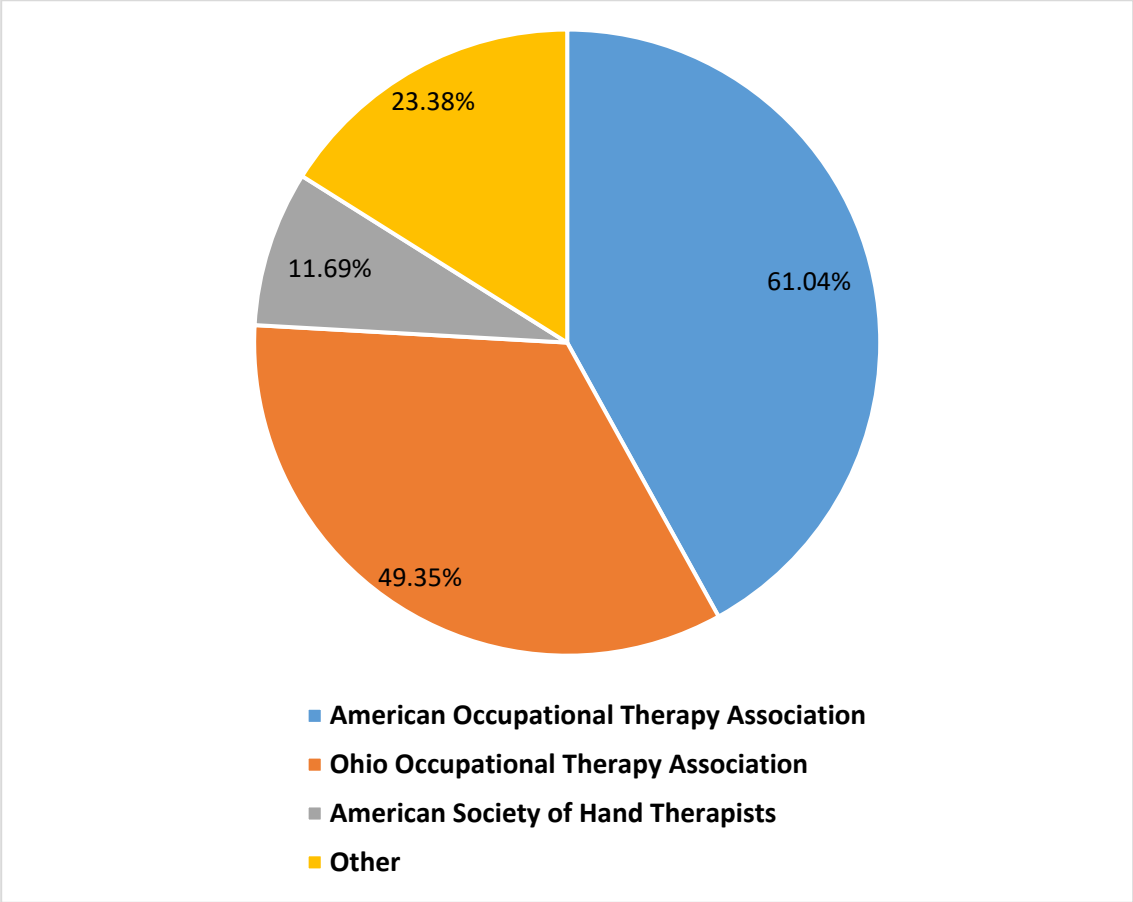

Figure 18. Distribution of professional organization membership

Most therapists reported that they rarely read peer-reviewed research articles for the evidence on neurological splinting such as literature review or journals from their professional organizations (n= 104; 39, 37.50%; see Figure 19). There were 34 participants (32.69%) who reported that they sometimes read research articles and 19 respondents (18.27%) who never looked into research results. Only 2 participants (1.92%) always searched for evidence on neurological splints. Similarly, most

participants rarely (n=104; 35, 33.65%) or sometimes (33, 31.73%) searched for information on neurological splinting from non-research based sources such as YouTube or Google Search (See Figure 20). However, no participants reported that they always searched for neurological splinting information from online non-research based sources.

