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## A Manual for Caregivers of Infants with Brachial Plexus Injuries

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A MANUAL FOR CAREGIVERS OF INFANTS WITH BRACHIAL PLEXUS INJURIES

by

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Masters of Occupational Therapy, University of North Dakota, 2015

Advisor: Mandy Meyer, Ph.D.

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This Scholarly Project Paper, submitted by Maranda Myrold and Taryn Wagner in partial fulfillment of the requirement of Master of Occupational Therapy from the University of North Dakota, has been read by the Faculty Advisor under whom the work has been done and is hereby approved.

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## ABSTRACT

The purpose of this scholarly project was to develop a holistic manual for occupational therapists to provide to caregivers of infants with neonatal brachial plexus palsy (NBPP). A literature review was conducted on the impact of NBPP on both the infant's and their caregiver's quality of life. The literature review revealed that NBPP can lead to functional deficits for infants, increasing the amount of care, attention, and resources they require. Due to these challenges, a caregiver may experience high levels of stress, which could result in depression, anger, and frustration (Matlow, Stevens, Harrison, & Laxer, 2006). Also, current research is lacking on the functional rehabilitation of infants and children with NBPP (Vaz et al., 2010). Based on the unmet needs identified, the guide titled "Supporting Caregiver and Infant Health in the Home: A Guide for Caregivers of Infants with Neonatal Brachial Plexus Injuries" was created.

Guided by the Model of Human Occupation (MOHO), this guide addresses the areas of volition, habituation, and performance capacity of the caregiver, all while using a client-centered and holistic approach to provide care for both the infant and the caregiver (Kielhofner, 2008). Principles from the Adult Learning Theory were also utilized in the creation of the product to make it applicable and understandable to caregivers from a variety of educational levels. Within this caregiver guide, the following topics are addressed: what NBPP is, what caregivers can expect from their



infant, activities to do with their infant, and how to provide adequate care for themselves. Also an “Occupational Therapist User Guide” was created in order to educate therapists on how the caregiver and infant guide was created and how to best implement it with their clients. Overall, this guide is meant to provide caregivers with a thorough and effective way to provide the best care for themselves and their infants with the help of their occupational therapist.

# **CHAPTER I**

## **INTRODUCTION**

### **Rationale**

Neonatal brachial plexus palsy (NBPP) is the partial or total paralysis of the upper extremity due to trauma of nerves of the brachial plexus during childbirth (Akel et al., 2013; Foad, Mehlman, & Ying, 2008; Vaz et al., 2010). Benjamin (2005) described two types of NBPP: Erb's palsy and Klumpke's palsy. Erb's palsy, also known as upper brachial plexus palsy, is the most common and affects cervical nerves five through seven (C5-C7) (Benjamin, 2005; Kawabata, 2004; Shenaq, Armenta, Roth, Lee, & Laurent, 2005a). Klumpke's palsy, on the other hand, is rare and results from injury to the lower plexus, involving cervical nerves seven and eight and thoracic nerve one (C7-T1) (Benjamin, 2005; Storment, 2014).

Even though the exact presentations differ, infants with NBPP experience limited range of motion, pain, loss of sensation, weakness, and/or partial to complete paralysis of the affected arm and hand (Harrison, 2009). These deficits may result in functional limitations. Due to these functional limitations, both infants and their caregivers may experience a diminished quality of life. Caring for an infant is a challenge, but the demands for this are increased when the infant has a disability due to the need for extensive resources and support (Alyanak, Kılınçaslan,

Kutlu, Bozkurt, & Aydın 2013). Due to these challenges, a caregiver may experience high levels of stress, which can result in depression, anger, and frustration (Matlow, et al., 2006).

### **Statement of Problem**

Due to the potential functional difficulties infants with NBPP may experience, treatment must occur early. Evidence has shown 92% of recovery occurs during the first three months of life (Memo, Caminiti, Memo, Garozzo, & Ferraresi, 2013; Sharkey et al., 1990; Shonkoff & Hauser-Cram, 1987). This statistic demonstrates the importance of immediate treatment for infants with NBPP in order to achieve the best functional outcome for the rest of their lives. Despite this importance of early treatment, current research is lacking on the functional rehabilitation of infants and children with NBPP (Vaz et al., 2010). Bialocerkowski, Kurlowicz, Vladusic, and Grimmer (2005) supported this by stating there is controversy regarding the best treatment options for infants with brachial plexus injuries.

The American Occupational Therapy Association (2014), well known as AOTA, identified the area of “developmental interventions for at-risk infants” as a priority research area in its 2014 Research Opportunities in Early Childhood Table developed through the Evidence-Based Practice Project. Specifically, it identifies the need for “caregiver-delivered home program(s) for infants updated at 1, 2, and 3 month(s) to improve motor performance” (American Occupational Therapy Association [AOTA], 2014). This need for home programming for infants addressing motor performance correlates with the needed research on interventions for infants with NBPP.

## **Scope of Occupational Therapy**

Occupational therapists are an ideal fit to assist in the rehabilitation process of infants with NBPP in order to help them regain functional use of their upper extremity. Occupational therapists are trained to evaluate their clients from a holistic viewpoint, which allows them to create individualized and effective treatments. This holistic view includes examining both the infant and caregivers' physical and emotional states, as well as how the environment impacts their occupational functioning. Evaluating each of these components allows the therapist to determine the priority areas to address for the infant and the caregiver, working to improve their overall quality of life. Occupational therapists can do this through providing the caregiver with education on how to care for their infant with NBPP, as well as information on how to care for themselves and achieve a healthy balance in their life.

One effective tool to achieve this goal of improved quality of life is a home program. Home programs are effective tools when designed and used properly. In order to design them well, therapists should make them simple and easy to use, and obtain input from the caregiver on what is and what is not realistic. This is easily done when applying principles from a theoretical framework, such as the Model of Human Occupation.

### **Theoretical Framework**

The Model of Human Occupation (MOHO) guided the development of this scholarly project. MOHO emphasizes client-centeredness, requiring the occupational therapist to incorporate and respect the client's perspectives and desires, therefore

giving them an active role in the therapy process (Kielhofner, 2008). The model also emphasizes a holistic view by looking at all aspects of the client in order to provide individualized care to meet his or her unique needs (Kielhofner, 2008). Lastly, habituation is an important concept of MOHO, as it focuses on the importance of habits and routines in daily life and how they affect an individual's occupational performance (Kielhofner, 2008).

The Adult Learning Theory was also used to guide this scholarly project, as the target audience for this project is caregivers of infants with NBPP who will likely be adults. This theory is learner-centered, which correlates with MOHO's client-centered approach and allows the client and therapist to have a collaborative relationship (Bastable & Dart, 2011). Adults are motivated to learn when they feel they are able to apply the knowledge and skills they learn to solve problems, and they can clearly see how and why information presented to them is relevant (Bastable & Dart, 2011). Information and materials presented to adults should use these principles in order to be effective.

### **Importance of the Study**

This scholarly project provides a manual for occupational therapists to utilize with infants who have NBPP and their caregivers. It provides a comprehensive guide with information and resources the caregiver can quickly and easily access for both them and their infant. Information for caregivers on what to expect from their infant with NBPP, how to care for their infant, activities to utilize from zero to twelve months of age to improve function, the importance of taking good care of themselves, and ways to do so are included in the manual.

Through research, the authors found limited resources for caregivers of young children with disabilities, especially for infants with NBPP. This manual fills this gap by serving as a holistic resource for caregivers to use in order to achieve a high quality of life for both themselves and their infant. This scholarly project contains a review of literature, methodology utilized when developing the product, the caregiver manual, the occupational therapist manual, and an overarching summary of the entire project.

## **CHAPTER II**

### **REVIEW OF LITERATURE**

Neonatal brachial plexus palsy (NBPP) occurs in 0.38 to 2.6 per 1,000 live births in the United States (Hoeksma et al., 2004; Hoeksma, Wolf, & Oei, 2000; Memo et al., 2013; Shenaq et al., 2004). This incidence is comparable to that of Down syndrome or cerebral palsy (Dunham, 2003; Shenaq et al., 2004). This is significant due to the fact that society is generally more aware of these conditions, and therefore more effort is focused on developing resources for them when compared to NBPP. Even though the incidence of NBPP is fairly low, the infants who retain lasting motor impairments have significant complications with functional use of the shoulder, elbow, forearm, hand, and/or fingers (Hale, Bae, & Waters, 2010; Kozin, 2011; Johnson, Troupis, Michalinos, Dimovelis, & Soucacos, 2013). As many as 30% of infants with NBPP have these functional difficulties resulting from their injury (Firat, Oskay, Akel, & Öksüz, 2012). These impairments can have a significant impact on the infants' and caregivers' quality of life.

Due to these functional difficulties, interventions for infants with NBPP must occur early. Evidence has shown 92% of recovery occurs during the first three months of life (Memo et al., 2013; Sharkey et al., 1990; Shonkoff & Hauser-Cram,

1987). This statistic demonstrates the importance of immediate treatment for infants with NBPP in order to achieve the best functional outcome for the rest of their lives. Despite this importance of early treatment, current research is lacking on the functional rehabilitation of infants and children with NBPP (Vaz et al., 2010). Bialocerkowski et al. (2005) supported this notion by stating there is controversy regarding the best treatment options for infants with brachial plexus injuries.

The American Occupational Therapy Association (2014), well known as AOTA, identified the area of “developmental interventions for at-risk infants” as a priority research area in its 2014 Research Opportunities in Early Childhood Table developed through the Evidence-Based Practice Project. Specifically, it identifies the need for “caregiver-delivered home program(s) for infants updated at 1, 2, and 3 month(s) to improve motor performance” (American Occupational Therapy Association [AOTA], 2014). This need for home programming for infants addressing motor performance correlates with the needed research on interventions for infants with NBPP.

Occupational therapists are an ideal fit to assist in the rehabilitation process of infants with NBPP in order to help them regain functional use of their upper extremity. The purpose of this scholarly project is to create an occupational therapy manual for caregivers of infants with NBPP in order to assist in this process, as well as provide caregivers with information for caring for themselves. The following literature review examines the definition of NBPP, types of NBPP, signs and symptoms of NBPP, treatment options, the role of occupational therapy, how quality of life is affected, and the use and importance of home programming.