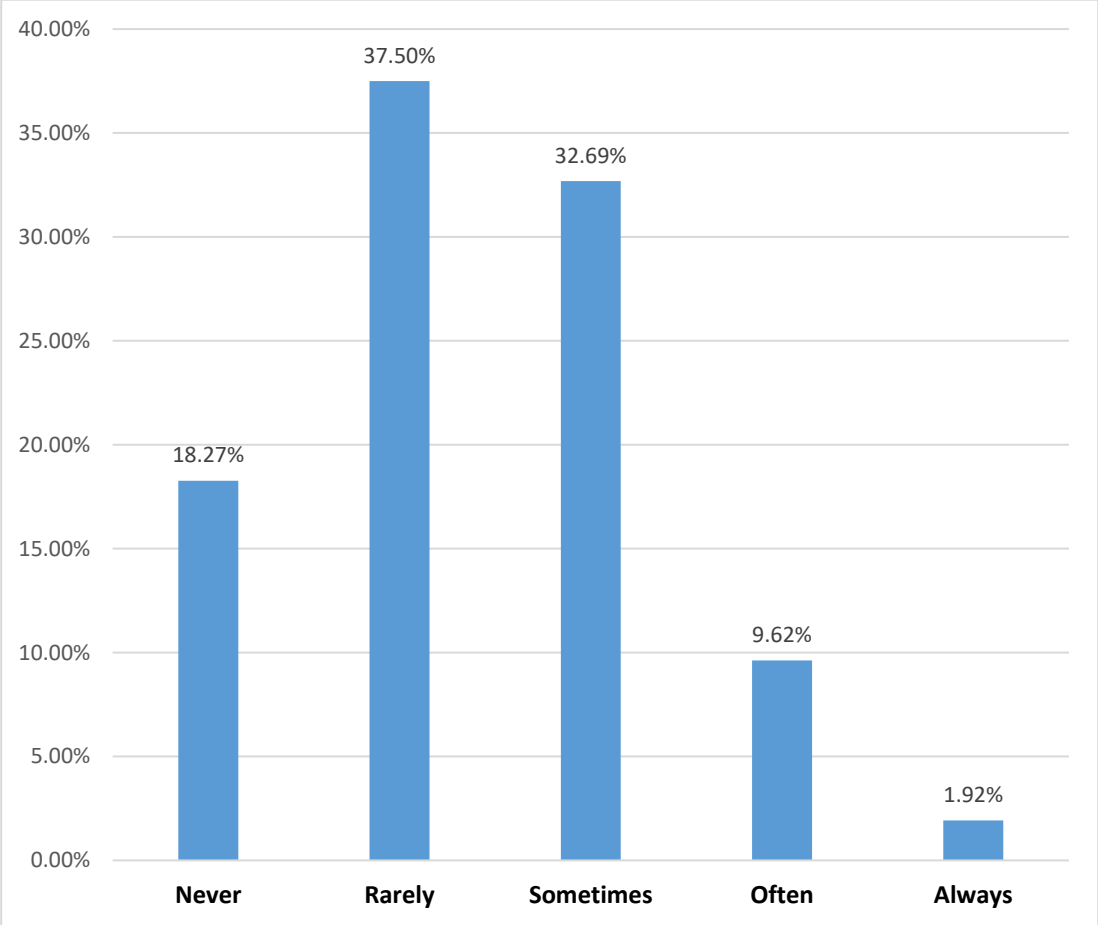

Figure 19. Search for evidence through research based sources

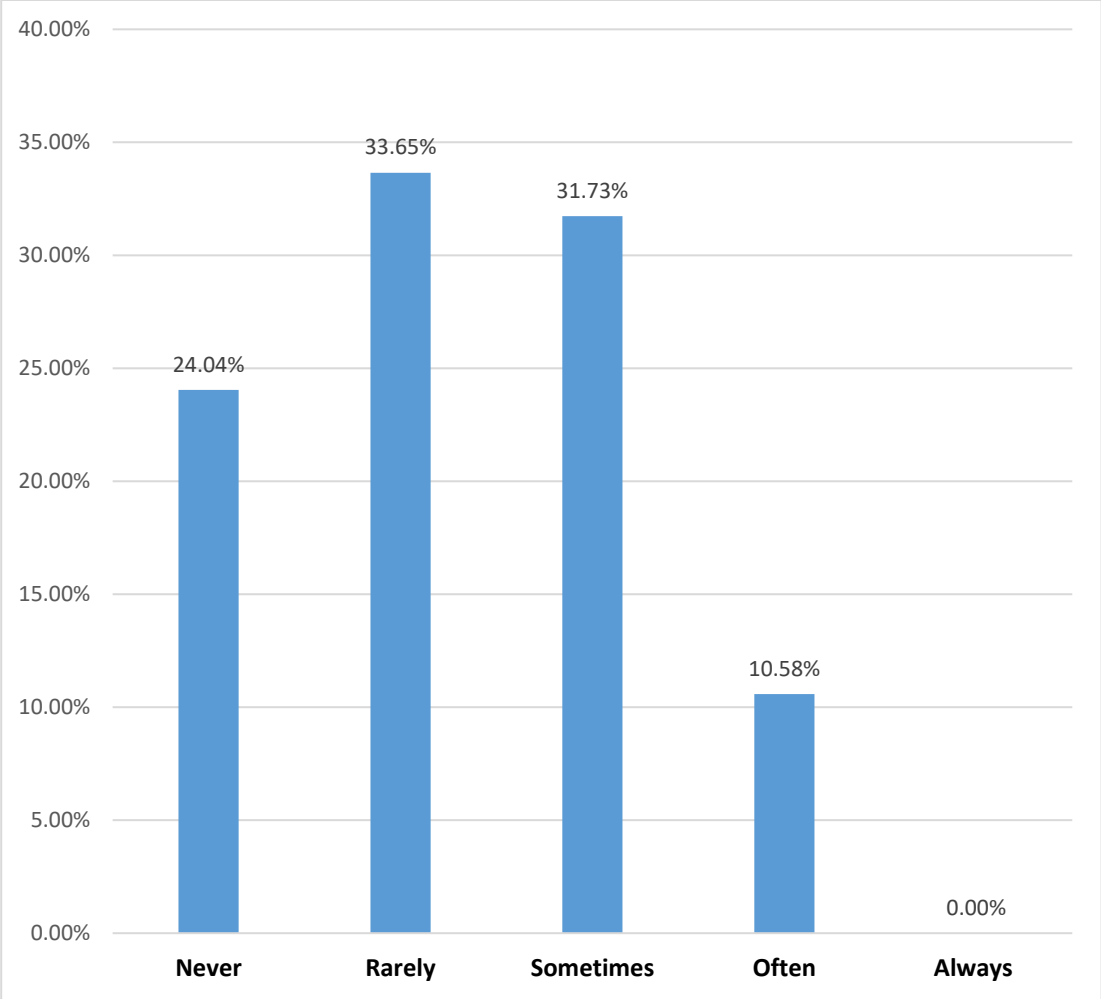

Figure 20. Search for evidence through non-research based sources

Discussion

This study has found that over half of the survey participants utilized neurological splinting with less than 10% of their clients and most therapists considered this intervention to be moderately or somewhat effective (69.23%). Practitioners' decision-making process and their perceived effectiveness of neurological splinting were influenced by not only procedural but also interactive and conditional reasoning; the client's functional outcomes and subjective feelings were considered even more important than objective measurements when evaluating the

effectiveness of neurological splints. The majority of the participants self-reported as less than knowledgeable (65.05%) or confident (68.26%) on prescribing or making neurological splints and most therapists (57.69%) considered university education as their primary source of neurological splinting knowledge. Continuing education opportunities on splinting for the neurologically impaired adult population were limited and participants overall rarely utilize research resources to support their implementation of this intervention.

Using interactive and conditional reasoning for effectiveness evaluation. In addition to procedural reasoning, both interactive and conditional reasoning processes were used during decision making and for evaluating the effectiveness of splinting for the neurologically impaired population. The OTs participating in this study reported that the client's motivation for wearing a splint, the client's functional level, the client's symptoms, and support provided by caregivers were all deciding factors in both neurological splint making and evaluating splinting effectiveness, although the final decision often varied based on the practitioner's personal values and beliefs. These findings are consistent with a study conducted by Shafaroodi, Kamali, Parvizy, Mehraban and O'Toole (2014) in which numerous complex factors influenced the clinical reasoning of therapists including both the client's and therapist's values and beliefs. The knowledge and beliefs of the client along with their family about the condition and the intervention was found to be essential for successful treatment. Other research has suggested that having an awareness of clients' psycho-social context, taking the functional level of the client into account, and the emphasis on

collaborative reasoning with the client were significant elements of experts' clinical reasoning process in assessment and condition management (May, Greasley, Reeve, & Withers, 2008). While procedural reasoning is commonly used during therapists' clinical decision making process, the client's personal preference, motivation and desire, and support from the surrounding environment should not be overlooked. Participants in this study reported that if the neurological splint met the client's functional requirements and promoted the client's subjective feelings about their symptoms, they would consider the intervention effective and beneficial even before obtaining objective measurements. These findings are important as future intervention studies that examine the effectiveness of neurological splinting should consider the impact of interactive and conditional reasoning and examine factors related to these types of reasoning in addition to procedural reasoning.

Needing more neurological splint training to feel knowledgeable and confident. The majority of the participants in this study felt less than knowledgeable (65%) or confident (68.25%) in prescribing or making splints for clients with neurological conditions. Although practitioners' confidence level was found to be highly subjective, a considerable amount of therapists (29.8%) reported that they were only somewhat confident or not confident at all in conducting this intervention. Since university education and continuing education courses were selected by most participants as the primary sources of neurological splint knowledge, more educational opportunities on this specific intervention during the academic preparation phase and professional development phase should be provided. This is similar to concerns

expressed by occupational therapy students in a previous study that they desire to learn more technical knowledge and concrete intervention strategies in their professional education program (Hodgetts, Hollis, Triska, Dennis, Madill, & Taylor, 2007). Furthermore, in alignment with the AOTA position paper on continued professional development (Schultz-Krohn et al., 2017), more accessible continuing education courses on creating neurological splints should be offered to improve therapists' competence and confidence level. Hands-on courses on this topic was mentioned as the preferred option in this study, which is contradicted with Pittman and Lawdis' (2017) suggestion that online professional development training is an effective strategy to improve practitioners' confidence and clinical competence. Due to the hands-on nature of the splinting process it may be necessary for therapists to feel and physically practice with the splint materials in order to achieve better learning outcomes. This is consistent with the study of Hearns, Miller, and Nelson (2010) suggesting that hands-on learning is more efficacious than learning through demonstration only, especially when recall was measured 24 to 48 hours after learning.

Lacking evidence based practice (EBP) implementation for neurological splints. Only 11.54% of the survey participants in this study reported that they often or always look up research evidence on the splinting intervention they used with individuals with neurological conditions. This was significantly lower than the 85% of OTs who reported reading scholarly articles from the *American Journal of Occupational Therapy* (AJOT; Philibert, Snyder, Judd, & Windsor, 2003) or the 56% who reported

utilizing research to make clinical decisions in earlier studies (Bennett et al., 2003). However, the previous research did not specify a specific intervention as the target research topic, which could explain the discrepancy between this current survey research and prior studies. Future research should explore therapists' knowledge, skills, attitudes, and behaviors related to EBP for a specific treatment method instead of general occupational therapy practice. A lack of EBP for splinting could negatively impact patient outcomes. Time constraints, difficulty interpreting results, lack of clinical information, and too much scientific information were previously discovered as barriers for practitioners to implement EBP (Philibert et al., 2003), which could relate to the low frequency of searching for evidence in this study.

Limitations

Because the OT email list from OTPTAT was the main recruitment source for the quantitative portion of this study, the majority of the survey participants were therapists in Ohio. The geographic region limits the ability for results from this survey to be generalized to OTs in other states in the United States. This research topic might benefit from data collection through a national survey with a larger sample size.