Throughout this project, the term *infant* will be utilized. Although there is debate as to what age range infant refers to, the authors of this project will refer to infants as being between the ages of zero and twelve months.

### **Neonatal Brachial Plexus Palsy Defined**

Neonatal brachial plexus palsy is the partial or total paralysis of the upper extremity due to trauma of nerves of the brachial plexus during childbirth (Akel et al., 2013; Foad et al., 2008; Vaz et al., 2010). The brachial plexus is a complex set of nerves that originates in the neck region of the spinal cord, and controls sensation and movement of muscles in the chest and upper extremity (Harrison, 2009). NBPP can result from high pressures in-utero or during delivery, with the primary mechanism of injury being compression or traction of either part or all of the brachial plexus (Dodds & Wolfe, 2000; Kay, 1998).

Approximately 54% of neonatal brachial plexus injuries do not have a known cause (Harrison, 2009). However, there have been several factors identified to contribute to an increased risk of NBPP, including increased fetal birth weight, maternal or gestational diabetes, maternal size, multiparity, having a history of a previous child with NBPP, and maternal pelvic abnormalities (Harrison, 2009; Memo et al., 2013; Vaz et al., 2010). Other risk factors associated with delivery include shoulder dystocia, perinatal dysphyxia, prolonged labor, use of forceps or vacuum, fetus presentation, and breech delivery (Harrison, 2009; Memo et al., 2013; Vaz et al., 2010). Foad, Mehlman, and Ying (2008) found that shoulder dystocia is associated with the greatest risk for NBPP among common risk factors, as the probability increases by almost 11% when shoulder dystocia occurs. However,

despite these many identified risk factors with some infants having multiple of them, Foad et al. (2008) reported 54% of infants with NBPP had no known risk factors.

### **Types of Neonatal Brachial Plexus Palsy**

Due to the complexity of the brachial plexus, injury can occur in various formations. Benjamin (2005) described two types of NBPP: Erb's palsy and Klumpke's palsy. Erb's palsy, also known as upper brachial plexus palsy, is the most common and affects cervical nerves five through seven (C5-C7) (Benjamin, 2005; Kawabata, 2004; Shenaq et al., 2005a). Infants with Erb's palsy generally present with an extended arm, internally rotated and adducted shoulder, a pronated forearm, and flexed wrist and fingers (Storment, 2014). Klumpke's palsy, on the other hand, is rare and results from injury to the lower plexus, involving cervical nerves seven and eight and thoracic nerve one (C7-T1) (Benjamin, 2005; Storment, 2014). Klumpke's palsy implicates weakness of the triceps, forearm pronators, and wrist flexors, resulting in a flexed arm, the shoulder in a relatively normal position, supinated forearm, and flaccid wrist and fingers (Storment, 2014).

### **Signs and Symptoms of Neonatal Brachial Plexus Palsy**

With NBPP, a wide variety of clinical presentations can occur. The functional deficits the individual experiences vary depending on the severity of the injury and the injury site (Akel et al., 2013; Vaz et al., 2010). The infant may experience limited range of motion, pain, loss of sensation, weakness, and/or partial to complete paralysis of the arm and hand (Harrison, 2009). These limitations may result in difficulties with the achievement of developmental milestones, such as holding a

bottle, using both hands to play with a toy, crawling, and pulling self up to standing. Performance challenges and restrictions in a number of areas of occupation in the future may occur as a result of these delayed milestones, especially in the areas of activities of daily living (ADLs), education, and community participation (Vaz et al., 2010). For example, if an infant does not achieve the bicep strength to flex the elbow against gravity to at least 90 degrees, then he or she will not be able to raise his or her hand to perform tasks such as eating, buttoning, or combing hair when older (Price, Tidwell, & Grossman, 2000). This further supports the importance of adequate and early treatment. Another limitation that could result if early treatment is not sought is the development of a pronation contracture, which can lead to future functional loss in hygiene, toileting, and sport activities (Liggio et al., 1999). Each of these limitations can greatly affect the infant's ability to perform everyday occupations, both immediately and as they continue to grow.

A phenomenon that can occur with functional deficits resulting from NBPP is termed *learned non-use*. Learned non-use occurs when an individual discovers he or she can do tasks without needing to use his or her affected extremity, which, without encouragement and intervention, leads to only using the non-affected extremity (Gordon, Charles, & Wolfe, 2005; Vaz et al., 2010). An infant with a brachial plexus injury may develop learned non-use, contributing to a lack of functional use of the affected extremity. Furthermore, if interventions are not graded correctly by skilled therapists, the infant may become frustrated and stop trying to use his or her affected extremity (DeLuca, Echols, Law, & Ramey, 2006; Sterr, Freivogel, & Schmalohr, 2002; Shepard, 1999). If learned non-use is not

addressed as soon as possible, the infant may have significant difficulty participating in age appropriate activities as they grow, such as tying shoes, zipping a jacket, playing with Legos, dressing a doll, making a sandwich, and taking money out of a purse (Krumlinde-Sundholm & Eliasson, 2003).

### **Treatment Options**

The treatment team of an infant with NBPP is one with many different disciplines involved. This team may consist of neurologists, neurosurgeons, plastic surgeons, physical medicine and rehabilitation staff, pediatricians, social workers, physical therapists, occupational therapists, and caregivers (Curtis, Stephens, Clarke, & Andrews, 2002; Ho & Ulster, 2011). Two treatment approaches are possible: a conservative approach or a surgical approach. The approach chosen depends on the severity and location of the injury. A conservative treatment approach requires an aggressive joint effort of both physical and occupational therapy (Ramos & Zell, 2000). Bialocerkowski et al., (2005) conducted a systematic review and also concluded primary conservative management including physical and occupational therapy is a well-established form of treatment for infants with brachial plexus injuries.

For some infants, surgical intervention is unavoidable. Currently in practice, there is support for surgical intervention at three to six months for infants who are not showing improvements (DeMatteo, Bain, Galea, & Gjertsen, 2006). Shenaq, Armenta, Roth, Lee, and Laurent (2005a) reported that the Texas Children's Hospital recommended surgical intervention only if there is a complete injury (when all of the nerves, C5-T1, are injured) without improvement in function by

three months of age, absent motor function in the deltoid, biceps and/or triceps, or if there has been no functional recovery by six months of age.

### **Role of Occupational Therapy**

Kawabata (2004) suggested for infants with brachial plexus injuries, occupational therapy should be started as soon as possible. Occupational therapists can assist infants and their caregivers with a multitude of things such as upper extremity movement, functional use, creating and monitoring home programs, and psychological support (Bialocerkowski & Grimmer, 2003; Kawabata, 2004). Occupational therapists can help improve infant's movement of the affected extremity through passive stretches, play, splinting, or facilitation techniques such as quick tapping (Bialocerkowski & Grimmer, 2003). Another reason occupational therapists are a good fit to treat infants with NBPP is their education and training in dealing with psychosocial aspects of an individual, which is an important aspect necessary to address with the caregivers of infants with NBPP. Caregivers of infants with physical disabilities may experience high levels of stress, as these infants require more care, attention, and direct supervision when compared to infants without physical disabilities (Firat et al., 2012). Psychological support may be given in the form of caregiver education on the diagnosis and how to care for their infant in order to aid in reducing stress levels (Kerr & McIntosh, 1998). Also, there are continuous demands on the infants and caregivers that cause unique stressors, making it important to evaluate the emotional and behavioral aspects of their context (Alyanak et al., 2013).

## **Evaluation**

An initial occupational therapy evaluation must include certain elements in order to provide the most effective care for the infant. One essential component of an evaluation is a physical assessment. A physical assessment should include details on range of motion (ROM), including both passive range of motion (PROM) and active range of motion (AROM), as well as muscle strength, sensation, and body posture (Dunham, 2003; Ramos & Zell, 2000). A second essential component of an initial evaluation is a detailed patient history, including psychosocial background information of both the patient and caregiver (Ramos & Zell, 2000). Examining a family's daily routine is a third essential component, as routines are there to complete a goal and provide order to life (Segal, 2004). Segal (2004) stated "family routines are mechanisms for the organization and coordination of activities toward the achievement of the instrumental goals in a timely manner." Routines can be an important part of a family's daily functioning; therefore, it is vital occupational therapists evaluate the family's routines and consider them when designing interventions for a home program. Doing so will aid in increasing compliance with the program, consequently improving the infant's functioning and the overall quality of life the infant and caregiver experience.

The evaluation process does not conclude after the initial evaluation is completed. Evaluation methods must continue throughout the course of treatment; it is essential occupational therapists remain consistent with the methods they utilize throughout this process in order to best determine improvements in function (Dunham, 2003). Also throughout the evaluation and treatment process, the overall

development of the infant must be considered by using a holistic approach (Chang, Yang, Driver & Nelson, 2014). This assists in determining the infant's improvements and areas requiring more intense treatment.

Certain elements may be difficult to evaluate in infants and small children. The assessment of the infant's ROM can prove to be a difficult process due to multiple factors, such as lack of comprehension of the purpose of the movement, or a lack of cooperation (Ramos & Zell, 2000). Another factor that may also be difficult to assess in infants and small children is muscle strength. In order to evaluate this, one should observe that movement of the affected upper extremity and compare it to that of the non-affected extremity (Ramos & Zell, 2000). Some methods that may reduce these difficulties and aid an occupational therapist in assessing an infant's movement and function include observing spontaneous activity, evaluating age appropriate reflexes, and encouraging the infant to reach for objects with and without gravity (Hale et al., 2010).

### **Interventions for the Infant**

A goal of occupational therapy is to improve the participation and performance of developmental and age-appropriate daily activities (Boeschoten, Folmer, van der Lee, & Nollet, 2007). Therapists may address either areas of occupation as a whole or performance components required to participate in those occupations. Two components that may need to be addressed are range of motion and strength, which may consist of PROM, AROM, or active assisted range of motion (AAROM) exercises (DiTaranto, Campagna, Price, & Grossmail, 2004; Dunham 2003). Occupations typically addressed with infants include play, feeding and

eating, and crawling. Despite the goals of the therapy session, or whether performance components or occupations are being addressed, the experience and creativity of the therapist is crucial when attempting to provide interventions to an infant, such as when attempting to perform therapeutic exercises designed to improve or maintain motion, joint mobility, and strength (Dunham, 2003; Price et al., 2000). A variety of interventions will be discussed in the remainder of this section including play, constraint-induced movement therapy, splinting, electrical stimulation, range of motion exercises, and interventions geared towards the caregivers.

#### **The use of play.**

Play is one of the main areas occupational therapists address for infants. Play activities should motivate and engage the infant while incorporating the desired motion and exercises (Price et al., 2000). For example, the child can reach for objects during play which encourages ROM and functional movement. Play activities may also be utilized to focus on stress reduction, sensory stimulation, motor stimulation, passive handling techniques, and enhancing the interactions between the infant and caregiver (Resnick, Eyler, Nelson, Eitzman, & Bucciarelli, 1987).

#### **Constraint-induced movement therapy.**

In a study conducted by Vaz et al. (2010), constraint-induced movement therapy (CIMT) was found to assist in improvements in the quality of upper extremity movement. CIMT is when non-affected extremity is constrained and the individual performs a variety of tasks to train the affected extremity (Vaz et al., 2010). In the study done by Vaz et al. (2010), the individual's willingness to use the



affected upper extremity, the ability to perform bimanual activities, and the mother's perception of the child's performance were all improved as well. It is believed that CIMT can help to overcome learned non-use of the affected extremity due to the fact it utilizes the brain's plasticity to promote development of physiological and functional movement patterns (Abdel-Kafy, Kamal, & Elshemy, 2013).

Research has shown adapted, client-friendly models of CIMT for use with infants can be successful. In such a model, the infant partakes in CIMT for shorter periods of time each day, but for a longer treatment period (Vaz et al., 2010). CIMT can be used during participation in a motivating play activity while constraining the unaffected extremity (Shepherd, 1999). If CIMT is utilized for infants with NBPP, occupational therapists should collaborate with the caregivers on whether or not this type of model would be possible, or what schedule would work best for them. Frequent follow-up should also occur in the case an adaptation or modification needs to be made to the program.

When developing a CIMT program for infants with NBPP, an occupational therapist must consider the motivation of the caregiver, age-appropriate activities that are motivating for the infant, and how repetition can be included in their routine (Abdel-Kafy et al., 2013). For example, Abdel-Kafy, Kamal, and Elshemy (2013) conducted a study on infants with NBPP using a CIMT protocol in which caregivers were supplied with a list of fine and gross motor skills activities they would typically practice by fitting them into their daily routine. The aim was to improve function of the affected extremity while maintaining the infant's interest.

Some of the age-appropriate activities included were reaching to an interesting item, postural reaction exercises, holding items with the affected extremity, and wiping the nose or face (Abdel-Kafy et al., 2013).

### **The use of splints.**

Splints are commonly used as a part of an occupational therapy treatment regimen for infants with NBPP. Chan (2002) found orthotics were a useful modality for minimizing deformities and preventing joint contractures. Typically, a wrist or hand cock up splint with the thumb in opposition is the first splint used for infants with NBPP, with a static elbow extension splint or dynamic elbow flexion typically being used later on. (DeMatteo, et al., 2006). Indications for splinting include lack of caregiver participation, high complexity of the home program, caregiver's lack of time, issues being faced by the caregiver, and caregiver fear of hurting the baby while doing the home program (Anderson & Anderson, 1988).

The wear schedule of splints varies depending on clinical assessment and the infant's age (Durlacher, Bellows, & Verchere, 2014). Ideally, the splint is utilized while the contracture is less severe and is initiated between three to six months of age, which may increase the infant's tolerance to the splint and the caregiver's participation (Durlacher et al., 2014). When the use of splints is included in treatment, it is also imperative the caregiver is provided education on splint usage (DeMatteo, et al., 2006). The caregiver should be informed to inspect the infant's arm and splint hourly for a minimum of four hours when a new splint is utilized in order to avoid skincare breakdown or other adverse reactions (Anderson & Anderson, 1988, Shenaq et al., 2005a). Durlacher, Bellows, and Verchere (2014) also

suggested the splint be removed at least twice a day for skin care, skin assessment, play, and range of motion exercises. If splints are utilized, exercises need to be done as well in order to avoid further hand dysfunction or contractures (Anderson & Anderson, 1988; Shenaq et al., 2005a).

### **Electrical stimulation.**

Electrical stimulation (E-Stim) is a common modality used in the treatment of NBPP and may be utilized by either occupational or physical therapy (Bager, 1997; Shenaq et al., 1998). E-Stim is typically indicated when an individual is unable to perform activities or exercises due to pain, restriction in ROM, or other dysfunctions of the neuromuscular system (Ramos & Zell, 2000). E-Stim may aid in preventing muscle atrophy or increase muscle mass (Piatt, 2004). Sherief (2011) reported the introduction of E-Stim to the deltoid and the forearm, as an addition to occupational therapy intervention, is strongly supported. Despite this support, controversy still exists on the use of E-Stim with infants and children as there is little research on the effects it has on these age groups (Ramos & Zell, 2000).

### **Range of motion exercises.**

A couple of weeks after the start of an occupational therapy treatment program, range of motion exercises should be started in order to prevent joint contracture, support normal development, and encourage the infant to pay attention to his or her affected limb (Kawabata, 2004). Benjamin (2005) suggested PROM exercises should be initiated at approximately one week of age and no later than three weeks of age, when soft tissue swelling subsides. Hoeksma et al. (2004) also suggested that during those first three weeks, shoulder abduction and elevation

should be limited to 90°. As the infant gets older, ROM exercises may be incorporated into daily activities. Examples of this include washing, eating and drinking, dressing, and infant activities such as reaching for objects during play (Abdel-Kafy et al., 2013; Boeschoten et al., 2007). These activities encourage use of the upper extremity and the use of adequate ROM. Sensory stimulation activities can also be started in order to re-educate the body to produce motor and sensory functions (Kawabata, 2004; Ramos & Zell, 2000). If caregivers are asked to complete any of these exercises or activities at home, they should be educated on their purpose and how to perform them (Abdel-Kafy et al., 2013). In order to ensure the exercises or activities are being performed correctly, and to possibly update them, an evaluation should be completed at a minimum of every two to four weeks (Shenaq et al., 2005a).

#### **Handling and positioning.**

Caregivers should be educated on protecting the affected arm by not letting it dangle when the infant is being moved or held (Benjamin, 2005). The caregiver can hold the affected extremity against the infant's abdomen so it is not left unsupported (Benjamin, 2005). The caregiver should be instructed to not lift the infant from the armpit area (Benjamin, 2005). They may place small blanket rolls for supporting the affected extremity when the infant is sitting in a swing or car seat (Benjamin, 2005). Infants with NBPP may create positional deficits such as torticollis and occipital plagiocephaly, or flattening of the head, by turning their head away from the affected side (van Ouwerkerk, van der Sluijs, Nollet, Barkhof, & Slooff, 2000). Caregivers should reposition the infant regularly to prevent the development of

acquired torticollis from a sternocleidomastoid muscle contracture (Clarke & Curtis, 2001).

### **Interventions for the Caregivers**

Emotional support for caregivers is an essential element of providing treatment (Benjamin, 2005). A traumatic birth can result in a maternal posttraumatic stress disorder (Beck, 2004). If an adverse outcome occurs with the infant, the parents may experience grief and anger. To provide adequate care for the caregivers, occupational therapists should include stress management, psychosocial education and suggestions, and information on support groups and resources. Strong rapport must be built to establish trust and ensure the caregivers know the therapists are there to answer their questions and help them through this process. Strong communication skills are required for working with this population. A variety of material should be included in the home program specifically for the caregiver, along with the interventions to be carried out with the infant.

### **Conclusion**

There are many conservative treatment options occupational therapists can utilize for infants with NBPP. Each intervention option has a window of opportunity in which it can positively impact functional outcomes (Price et al., 2000). The combination of treatment interventions will vary depending on the unique needs of each infant and their caregiver. Occupational therapists must carefully evaluate the infant and caregiver's situation in order to provide the most effective treatment possible.

## Quality of Life

Quality of life for infants with NBPP can be affected greatly. Quality of life has multiple definitions, but according to the Centers for Disease Control and Prevention, or CDC, (2011), quality of life is “a broad multidimensional concept that usually includes subjective evaluations of both positive and negative aspects of life.” Health-related quality of life (HRQL) is a more specific term that is utilized in literature and refers to the “multi-dimensional concept that includes domains related to physical, mental, emotional and social functioning. It goes beyond direct measures of population health, life expectancy and causes of death, and focuses on the impact health status has on quality of life” (Healthy People 2020, 2014).

Akel et al. (2013) conducted a study in which they examined the HRQL in children with NBPP and found those individuals have a poorer HRQL when compared to their healthy peers. Furthermore, not only does NBPP cause the infant functional disability and a poorer quality of life, but also affects the caregiver and/or family and their quality of life (Firat et al., 2012) Firat, Oskay, Akel, and Öksüz (2012) explored the impact of NBPP on parents of children with NBPP by administering the Impact on Family Scale (IPFAM) questionnaire. The IPFAM questionnaire is “a self-report instrument that measures the effects of childhood chronic conditions and disabilities on parents” based on four parameters: financial burden, social impact, personal strain, and mastery/coping. The authors discovered parents of children with NBPP are moderately affected by their child’s disorder, meaning as a percentage, the overall mean impact was 56%. The area with the greatest impact on the mothers was in the social parameter. These results indicate

the significant impact NBPP may have on a parent or caregiver's social life due to the added time and responsibilities required to care for the infant (Firat et al., 2012).

Managing the infant's health condition effectively can be a challenge that can be overwhelming for caregivers (Karadavut & Uneri, 2011). The demands of caring for an infant are increased when the infant has a disability due to the need for extensive resources and support (Alyanak et al., 2013). Alyanak, Kılınçaslan, Kutlu, Bozkurt, and Aydın (2013) found that families of children with chronic disabilities experience challenges in family adaptability, family cohesion, family conflict, parent-child interaction and family problem-solving skills. All of these challenges a caregiver must face can result in high stress levels, which can be both physically and psychologically taxing on health and well being (Raina et al., 2004). Stress experienced may be due to emotional demands, social isolation and/or a perceived lack of competence in caring for the infant (Dellve, Samuelsson, Tallborn, Fasth, & Hallberg, 2006).