The OTPTAT email list provided therapists' name, address, and contact information but did not specify the facility where they were working. Since the setting determines the population therapists work with, the researcher was unable to narrow down the potential participants who met the inclusion criteria on the email list. Not meeting the inclusion criteria for the study is a potential reason that a large number of

recruitment email recipients did not enter the survey or entered but did not respond to any question items. Thus, the response rate for the survey is likely lower than it would have been if the individuals receiving the survey could have been more specifically targeted by setting and treatment population.

The inclusion criteria were described in all recruitment documents and emails, however it was possible that some participants who were intended to be excluded from the study overlooked the requirements and may have taken the survey partially or in-full. Twenty-four participants discontinued the survey after completing the demographic question items, meaning that they may not have met the inclusion criteria due to their inability to answer the questions that followed regarding the current trends in neurological splinting with adults. However, this did allow the researcher to determine the percentage of respondents who completed splinting with adults who have neurological conditions. Survey Monkey software was another limitation since it did not provide effective 'skip logic' and 'end the survey' services to exclude the respondents who did not meet inclusion criteria. While unlikely, people who did not meet inclusion criteria may have completed the survey in full despite a lack of knowledge regarding the study topic which may have negatively affected the accuracy of the survey results. Based on survey response patterns, it appears that participants ended survey participation in alignment with their ability to contribute accurately to the survey results.

Additionally, the survey was previously piloted on a small sample of three OTs, which may have resulted in limited suggestions for clarification, additional questions,

or response items. To counteract this, the preliminary survey was also evaluated by three experienced OTs on the MSOT thesis committee prior to data collection. The pilot survey was also not delivered to participants through Survey Monkey, which differed from the survey experiences of the sample in this study. However, the survey delivery process through Survey Monkey was piloted with the primary faculty advisor to ensure that the online mode would be successful before distributing the survey to potential participants.

The principle investigator was only able to interview four participants. Data saturation was not reached for the qualitative portion of the study, meaning that additional participants could have revealed additional insights or themes. Furthermore, these four interview participants were all working therapists in different time zones and with busy work schedules. The interviews were more likely to take in place in the evenings after therapists got off work, were on their way home, or when they were home with their young children. This could have impacted the detail that therapists provided during the interviews or limited their ability to participate in member checking. To offset this, the method (face-to-face, skype, phone call) and time of the interviews were selected by participants based on what was most convenient for them.

Timing was a significant limitation in this study. Given that the primary investigator had a limited window during which to complete the research to meet graduation requirements, there was not time to conduct chi-square analysis on the survey data to further examine whether there is a significant association between two

variables, such as if there is a significant relationship between being a member of professional organizations and the frequency of searching for research evidence.

Implementation for Practice

Studies on neurological splinting and the clinical use of this intervention may be improved since the results of this study allow both researchers and practitioners to gain a better understanding of the current neurological splinting patterns, therapists' clinical reasoning process, and their perceived effectiveness of splints. In addition, training on splinting the neurologically impaired population during academic preparation was reported as lacking by participants. Clients and therapists can both benefit from more accessible hands-on continuing education course opportunities to promote therapists' competence and confidence level, and to improve the outcome of clients' UE use. These findings may offer important implications for occupational therapy educators.

This study shows that practitioners may need re-education on the benefits and process of completing EBP, especially because fieldwork educators and therapists function as role models to demonstrate EBP in action and reinforce the use of evidence to inform clinical decision making (Stronge & Cahill, 2012). In line with other research on therapists' access to bibliographic databases (Bennett et al., 2003), practitioners need access to databases for searching the literature if they are not affiliated with a university such as through open access journals and databases. Access to literature can also be achieved through membership with professional associations,

such as the American Occupational Therapy Association (AOTA). AOTA membership allows access to the following journals: *American Journal of Occupational Therapy* (AJOT), *British Journal of Occupational Therapy* (BJOT), and *Canadian Journal of Occupational Therapy* (CJOT). Some additional non-journal resources include *OT Practice* Magazine, and *SIS Quarterly Practice Connections*.