Caregivers may experience depression, anger, and frustration as a result of these challenges and high stress levels (Matlow et al., 2006). Karadavut & Uneri (2011) reported the caregivers of children with disabilities have been found to have an increased incidence of depressive disorders and higher anxiety levels, but in their study, there was no significant difference in anxiety, exhaustion, depersonalization, and personal accomplishment between the mothers of children with NBPP of varying levels. This indicates the disability itself has a larger impact than the severity of the disability.

Bellew and Kay (2003) discussed how initial distress may be due to the discrepancy between the baby that was expected and planned for and the baby that was born (Bellew & Kay, 2003). This can be worsened when they view themselves as being surrounded by parents who are happy with “perfect” babies (Bellew & Kay, 2003). Bicknell (1983) explained a “modified” bereavement response where the parents go through stages of mourning for the anticipated baby. The stages that lead to acceptance and attachment to the baby are “shock, panic, denial, grief, guilt, anger, bargaining, acceptance, ego-centered work and ‘other’ center work” (Bicknell, 1983).

Additionally, caregiver burnout can be a major concern. Karadavut and Uneri (2011) stated, “burnout can be defined as the state of physical and emotional depletion.” The three key symptoms associated with burnout include depersonalization, exhaustion, and decreased personal accomplishment (Karadavut & Uneri, 2011). Along with emotional and physical problems, burnout is reflected in the behavior of the caregivers and can interfere with their daily occupations (Karadavut & Uneri, 2011; Matlow et al., 2006) At an extreme level they may harm themselves or others as a result (Maslach, 1978; Maslach & Jackson, 1981).

Psychosocial support and connection to resources is essential for caregivers who are struggling with their given situation (Ramos & Zell, 2000). Occupational therapists can assist caregivers with these issues by making them a collaborative partner of the treatment team using a client-centered approach. In order to do this, occupational therapists need to identify chronic stressors and help caregivers



establish the skills to reduce or eliminate them in order to prevent psychiatric problems that interfere with daily life (Karadavut & Uneri, 2011).

### **Home Programming**

Caregivers are often expected to continue their infant's therapy at home, and therefore are integral members of the treatment team. According to Ramos & Zell (2000), a comprehensive home program is an essential component in the treatment of NBPP. Segal and Beyer (2006) stated home programs are "sets of activities introduced by occupational therapists to be performed at home." Home exercise programs (HEPs) have been shown to be critical in ensuring infants with disabilities achieve the greatest functional outcomes possible (Rasmussen, Justice, Chang, Nelson, & Yang, 2013).

A home program should include, but is not limited to, things such as PROM, positioning and carrying techniques, age-appropriate activities to incorporate sensory stimulation, and weight bearing to the affected upper extremity (Durlacher, et al., 2014; Ramos & Zell, 2000). It may also include information on patient and family support, how to prevent contractures, and techniques to optimize returned function (Giele, 1999). Initially, the home therapy may need to be supervised by the therapist in order to educate the caregiver adequately on the HEP and maintain the infant's ROM until the caregiver feels comfortable with the program (Hale et al., 2010). The home program should be assessed and updated on a regular basis (Ramos & Zell, 2000).

There are many factors that contribute to the ability of a family to successfully integrate a home program into their lives, making it a complex process.

Some of these factors include: other competing demands, time, support, skill, differing roles of parents and occupational therapists, and differing values and priorities (Segal & Beyer, 2006). One of the most important factors a therapist must take into consideration is the family's daily routines, as routines provide a sense of order and organize daily life, as well as expose the values and priorities of a family (Segal & Beyer, 2006). Segal (2004) stated routines are "patterned behaviors that have instrumental goals" and "repeat in predictable intervals." Through this, they give order to life. Routines allow people to function smoothly and efficiently; a disruption in this may cause temporary chaos for the individual. Occupational therapists must take this into consideration when implementing a home program and work with the caregiver to create a home program that fits into existing routines, or disrupts it as little as possible. For example, occupational therapists may instruct caregivers to perform ROM exercises with each diaper change, clothing change or bottle feeding in order to ensure it fits easily into their daily routine (Muhlig, Blaauw, Sloof, Kortleve, & Tonino, 2001; Piatt, 2004).

Adherence to a home program is a common issue therapists face. Segal and Beyer (2006) conducted a study on parental adherence to home treatment programs found three major issues that contributed to family's adhering to a brushing and compression program for children with sensory defensiveness: how the child responded to the intervention, the perceived efficacy of the intervention, and issues that arose when the program was incorporated into the family's daily life. Strategies occupational therapists found to contribute to increase adherence to a home program include educating parents about the intervention and why it is being

used; fitting the program into the family's existing daily routine; using charts to track adherence; and asking the parents to implement the program for a trial period (Segal & Beyer, 2006).

Some therapists may be reluctant to provide caregivers with too much information and overwhelm them. Bellew and Kay (2003) examined early experiences of parents with NBPP in order to determine areas of dissatisfaction with care and found dissatisfaction with communication existed. The participants of this study reported dissatisfaction with how health professionals handled the situation overall and how information was communicated to them (Bellew & Kay, 2003). Bellew and Kay (2003) also found that no participant felt they were given too much information and approximately one-third of each group said they did not receive enough information. One participant stated, "The hospital and G.P. did not give us any information on Erb's Palsy or support. It was left to ourselves to find out about his condition and treatment". Another participant said, "My G.P.'s ignorance caused me to learn about Erb's Palsy through a magazine article" (Bellew & Kay, 2013).

Benjamin (2005) stressed the importance of fully informing caregivers about the child's brachial plexus injury, specifically on the type and possible unfavorable outcomes. Giele (1999) elaborated on this statement by suggesting caregivers should be informed by members of the treatment team of the diagnosis, possible etiology, significance of nerve injury to the upper limb, the uncertainty of the degree of nerve injury, possible outcomes, the need for regular follow-up, how to protect the affected limb, and the importance of therapy (Giele, 1999).

These findings imply the communication process should be individualized for each caregiver and the necessity of finding a balance of how much and when the information is provided (Gibbs, 2013). Bellew & Kay (2003) stated communication should happen both verbally and in writing, and the caregivers should be given sufficient time to process and understand the information. There should always be an opportunity to ask questions, because providing information is not a one-time event and occurs throughout treatment. Participants in their study reported that they did not want to know vague details, but rather detailed information about the effect on their child. They wanted practical information on what they can do, which would provide them hope (Bellew & Kay, 2003). Similarly, in a study by Bager (1997), mothers reported not receiving enough information early on about their child's injury and were unsure of how to handle the situation. Bellew and Kay (2003) suggested during communication with the caregivers, the child should be portrayed positively, and any negative information provided to the caregiver should include a positive statement as well.

Throughout treatment, occupational therapists must consider the individual's background and strive to be culturally competent in order to meet their unique needs. As cited in Suarez-Balcazar et al. (2009), Campinha-Bacote stated *cultural competence* is when a therapist understands and respects the differences in an individual's health beliefs and behaviors, and is able to adjust treatment to provide effective interventions for the client. An individual's culture assists in shaping their values, routines, beliefs, interests, and the occupations they

participate in, which are important things an occupational therapist must consider when working with a caregiver and designing a treatment plan.

### **Theoretical Framework**

The Model of Human Occupation (MOHO) was utilized to develop and organize this scholarly project. This model was chosen due to the connection between its main concepts with the overall focus of this project. MOHO emphasizes client-centeredness, which allows a therapist to incorporate and respect the client's perspectives and desires (Kielhofner, 2008). This will allow the caregivers to have an active role in the therapy process and help develop a program that is effective. The model also emphasizes a holistic view of the client, requiring the therapist to look at all aspects of the client in order to provide individualized care to meet his or her unique needs (Kielhofner, 2008). Lastly, habituation is another main concept of MOHO, which focuses on the importance of habits and routines in daily life and how they affect an individual's occupational performance (Kielhofner, 2008). This concept is important for a therapist to consider when developing a home program for a caregiver and their infant. It is key to incorporate home program activities within the family's routines and daily life in order to increase compliance and outcomes.

The Adult Learning Theory was also used to guide the formation of this scholarly project. The target audience for this project is caregivers of infants with NBPP who will be adults the majority of the time. This theory is learner-centered, which correlates with MOHO's client-centered approach and allows the client and therapist to have a collaborative relationship (Bastable & Dart, 2011). With adults,

the prime motivator for learning is being able to apply the knowledge and skills they learn to solve problems, and they must clearly see how and why information presented to them is relevant (Bastable & Dart, 2011). When these principles are addressed, the caregiver is more motivated and has adequate volition to provide the best care for their infant.

### **Summary**

Neonatal brachial plexus palsy is the partial or total paralysis of the upper extremity due to trauma of nerves of the brachial plexus during childbirth that results from high pressures in-utero or during delivery (Akel et al., 2013; Dodds & Wolfe, 2000; Foad et al., 2008; Kay, 1998; Vaz et al., 2010). The two types of NBPP discussed throughout this literature were Erb's palsy and Klumpke's palsy (Benjamin, 2005). Infants with NBPP may experience limited ROM, pain, loss of sensation, weakness, and/or partial to complete paralysis of the arm and hand, resulting in functional deficits, difficulties with achievement of developmental milestones, and challenges in the participation of daily occupations (Harrison, 2009). These deficits create additional stress on caregivers, as infants with physical disabilities require more care, attention, and direct supervision (Firat et al., 2012). Caregivers are also expected to carry out home programs, which can create additional demands and stress.

Home programs are an essential component of treatment for infants with NBPP as they can address all of the necessary concerns for both the infant and caregiver. Occupational therapists are an ideal fit to treat infants with NBPP due to their educational background and experience in many areas including pediatrics,

psychosocial issues, and physical disabilities. However, despite this ideal fit, there are no other home programs or guidelines in current literature for occupational therapists to utilize when working with infants with NBPP and their caregivers. This scholarly project is therefore unique and desirable in the field of occupational therapy. The manual created in this scholarly project allows the therapist to use a holistic viewpoint in order to evaluate all aspects of the client and discover how they impact one another. This allows the development of a comprehensive and effective treatment plan, and results in better outcomes. Through this, caregivers and infants will experience an overall better quality of life.

## **CHAPTER III**

### **METHODOLOGY**

The product, a manual entitled *Supporting Caregiver and Infant Health in the Home: A Guide for Caregivers of Infants with Neonatal Brachial Plexus Palsy*, was created in order to provide caregivers with a resource containing a plethora of information all in one location. The goal of this manual was to aid caregivers in caring for their infant with an easy-to-use occupational therapy home program. The manual contains information on a variety of topics, including information for caregivers on what to expect from their infant with NBPP, how to care for their infant, activities to utilize from zero to twelve months of age to improve function, the importance of taking good care of themselves, and ways to do so is included in the manual. A manual for the occupational therapist was also developed in order to assist them in implementing the program with clients. The manual contains information on what the caregiver's guide contains, how the manual is intended to be used, and how the therapist can modify or adapt the manual as needed in order to best fit with the needs of the caregiver and infant.

The Model of Human Occupation (MOHO) was utilized to develop and organize this scholarly project. This model was chosen due to the connection between its main concepts with the overall focus of this project. MOHO emphasizes



client-centeredness, which allows a therapist to incorporate and respect the client's perspectives and desires (Kielhofner, 2008). The Adult Learning Theory was also used to guide this scholarly project. The target audience for this project is caregivers of infants with NBPP, who will be adults the majority of the time. This theory is learner-centered, which correlates with MOHO's client-centered approach and allows the client and therapist to have a collaborative relationship (Bastable & Dart, 2011). With adults, the prime motivator for learning is being able to apply the knowledge and skills they learn to solve problems, and they must clearly see how and why information presented to them is relevant (Bastable & Dart, 2011). When these principles are addressed, the caregiver is more motivated and has adequate volition to provide the best care for their infant.

In order to create this manual, a thorough review of the literature was completed from April 2014 to November 2014. Relevant literature was found by using various combinations of the following search terms: brachial plexus injury, brachial plexus injuries, brachial plexus, neonatal brachial plexus palsy, neonatal brachial plexus injury, obstetric brachial plexus injury, occupational therapy, treatment, evaluation, pediatrics, children, quality of life, caregivers, and home programming. These terms were utilized within a variety of search engines including CINAHL, PubMed, American Journal of Occupational Therapy, Academic Search Premiere, EBSCO, Science Direct, OT Seeker, and Google Scholar.

# **SUPPORTING CAREGIVER AND INFANT HEALTH IN THE HOME**

A Guide for Caregivers of Infants with  
Neonatal Brachial Plexus Injuries



Maranda Myrold, MOTS  
Taryn Wagner, MOTS  
Mandy Meyer, Ph.D.

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Anxiety

Depression

Coping Skills

Caregiver Burnout

The Importance of a Healthy Life Balance

## **Introduction**

The purpose of this manual is to be a resource for you as a caregiver while caring for your infant with a brachial plexus injury. There may be times when you feel overwhelmed and find it hard to remember everything you have been told. This manual is a place where you can keep all of this information.

Included in this manual is information about brachial plexus injuries, your role as a caregiver, and instructions for the home program. It is the authors' and therapists' hope this will be a great resource for you and meet your needs. Information about infants the same age as yours, what types of things they typically do, and what you can expect is also included in this manual. This includes ideas for activities, things to look for, and guidelines to follow from your occupational therapist.

Also in this manual is information about taking care of yourself, including areas of mental and emotional wellness caregivers often experience challenges in, as well as resources to utilize during these challenging times. Taking good care of yourself is a top priority and will allow you to provide the best care you can for your infant. Your occupational therapist may provide you with other handouts throughout your time in occupational therapy. Let your occupational therapist know if you feel you would like more information on any topic.

## **Your Role as a Caregiver**

Based on your daily life and responsibilities, how you define being a caregiver may be different from how others define this role. Your responsibilities may be different from others, and may change over time as your infant grows and learns. It is important to remember you are your infant's best support and an important part of the treatment team. With the help of the rest of the treatment team, you will provide the best care for your infant possible during these early years.

Your occupational therapist will help you begin a home program as soon as possible. The first three months are the most important time to help your child recover. Three months is typically the time when you and your surgeon will decide if your infant should have surgery, as brachial plexus injuries typically resolve within the first six months, although some injuries can be permanent. It has been found that starting therapy early gives infants the best chance for recovery.

As a caregiver, you are the person who will spend the most time with your infant, which makes you a large part of the therapy process. This guide will help you to keep track of questions you may have throughout the process, as well as contact information for the various members of the treatment team. It will also help your occupational therapists provide you with the best care by allowing them to find ways to fit activities into your day in the best way possible.

Communicating with the treatment team on what is working well and what you are having trouble with is important in order to provide the best care for your infant. Your occupational therapists want to find the best way to assist you and help you learn effective methods for you and your infant. Your therapy team is here to answer your questions, help you get the information you need, and guide you in providing care for your infant and yourself.

# Neonatal Brachial Plexus Injuries

## The Brachial Plexus

The brachial plexus is a bundle of five nerves that travel through the shoulder area to the fingers. These nerves come out of the spinal cord in the back and upper back. The part of the spine that is in the neck is made up of cervical (C) vertebrae. With a brachial plexus injury, the areas that can be affected include C5, C6, C7, and C8. The vertebrae in the upper back are called the thoracic (T) vertebrae. The T1 vertebrae may also be affected when a brachial plexus injury occurs. The nerves associated with these vertebrae control movement and feeling from the shoulder to the fingers. Figure 1 shows an example of the brachial plexus.

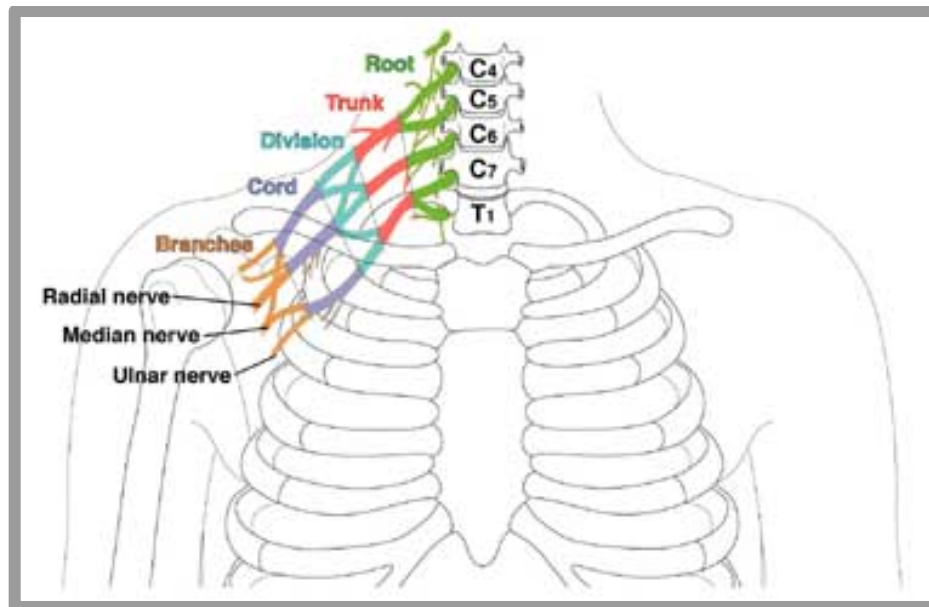


Figure 1

Image used with permission from Cincinnati Children's Hospital Medical Center

## **Types**

There are different types of brachial plexus injuries. The two most common are Erb's Palsy and Klumpke's Palsy. The types vary depending on the location of the injury and how nature of the injury, whether it was a stretch or a tear of the nerve(s).

### **Erb's Palsy**

Erb's Palsy is a type of neonatal brachial plexus palsy (NBPP) caused by damage to the C5, C6 and C7 nerves. Erb's Palsy can result in some or full paralysis of the arm. The ability to feel can also be effected.

### **Klumpke's Palsy**

Klumpke's Palsy is a type of NBPP caused by damage to the C7, C8, and T1 nerves. Klumpke's Palsy can involve paralysis in the arm from the elbow to the hand. This type of injury primarily affects the wrist and fingers.



## What to Expect

This guide provides you with ideas for activities that will help your infant try to do the tasks that other infants their age without NBPP are expected to do. Your infant may have more trouble with some of these tasks due to difficulty moving his or her hand and arm. Activities such as sitting up, rolling, and playing with toys with both hands will also be challenging for your infant due to their NBPP symptoms. For example, when your infant starts to sit on their own, he or she may need to use their non-affected arm to hold them up and their affected arm may not be able to move enough to play. Play will then require extra support so both arms are free, and your infant may need to do different play activities to practice balancing, using both hands, and putting weight through both hands. This will vary for each infant with NBPP, but your infant's symptoms may affect his or her ability to complete various activities in the same way as other infants.

As the torn or stretched nerves heal and can communicate more with your infant's brain, you may see improvements in how your infant moves their affected arm and hand. Helping your infant to move their arm and hand is important for helping their body to heal and build pathways from their brain to their arm so their body may work effectively. When your infant tries to or is able to move their arm and hand it signals the brain which in turn helps to the brain to recognize the arm and hand are there for movement. The activities for each month in this guide focus on building the skills needed for these movements, and once those are achieved, the guide focuses on activities that promote moving the hand and arm. These activities are best done along with things you do throughout your day, such as feeding, diaper changes, dressing and play time.

## Contact Information

### Occupational Therapist

Name: \_\_\_\_\_

Phone Number: \_\_\_\_\_

Email Address: \_\_\_\_\_

Address: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

### Physical Therapist

Name: \_\_\_\_\_

Phone Number: \_\_\_\_\_

Email Address: \_\_\_\_\_

Address: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

### Neurologist

Name: \_\_\_\_\_

Phone Number: \_\_\_\_\_

Email Address: \_\_\_\_\_

Address: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

### Other

Name: \_\_\_\_\_

Phone Number: \_\_\_\_\_

Email Address: \_\_\_\_\_

Address: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

### Medical Doctor

Name: \_\_\_\_\_

Phone Number: \_\_\_\_\_

Email Address: \_\_\_\_\_

Address: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

### Early Interventionist

Name: \_\_\_\_\_

Phone Number: \_\_\_\_\_

Email Address: \_\_\_\_\_

Address: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

### Orthopedist

Name: \_\_\_\_\_

Phone Number: \_\_\_\_\_

Email Address: \_\_\_\_\_

Address: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

### Other

Name: \_\_\_\_\_

Phone Number: \_\_\_\_\_

Email Address: \_\_\_\_\_

Address: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

## **Question Log**

You may write down any questions you have for members of the treatment team on this page. It is common to forget some of the questions you want to ask, so this can serve as a place to keep track of questions between appointments in order to ensure all your questions are being answered.