Conclusion

In summary, to the researcher's knowledge, this is the first study to explore OTs' perceptions of effectiveness and the clinical decision making process for splinting individuals with neurological conditions in the United States. Therapists considered neurological splinting to be moderately effective, and it was found that interactive reasoning and conditional reasoning was utilized by therapists in addition to procedural reasoning in both decision making and evaluating the effectiveness of splinting. Therapists reported moderate or less knowledge and confidence levels as well as limited university education and continuing education opportunities on neurological splinting. EBP on this specific intervention was rarely or even never conducted by therapists related to neurological splinting. Therapists may need access to education and training for both EBP and neurological splinting to positively impact patient outcomes.

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APPENDICES

Appendix A: Semi-Structured Interview Guide

Appendix A: Semi-Structured Interview Guide

1. How would you describe your professional background?
    a. How long have been practicing in a neurological rehabilitation setting?
    b. Workload (Weekly)?
    c. How often do you prescribe a neurological splint?
2. What kind of neurological splint do you prescribe the most? Why?
3. Describe the typical process of making a neurological splint for a client.
    a. Patient's diagnosis?
    b. Material of the splint?
    c. Type of the splint?
    d. Your competence of making the splint? If you have made this kind of splint before?
4. Can you tell me a story of a time you made a splint that **did not go well**? What was your rationale of prescribing that splint?
    a. *Procedural reasoning* which is to consider clients' physical performance problems (Contracture? Spasticity? ROM? Pain?)
    b. *Interactive reasoning* which is to understand the client as a person (Patient's hand dominance? Personality? Age?)
    c. *Conditional reasoning* which is to consider the condition and situation for the client (Family and caregivers' influences especially when the patient has cognitive deficits? Home environment? Working environment?)
5. Can you tell me a story of a time you made a splint that **went very well?** What was your rationale of prescribing that splint?
    a. Physical performance problems (Contracture? Spasticity? ROM? Pain?)
    b. Understanding the client as a person (Patient's hand dominance? Personality? Age?)
    c. Condition and situation for the client (Family and caregivers' influences especially when the patient has cognitive deficits)

6. Do you find splinting effective or not effective on certain clients? Why would you think so?
7. How would you evaluate the effectiveness of the splint you made for your client?
8. Describe what makes it easy or hard to prescribe a neurological splint?
9. How confident are you in creating custom-made neurological splints?
10. What do you think affects your confidence level in prescribing neurological splints for clients?
    a. Splint fabrication knowledge
    b. Clinical experience of making splints
    c. Research evidence on effectiveness of neurological splints
11. Do you feel as though you have enough resources or support to create custom-made neurological splints? How so?
    a. Access to desired materials
    b. Learning opportunities from experienced therapists
    c. Continue education opportunities for making neurological splints
12. What else would you like to tell me about your experiences prescribing splints for patients with neurological conditions?

Appendix B: Survey Instrument

Appendix B: Survey Instrument

Thank you for your participation. Completion of this survey will be considered as providing informed consent to participate in this research.

Demographics:

1. Are you currently treating neurologically impaired adults within the United States?

☐ Yes

☐ No (End survey participation)

2. Have you prescribed a neurological splint to at least one adult client within the last year?

☐ Yes

☐ No (End survey participation)

3. How long have you been practicing as a certified occupational therapist?

☐ Less than 1 year (End survey participation)

☐ 1-<2 years

☐ 2-5 years

☐ 6-10 years

☐ 11-15 years

☐ 16-20 years

☐ Over 20 years

4. How long have you been directly working with adults with neurological conditions?

☐ Less than 1 year (End survey participation)