**Question:** \_\_\_\_\_

\_\_\_\_\_

**Who is this question for?** \_\_\_\_\_

**Answer:** \_\_\_\_\_

\_\_\_\_\_

**Question:** \_\_\_\_\_

\_\_\_\_\_

**Who is this question for?** \_\_\_\_\_

**Answer:** \_\_\_\_\_

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**Question:** \_\_\_\_\_

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**Who is this question for?** \_\_\_\_\_

**Answer:** \_\_\_\_\_

\_\_\_\_\_

**Question:** \_\_\_\_\_

\_\_\_\_\_

**Who is this question for?** \_\_\_\_\_

**Answer:** \_\_\_\_\_

\_\_\_\_\_

**Question:** \_\_\_\_\_

\_\_\_\_\_

**Who is this question for?** \_\_\_\_\_

**Answer:** \_\_\_\_\_

\_\_\_\_\_

**Question:** \_\_\_\_\_

\_\_\_\_\_

**Who is this question for?** \_\_\_\_\_

**Answer:** \_\_\_\_\_

\_\_\_\_\_

**Please let your occupational therapist know if you would like more  
question sheets.**

## Daily Schedule

Schedules can vary from day to day, but giving a general idea of what your typical day looks like will help the therapist(s) design the best interventions for you as a caregiver and your infant. Please list activities you complete each day within the time slot you complete them. For example, when you typically go to bed, eat meals, run errands, etc.

	<b>On a Weekday</b>	<b>On the Weekend</b>
5:00am		
6:00am		
7:00am		
8:00am		
9:00am		
10:00am		
11:00am		
12:00pm		
1:00pm		
2:00pm		
3:00pm		
4:00pm		
5:00pm		
6:00pm		
7:00pm		
8:00pm		
9:00pm		
10:00pm		
11:00pm		
12:00am		
1:00am		
2:00am		
3:00am		
4:00am		

## **Other Activities**

Many activities do not take place on a regular schedule and occur only occasionally. This section is for you to tell us about things you do that are not listed on the chart above. Please list these activities and information about when and where you do them. You can add to this list over time to help make the home program fit better into your schedule and activities. Examples of activities that may fit here include going out to eat, getting groceries, or visiting family or friends.

- **Activity:**
  - **Information** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
  
- **Activity:** \_\_\_\_\_
  - **Information** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
  
- **Activity:** \_\_\_\_\_
  - **Information** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

• **Activity:** \_\_\_\_\_

○ **Information** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

• **Activity:** \_\_\_\_\_

○ **Information** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

• **Activity:** \_\_\_\_\_

○ **Information** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

• **Activity:** \_\_\_\_\_

○ **Information** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**Please let your occupational therapist know you would like more  
schedule or activity sheets.**

## Support System

Family and friends can be important supports for you during this time. You may need extra help to get tasks done each day, someone who you can talk to, or someone you can count on to be there without notice. This is a place for you to think about who those people are in your life and write down some information about them so the occupational therapist has an idea of who the supportive people in your life are. You do not need to fill every space, just think of the people you would call if something went wrong.

**Name:** \_\_\_\_\_

**Name:** \_\_\_\_\_

Relationship: \_\_\_\_\_

Relationship: \_\_\_\_\_

How could this person support you?

How could this person support you?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**Name:** \_\_\_\_\_

**Name:** \_\_\_\_\_

Relationship: \_\_\_\_\_

Relationship: \_\_\_\_\_

How could this person support you?

How could this person support you?

\_\_\_\_\_

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\_\_\_\_\_

\_\_\_\_\_

**Name:** \_\_\_\_\_

**Name:** \_\_\_\_\_

Relationship: \_\_\_\_\_

Relationship: \_\_\_\_\_

How could this person support you?

How could this person support you?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

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## References

- Al-Mohanna, A., Al-Ramezi, K., Mohammad, S., Al-Jwear, N., Al-Ajmi, M., Abdulkareem, L.A.,...Al-defery, G. (2004). Physical therapy management of obstetric brachial plexus injury. Ministry of Health, Kuwait.
- Aman, J. (2014). Relaxation and coping techniques [Patient handout]. Partial Hospitalization Program, St. Alexius Hospital, Bismarck, ND.
- American Heart Association. (2012). What is caregiver burnout? [Handout]. Retrieved from [https://www.heart.org/idc/groups/heart-public/@wcm/@hcm/documents/downloadable/ucm\\_300657.pdf](https://www.heart.org/idc/groups/heart-public/@wcm/@hcm/documents/downloadable/ucm_300657.pdf)
- Chan, R. K. (2002). Splinting for peripheral nerve injury in upper limb. *Hand Surgery*, 7(02), 251-259.
- Durlacher, K. M., Bellows, D., & Verchere, C. (2014). Sup-ER orthosis: An innovative treatment for infants with birth related brachial plexus injury. *Journal of Hand Therapy*, x(x), 1-5. doi:10.1016/j.jht.2014.06.001
- Hervey-Jumper, S. L., Justice, D., Vanaman, M. M., Nelson, V S., & Yang, L. J. S. (2011). Torticollis associated with neonatal brachial plexus palsy. *Pediatric Neurology*, 45(5), 305-310.
- Mayo Clinic Staff. (2013, July 19). Stress management. Retrieved from <http://www.mayoclinic.org/healthy-living/stress-management/in-depth/stress-symptoms/art-20050987>
- Mayo Clinic Staff. (2014a, February 21). Depression. Retrieved from <http://www.mayoclinic.org/diseases-conditions/depression/basics/symptoms/con-20032977>

- Mayo Clinic Staff. (2014b, August 15). Anxiety. Retrieved from <http://www.mayoclinic.org/diseases-conditions/anxiety/basics/symptoms/con-20026282>
- National Institute of Mental Health. (n.d.). Signs and symptoms of depression. Retrieved from <http://www.nimh.nih.gov/health/topics/depression/men-and-depression/signs-and-symptoms-of-depression/index.shtml>
- Price, A., Tidwell, M., & Grossman, J. A. (2000). Improving shoulder and elbow function in children with Erb's palsy. *Seminars in Pediatric Neurology*, 7(1), 44-51. WB Saunders.
- Ramos, L. E., & Zell, J. P. (2000). Rehabilitation program for children with brachial plexus and peripheral nerve injury. *Seminars in Pediatric Neurology*, 7(1), 52-57. Retrieved from <http://ezproxy.undmedlibrary.org/login?url=http://search.ebscohost.com.ezproxy.undmedlibrary.org/login.aspx?direct=true&AuthType=ip,url,uid,cookie&db=c8h&AN=2000040863&site=ehost-live>
- Sherief, A. A. A. (2011). Electrical stimulation versus arm splint in improving fine motor skills in Erb's Palsy children. *Bull. Fac. Ph. Th. Cairo Univ*, 16(1), 91-96.
- Smith, M., & Kemp, G. (2014, November). Caregiver stress and burnout. Retrieved from <http://www.helpguide.org/articles/stress/caregiving-stress-and-burnout.htm>
- Smith, M., Robinson, L., & Segal, J. (2014, October). Anxiety attacks and anxiety disorders. Retrieved from

- <http://www.helpguide.org/articles/anxiety/anxiety-attacks-and-anxiety-disorders.htm>
- Smith, M., Saisan, J., & Segal, J. (2014, November). Depression symptoms and warning signs. Retrieved from <http://www.helpguide.org/articles/depression/depression-signs-and-symptoms.htm>
- Smith, M., & Segal, J. (2014, November). Coping with grief and loss. Retrieved from <http://www.helpguide.org/articles/grief-loss/coping-with-grief-and-loss.htm>
- Smith, M., Segal, R., & Segal, J. (2014, November). Stress symptoms, signs, and causes. Retrieved from <http://www.helpguide.org/articles/stress/stress-symptoms-causes-and-effects.htm>
- Sterr, A., Freivogel, S., & Schmalohr, D. (2002). Neurobehavioral aspects of recovery: Assessment of the learned nonuse phenomenon in hemiparetic adolescents. *Archives of Physical Medicine and Rehabilitation, 83*(12), 1726-1731.
- Vaz, D. V., Mancini, M. C., do Amaral, M. F., Brandao, M. B., Drummond, A. F., & da Fonseca, S. T. (2010). Clinical changes during an intervention based on constraint-induced movement therapy principles on use of the affected arm of a child with obstetric brachial plexus injury: A case report. *Occupational Therapy International, 17*(4), 159-167. doi:10.1002/oti.295
- Walravens, S. P. (2011, May 2). 10 tips for achieving a healthier work-life balance. Retrieved from <http://www.healthywomen.org/content/blog-entry/10-tips-achieving-healthier-work-life-balance>

Warshaw, S.P. (2006) *Help...at home: Developmental Support and information*  
handouts for families with infants and toddlers birth to three. Palo Alto, CA:  
VORT.

Your Life Your Voice. (n.d.). Stress and you: 99 coping skills. Retrieved from  
<http://www.yourlifeyourvoice.org/sitepages/tips/tip-99-coping-skills.aspx>

## References

- Abdel-Kafy, E. M., Kamal, H. M., & Elshemy, S. A. (2013) Effect of modified constraint induced movement therapy on improving arm function in children with obstetric brachial plexus injury. *The Egyptian Journal of Medical Human Genetics, 14*(3), 299-305. doi:10.1016.j.ejmhg.2012.11.006
- Akel, B. S., Öksüz, Ç., Oskay, D., Fırat, T., Tarakcı, E., & Leblebicioğlu, G. (2013). Health-related quality of life in children with obstetrical brachial plexus palsy. *Quality of Life Research, 22*(9), 2617-2624.
- Al-Mohanna, A., Al-Ramezi, K., Mohammad, S., Al-Jwear, N., Al-Ajmi, M., Abdulkareem, L.A.,...Al-defery, G. (2004). Physical therapy management of obstetric brachial plexus injury. Ministry of Health, Kuwait.
- Alyanak, B., Kılınçaslan, A., Kutlu, L., Bozkurt, H., & Aydın, A. (2013). Psychological adjustment, maternal distress, and family functioning in children with obstetrical brachial plexus palsy. *The Journal of Hand Surgery, 38A*, 137-142.
- Aman, J. (2014). Relaxation and coping techniques [Patient handout]. Partial Hospitalization Program, St. Alexius Hospital, Bismarck, ND.
- American Heart Association. (2012). What is caregiver burnout? [Handout]. Retrieved from [https://www.heart.org/idc/groups/heart-public/@wcm/@hcm/documents/downloadable/ucm\\_300657.pdf](https://www.heart.org/idc/groups/heart-public/@wcm/@hcm/documents/downloadable/ucm_300657.pdf)
- American Occupational Therapy Association. (2014). Research opportunities in the area of early childhood: Birth through 5 years. *American Journal of Occupational Therapy, 68*, 367-370. <http://dx.doi.org/10.5014/ajot.2014.683002>

- Anderson, L. J., & Anderson, J. M. (1988). Hand splinting for infants in the intensive care and special care nurseries. *American Journal of Occupational Therapy*, 42(4), 222-226.
- Bager, B. (1997). Perinatally acquired brachial plexus palsy—a persisting challenge. *Acta Paediatrica*, 86(11), 1214-1219.
- Bastable, S. B., & Dart, M. A. (2011). Developmental stages of the learner. In S. B. Bastable, P. Gramet, K. Jacobs, & D. L. Sopczyk (Eds.), *Health Professional as Educator: Principles of Teaching and Learning* (pp. 151-197). Sudbury, MA: Jones & Bartlett Learning, LLC.
- Beck, C. T. (2004). Birth trauma: In the eye of the beholder. *Nursing Research*, 53(1), 28-35.
- Bellew, M., & Kay, S. P. (2003). Early parental experiences of obstetric brachial plexus palsy. *The Journal of Hand Surgery (British & European Volume)*, 28B(4), 339-346.
- Benjamin, K. (2005). Part 2. Distinguishing physical characteristics and management of brachial plexus injuries. *Advances in Neonatal Care*, 5(5), 240-251.
- Bialocerkowski, A., & Grimmer, K. (2003). The clinical effectiveness of conservative management of children (under the age of two years) diagnosed with obstetric brachial plexus palsy. *JBIC Library of Systematic Reviews*, 1(6 Suppl), S25-S37.
- Bialocerkowski, A., Kurlowicz, K., Vladusic, S., & Grimmer, K. (2005). Effectiveness of primary conservative management for infants with obstetric brachial plexus

palsy. *International Journal of Evidence-Based Healthcare*, 3(2), 27-44.

doi:10.1111/j.1479-6988.2005.00020.x

Bicknell, D. J. (1983). The psychopathology of handicap. *British Journal of Medical Psychology*, 56, 167-178.

Boeschoten, K. H., Folmer, K. B., van der Lee, J. H., & Nollet, F. F. (2007). Development of a set of activities to evaluate the arm and hand function in children with obstetric brachial plexus lesion. *Clinical Rehabilitation*, 21(2), 163-170.

Centers for Disease Control. (2011). Health-related quality of life (HRQOL).

Retrieved from <http://www.cdc.gov/hrqol/concept.htm>

Chan, R. K. (2002). Splinting for peripheral nerve injury in upper limb. *Hand Surgery*, 7(02), 251-259.

Chang, K. W-C., Yang, L. J-S., Driver, L., & Nelson, V. S. (2014). High prevalence of early language delay exists among toddlers with neonatal brachial plexus palsy. *Pediatric Neurology*, 51, 384-389.

Clarke, H. M., & Curtis, C. G. (2001). Examination and prognosis. In A. Gilbert (Eds.), *Brachial plexus injuries* (pp. 159-172). London: Martin Dunitz.

Curtis, C., Stephens, D., Clarke, H. M., & Andrews, D. (2002). The active movement scale: an evaluative tool for infants with obstetrical brachial plexus palsy. *The Journal of Hand Surgery*, 27(3), 470-478.

Dellve, L., Samuelsson, L., Tallborn, A., Fasth, A., & Hallberg, L. R. (2006). Stress and well-being among parents of children with rare diseases: A prospective intervention study. *Journal of Advanced Nursing*, 53, 392-402.

- Deluca, S. C., Echols, K., Law, C. R., & Ramey, S. L. (2006). Intensive pediatric constraint-induced therapy for children with cerebral palsy: Randomized, controlled, crossover trial. *Journal of Child Neurology, 21*(11), 931-938.
- DeMatteo, C., Bain, J. R., Galea, V., & Gjertsen, D. (2006). Botulinum toxin as an adjunct to motor learning therapy and surgery for obstetrical brachial plexus injury. *Developmental Medicine & Child Neurology, 48*(04), 245-252.  
doi:10.1017/S0012162206000557
- DiTaranto, P., Campagna, L., Price, A. E., & Grossmail, J. I. (2004). Outcome following nonoperative treatment of brachial plexus birth injuries. *Journal Of Child Neurology, 19*(2), 87-90.
- Dodds, S. D., & Wolfe, S. W. (2000). Perinatal brachial plexus palsy. *Current Opinion in Pediatrics, 12*(1), 40-47.
- Dunham, E. A. (2003). Obstetrical brachial plexus palsy. *Orthopaedic Nursing, 22*(2), 106-116.
- Durlacher, K. M., Bellows, D., & Verchere, C. (2014). Sup-ER orthosis: An innovative treatment for infants with birth related brachial plexus injury. *Journal of Hand Therapy, x*(x), 1-5. doi:10.1016/j.jht.2014.06.001
- Firat, T., Oskay, D., Akel, B. S., & Öksüz, Ç. (2012). Impact of obstetrical brachial plexus injury on parents. *Pediatrics International, 54*(6), 881-884.  
doi:10.1111/j.1442-200X.2012.03734.x
- Foad, S. L., Mehlman, C. T., & Ying, J. (2008). The epidemiology of neonatal brachial plexus palsy in the United States. *The Journal of Bone & Joint Surgery, 90*(6), 1258-1264.



- Gibbs, D. (2013). Supporting parents and infants in neonatal intensive care. Winston Churchill Memorial Trust.
- Giele, H. (1999). Management of obstetrical brachial plexus palsy. *Current Paediatrics*, 9, 182-187.
- Gordon, A. M., Charles, J., & Wolf, S. L. (2005). Methods of constraint-induced movement therapy for children with hemiplegic cerebral palsy: Development of a child-friendly intervention for improving upper-extremity function. *Archives of Physical Medicine and Rehabilitation*, 86, 837-844.
- Hale, H. B., Bae, D. S., & Waters, P. M. (2010). Current concepts in the management of brachial plexus birth palsy. *The Journal of Hand Surgery*, 35(2), 322-331.
- Harrison, C. (2009). Brachial plexus injuries: What parents need to know. *Pediatrics For Parents*, 25(11/12), 26-27.
- Healthy People 2020. (2014). Health-related quality of life and well-being. Retrieved from <https://www.healthypeople.gov/2020/about/foundation-health-measures/Health-Related-Quality-of-Life-and-Well-Being>
- Hervey-Jumper, S. L., Justice, D., Vanaman, M. M., Nelson, V. S., & Yang, L. J. S. (2011). Torticollis associated with neonatal brachial plexus palsy. *Pediatric Neurology*, 45(5), 305-310.
- Ho, E. S., & Ulster, A. A. (2011). Evaluation of an education day for families of children with obstetrical brachial plexus palsy. *Families, Systems & Health: The Journal of Collaborative Family Healthcare*, 29(3), 206-214.  
doi:10.1037/a0025105

- Hoeksma, A. F., Steeg, T., Marie, A., Nelissen, R. G., Van Ouwerkerk, W. J., Lankhorst, G. J., & De Jong, B. A. (2004). Neurological recovery in obstetric brachial plexus injuries: A historical cohort study. *Developmental Medicine & Child Neurology, 46*(2), 76-83.
- Hoeksma, A. F., Wolf, H., & Oei, S. L. (2000). Obstetrical brachial plexus injuries: Incidence, natural course and shoulder contracture. *Clinical Rehabilitation, 14*(5), 523-526.
- Johnson, E. O., Troupis, T., Michalinos, A., Dimovelis, J., & Soucacos, P. N. (2013). Obstetrical brachial plexus palsy: Lessons in functional neuroanatomy. *Injury, 44*(3), 293-298.
- Karadavut, K. I. & Uneri, S. O. (2011). Burnout, depression and anxiety levels in mothers of infants with brachial plexus injury and the effects of recovery on mothers' mental health. *European Journal of Obstetrics & Gynecology and Reproductive Biology, 157*, 43-47. doi:10.1016/j.ejogrb.2011.03.001
- Kawabata, H. (2004, November). Treatment of obstetrical brachial plexus injuries: Experience in Osaka. *Seminars in Plastic Surgery 18*(4), 339. Thieme Medical Publishers.
- Kay, S. P. (1998). Obstetrical brachial palsy. *British Journal of Plastic Surgery, 51*(1), 43-50.
- Kerr, S. M., & McIntosh, J. B. (1998). Disclosure of disability: Exploring the perspective of parents. *Midwifery, 14*(4), 225-232.
- Kielhofner, G. (2008). *Model of human occupation: Theory and application*. Baltimore, MD: Lippincott Williams & Wilkins.