☐ 1-<2 years

☐ 2-5 years

☐ 6-10 years

☐ 11-15 years

☐ 16-20 years

☐ Over 20 years

5. Are you currently a certified hand therapist?

☐ Yes

☐ No - Skip Question 6

6. How long have you been practicing as a certified hand therapist?

☐ Less than 1 year

☐ 1-<2 years

☐ 2-5 years

☐ 6-10 years

☐ 11-15 years

☐ 16-20 years

☐ Over 20 years

7. What is your age?

☐ 20-29

☐ 30-39

☐ 40-49

☐ 50-59

☐ 60-69

☐ 70-79

8. What is your gender?

☐ Male

☐ Female

☐ Other

9. What is the highest level of education that you have completed?

☐ Bachelor's

☐ Master's

☐ Clinical Doctorate

☐ Research Doctorate

☐ Other (Please list):

10. In what state do you primarily practice as an occupational therapist?
*Drop down box of all 50 states

11. In what setting do you primarily practice?
☐ Acute Care
☐ Inpatient rehabilitation
☐ Outpatient rehabilitation
☐ Skilled nursing facility
☐ Neurorestorative
☐ Other (Please list):

12. How many hours per week do you see adult clients with neurological conditions?
☐ Less than 1 hour
☐ 1-5 hours
☐ 6-10 hours
☐ 11-15 hours
☐ 16-20 hours
☐ Over 20 hours

13. What percentage of your clients receive neurological splints?
☐ Less than 10%
☐ 10%-20%
☐ 21%-30%
☐ 31%-40%
☐ 41%-50%
☐ 51%-60%
☐ 61%-70%
☐ 71%-80%
☐ Over 80%

Current Trends in Neurological Splinting at Your Facility:

14. Please rank the diagnosis that you prescribe splints for most commonly from 1-6 (1 being most common and 6 being least common).

___ Cerebrovascular accident (Stroke)
___ Multiple sclerosis (MS)
___ Traumatic brain injury (TBI)
___ Spinal cord injury (SCI)
___ Amyotrophic Lateral Sclerosis (ALS)
___ Other (Please list):

15. Please rank the type of splint that you prescribe most commonly from 1-7 (1 being most common and 7 being least common).

___ Functional resting splint
___ Wrist extension splint
___ Elbow extension splint
___ Dynamic splint
___ Weight-bearing splint
___ Serpentine splint
___ Other (Please list):

16. What splinting material(s) do you commonly use? Check as many as apply.

☐ Thermoplastic
☐ Lycra or neoprene
☐ Plaster of paris
☐ Air splint
☐ Other (Please list):

Clinical Decision-Making Process of Prescribing Neurological Splints

17. On a 5-point scale, how would you rate the effectiveness of splinting in clients with neurological impairment?

☐ 1 (Not effective at all)
☐ 2 (Somewhat effective)
☐ 3 (Moderately effective)
☐ 4 (Effective)
☐ 5 (Extremely effective)

18. Please rank the factors that you think affect the effectiveness of splinting in clients with neurological impairment from 1-6 (1 being the most important factor and 6 being the least important factor).

___ Client's physical condition (such as tone, pain level)
___ Client's personal traits (such as participation, personal preference)
___ Caregiver's participation when client has cognitive deficits
___ Therapist's splinting skill level
___ The type of splint (Please list):
____Other factors (Please list):

19. Please rank the factors that you think are important for evaluating the effectiveness of the splint you made for your client from 1-5 (1 being most important and 5 being least important).

___ Functional outcome
___ Objective measurements (such as ROM assessment)
___ Client's subjective feelings (including their perceived pain level)
___ Hygiene
___ Other (Please list):

20. On a 5-point scale, how often do you consider client's diagnosis (such as stroke, ALS, TBI, SCI, etc.) before you decide to prescribe/make a neurological splint?

☐ 1 (Never)
☐ 2 (Rarely)
☐ 3 (Sometimes)
☐ 4 (Often)
☐ 5 (Always)

21. On a 5-point scale, how often do you consider client's diagnosis and symptoms (such as contracture, spasticity, ROM, pain, etc.) before you decide to prescribe/make a neurological splint?

☐ 1 (Never) - Skip Question 22
☐ 2 (Rarely)
☐ 3 (Sometimes)
☐ 4 (Often)
☐ 5 (Always)

22. Which of the following is typically the most important symptom to consider when prescribing/making a neurological splint?

☐ Contracture

☐ Spasticity

☐ Range of motion

☐ Pain

☐ Skin integrity

☐ Other (Please list):

23. On a 5-point scale, how often do you consider client factors (such as age, personal preference, knowledge about splints, hand dominance, etc.) before you decide to prescribe/make a neurological splint?

☐ 1 (Never) - Skip Question 24

☐ 2 (Rarely)

☐ 3 (Sometimes)

☐ 4 (Often)

☐ 5 (Always)

24. Which of the following is typically the most important client factor to consider when prescribing/making a neurological splint?

☐ Age

☐ Personal preference

☐ Cognition

☐ Hand dominance

☐ Knowledge about splints (wearing schedule & care)

☐ Other (Please list):

25. On a 5-point scale, how often do you consider context factors (such as caregivers, home environment, working environment, etc.) when client has cognitive deficits before you decide to prescribe/make a neurological splint?

☐ 1 (Never) - Skip Question 26

☐ 2 (Rarely)

☐ 3 (Sometimes)

☐ 4 (Often)

☐ 5 (Always)

26. Which of the following is typically the most important context factor to consider when prescribing a neurological splint?

☐ Caregiver's attitude towards splinting (when client has cognitive deficits)

☐ Home environment

☐ Client's work environment

☐ Other (Please list):

Resources That Support Your Splint-Making Process

27. What is your primary source(s) of splint fabrication knowledge? Check as many as apply.

☐ University education

☐ Trial & error approach

☐ Joint sessions with colleagues

☐ Attending splint courses

☐ Independent learning (such as reading or watching online videos)

☐ Other (Please list):

28. On a 5-point scale, how would you rate your knowledge level in splint fabrication?

☐ 1 (Not knowledgeable at all)

☐ 2 (Somewhat knowledgeable)

☐ 3 (Moderately knowledgeable)

☐ 4 (Knowledgeable)

☐ 5 (Extremely knowledgeable)

29. On a 5-point scale, how would you rate your confidence level in creating custom-made neurological splint?

☐1 (Not confident at all)

☐2 (Somewhat confident)

☐3 (Moderately confident)

☐4 (Confident)

☐5 (Extremely confident)

30. On a 5-point scale, how would you rate your access to desired splint materials?

☐1 (Not accessible at all)

☐2 (Somewhat accessible)

☐3 (Moderately accessible)

☐4 (Accessible)

☐5 (Extremely accessible)

31. On a 5-point scale, how would you rate the opportunity for you to learn splinting skills with neurologically impaired population at your university?

☐1 (No opportunity at all)

☐2 (Very little opportunity)

☐3 (Some opportunity)

☐4 (A lot of opportunity)

☐5 (Maximum opportunity)

32. On a 5-point scale, how would you rate the opportunity for you to learn from more experienced therapists related to splinting skills?

☐1 (No opportunity at all)

☐2 (Very little opportunity)

☐3 (Some opportunity)

☐4 (A lot of opportunity)

☐5 (Maximum opportunity)

33. On a 5-point scale, how would you rate your access to continuing education opportunities for learning about making neurological splints?

☐1 (No opportunity at all)

☐2 (Very little opportunity)

☐3 (Some opportunity)

☐4 (A lot of opportunity)

☐5 (Maximum opportunity)

34. Are you currently a member of any professional organization?

☐ Yes

☐ No - Skip Question 35

35. What professional organizations are you currently belonging to? Check as many as apply.

☐ American Occupational Therapy Association

☐ Ohio Occupational Therapy Association

☐ American Society of Hand Therapists

☐ Other (Please list):

36. On a 5-point scale, how often do you research for evidence on neurological splints through reading a research article? (Can be from literature review or journal from professional organization)

☐ 1 (Never)

☐ 2 (Rarely)

☐ 3 (Sometimes)

☐ 4 (Often)

☐ 5 (Always)

37. On a 5-point scale, how often do you research for information on neurological splints from non-research based sources (YouTube, Google among others)?

☐ 1 (Never)

☐ 2 (Rarely)

☐ 3 (Sometimes)

☐ 4 (Often)

☐ 5 (Always)