- Kozin, S. H. (2011). The evaluation and treatment of children with brachial birth palsy. *Journal of Hand Surgery, 36A*, 1360-1369.
- Krumlinde-Sundholm, L. & Eliasson, A-C. (2003). Development of the Assisting Hand Assessment: A Rasch-built measure intended for children with unilateral upper limb impairments. *Scandinavian Journal of Occupational Therapy, 10*, 16-26.
- Liggio, F. J., Tham, S., Price, A., Ramos, L. E., Mulloy, E., & Grossman, J. A. I. (1999). Outcome of surgical treatment for forearm pronation deformities in children with obstetric brachial plexus injuries. *Journal of Hand Surgery (British and European Volume), 24*(1), 43-45.
- Maslach, C. (1978). The client role in staff burn-out. *Journal of Social Issues, 34*(4), 111-124.
- Maslach, C., & Jackson, S. E. (1981). The measurement of experienced burnout. *Journal of Organizational Behavior, 2*(2), 99-113.
- Matlow, A., Stevens, P., Harrison, C., & Laxer, R. (2006). Disclosure of medical errors. *Pediatric Clinics of North America, 53*(6), 1091-1104.  
doi:10.1016/j.pcl.2006.09.008
- Mayo Clinic Staff. (2013, July 19). Stress management. Retrieved from <http://www.mayoclinic.org/healthy-living/stress-management/in-depth/stress-symptoms/art-20050987>
- Mayo Clinic Staff. (2014a, February 21). Depression. Retrieved from <http://www.mayoclinic.org/diseases-conditions/depression/basics/symptoms/con-20032977>

- Mayo Clinic Staff. (2014b, August 15). Anxiety. Retrieved from <http://www.mayoclinic.org/diseases-conditions/anxiety/basics/symptoms/con-20026282>
- Memo, L., Caminiti, S., Memo, A., Garozzo, D., & Ferraresi, S. (2013). Obstetrical brachial plexus injury. *Early Human Development, 89*(SUPPL4), S82-S84.
- Muhlig, R. S., Blaauw, G., Sloof, A. C. J., Kortleve, J. W., & Tonino, A. J. (2001). Conservative treatment of obstetrical brachial plexus palsy (OBPP) and rehabilitation. In A. Gilbert A (Eds.), *Brachial Plexus Surgery* (pp. 173-189). London: Martin Dunitz.
- National Institute of Mental Health. (n.d.). Signs and symptoms of depression. Retrieved from <http://www.nimh.nih.gov/health/topics/depression/men-and-depression/signs-and-symptoms-of-depression/index.shtml>
- Piatt Jr, J. H. (2004). Birth injuries of the brachial plexus. *Pediatric Clinics of North America, 51*(2), 421-440.
- Price, A., Tidwell, M., & Grossman, J. A. (2000). Improving shoulder and elbow function in children with Erb's palsy. *Seminars in Pediatric Neurology, 7*(1), 44-51.
- Raina P., O'Donnell M., Schwellnus, H., Rosenbaum P., King, G., Brehaut, J., . . . Wood, E. (2004). The health and well-being of caregivers of children with cerebral palsy. *Pediatrics, 115*:e626-36.
- Ramos, L. E., & Zell, J. P. (2000). Rehabilitation program for children with brachial plexus and peripheral nerve injury. *Seminars in Pediatric Neurology, 7*(1), 52-57. Retrieved from

<http://ezproxy.undmedlibrary.org/login?url=http://search.ebscohost.com.ezproxy.undmedlibrary.org/login.aspx?direct=true&AuthType=ip,url,uid,cookie&db=c8h&AN=2000040863&site=ehost-live>

- Rasmussen, L., Justice, D., Chang, K. W., Nelson, V. S., & Yang, L. J. (2013). Home exercise DVD promotes exercise accuracy by caregivers of children and adolescents with brachial plexus palsy. *PM&R: The Journal of Injury, Function, and Rehabilitation*, 5(11), 924-930. doi.org/10.1016/j.pmrj.2013.06.003
- Resnick, M. B., Eyler, F. D., Nelson, R. M., Eitzman, D. V., & Bucciarelli, R. L. (1987). Developmental intervention for low birth weight infants: Improved early developmental outcome. *Pediatrics*, 80(1), 68-74.
- Segal, R. (2004). Family routines and rituals: A context for occupational therapy interventions. *American Journal of Occupational Therapy*, 58, 499-508.
- Segal, R., & Beyer, C. (2006). Integration and application of a home treatment program: A study of parents and occupational therapists. *American Journal of Occupational Therapy*, 60, 500-510.
- Sharkey, M. A., Palitz, M. E., Reece, L. F., Rutherford, B. L., Akers, J. P., Alvin, B. L., & Budenholzer, B. R. (1990). The effect of early referral and intervention on the developmentally disabled infant: Evaluation at 18 months of age. *The Journal of the American Board of Family Practice*, 3(3), 163-170.
- Shenaq, S. M., Berzin, E., Lee, R., (1998). Brachial plexus birth injuries and current management. *Clinics in Plastic Surgery*, 25, 527-536.
- Shenaq, S. M., Armenta, A. H., Roth, F. S., Lee, R. T., & Laurent, J. P. (2005a). Current management of obstetrical brachial plexus injuries at Texas Children's

Hospital Brachial Plexus Center and Baylor College of Medicine. *Seminars in Plastic Surgery*, 19(1), 42. Thieme Medical Publishers.

Shenaq, S. M., Kim, J. Y., Armenta, A. H., Nath, R. K., Cheng, E., & Jedrysiak, A. (2004).

The surgical treatment of obstetric brachial plexus palsy. *Plastic and Reconstructive Surgery*, 113(4), 54e-67e.

Shepard. (1999). Brachial plexus injury. In S. K. Campbell (Eds.), *Decision-making in neurologic physical therapy* (pp. 235-259). PA: Churchill Livingstone.

Sherief, A. A. A. (2011). Electrical stimulation versus arm splint in improving fine motor skills in Erb's Palsy children. *Bulletin of Faculty of Physical Therapy*, 16(1), 91-96.

Shonkoff, J. P., & Hauser-Cram, P. (1987). Early intervention for disabled infants and their families: A quantitative analysis. *Pediatrics*, 80(5), 650-658.

Smith, M., & Kemp, G. (2014, November). Caregiver stress and burnout. Retrieved from <http://www.helpguide.org/articles/stress/caregiving-stress-and-burnout.htm>

Smith, M., Robinson, L., & Segal, J. (2014, October). Anxiety attacks and anxiety disorders. Retrieved from <http://www.helpguide.org/articles/anxiety/anxiety-attacks-and-anxiety-disorders.htm>

Smith, M., Saisan, J., & Segal, J. (2014, November). Depression symptoms and warning signs. Retrieved from <http://www.helpguide.org/articles/depression/depression-signs-and-symptoms.htm>

- Smith, M., & Segal, J. (2014, November). Coping with grief and loss. Retrieved from <http://www.helpguide.org/articles/grief-loss/coping-with-grief-and-loss.htm>
- Smith, M., Segal, R., & Segal, J. (2014, November). Stress symptoms, signs, and causes. Retrieved from <http://www.helpguide.org/articles/stress/stress-symptoms-causes-and-effects.htm>
- Sterr, A., Freivogel, S., & Schmalohr, D. (2002). Neurobehavioral aspects of recovery: Assessment of the learned nonuse phenomenon in hemiparetic adolescents. *Archives of Physical Medicine and Rehabilitation, 83*(12), 1726-1731.
- Storment. (2014). Guidelines for therapists: Treating children with brachial plexus injuries. United Brachial Plexus Network, Inc. Retrieved from <http://www.ubpn.org/resources/medical/pros/therapists/122-therapyguidelins>
- Suarez-Balcazar, Y., Rodawoski, J., Balcazar, F., Taylor-Ritzler, T., Portillo, N., Barwacz, E., et al. (2009). Perceived levels of cultural competence among occupational therapists. *American Journal of Occupational Therapy, 63*, 498-505.
- van Ouwerkerk, W. J. R., van der Sluijs, J. A., Nollet, F., Barkhof, F., & Slooff, A. C. J. (2000). Management of obstetric brachial plexus lesions: State of the art and future developments. *Child's Nervous System, 16*(10-11), 638-644.
- Vaz, D. V., Mancini, M. C., do Amaral, M. F., Brandao, M. B., Drummond, A. F., & da Fonseca, S. T. (2010). Clinical changes during an intervention based on constraint-induced movement therapy principles on use of the affected arm of a

child with obstetric brachial plexus injury: A case report. *Occupational Therapy International*, 17(4), 159-167. doi:10.1002/oti.295

Walravens, S. P. (2011, May 2). 10 tips for achieving a healthier work-life balance.

Retrieved from <http://www.healthywomen.org/content/blog-entry/10-tips-achieving-healthier-work-life-balance>

Warshaw, S.P. (2006) *Help...at home: Developmental Support and information*

handouts for families with infants and toddlers birth to three (2<sup>nd</sup> ed.). Palo Alto, CA: VORT Corporation.

Your Life Your Voice. (n.d.). Stress and you: 99 coping skills. Retrieved from

<http://www.yourlifeyourvoice.org/sitepages/tips/tip-99-coping-skills.aspx>



## APPENDICES

## APPENDIX A

## Consent to be Photographed and Published

I, Mary Beth Wagner, give my consent for my child to be photographed by Taryn Wagner and Maranda Myrold for the purposes of their scholarly project. I further authorize that the photographs may be published for the same purposes. I understand neither my nor my child's name will be included with the photographs, and will only be on this consent form.

Mary Beth Wagner  
Parent or Guardian Signature

11/9/14  
Date

## Consent to be Photographed and Published

I, Alicia Moss, give my consent for my child to be photographed by Taryn Wagner and Maranda Myrold for the purposes of their scholarly project. I further authorize that the photographs may be published for the same purposes. I understand neither my nor my child's name will be included with the photographs, and will only be on this consent form.

Alicia Moss

Parent or Guardian Signature

11/8/14

Date

## Consent to be Photographed and Published

I, Emily Wolters, give my consent for my child to be photographed by Taryn Wagner and Maranda Myrold for the purposes of their scholarly project. I further authorize that the photographs may be published for the same purposes. I understand neither my nor my child's name will be included with the photographs, and will only be on this consent form.

Emily Wolters  
Parent or Guardian Signature

11-15-2014  
Date

## Consent to be Photographed and Published

I, ASHLEY WEEMS, give my consent for my child to be photographed by Taryn Wagner and Maranda Myrold for the purposes of their scholarly project. I further authorize that the photographs may be published for the same purposes. I understand neither my nor my child's name will be included with the photographs, and will only be on this consent form.

Ashley Weems  
Parent or Guardian Signature

12/16/14  
Date

## Consent to be Photographed and Published

I, Cody Brekken, give my consent for my child to be photographed by Taryn Wagner and Maranda Myrold for the purposes of their scholarly project. I further authorize that the photographs may be published for the same purposes. I understand neither my nor my child's name will be included with the photographs, and will only be on this consent form.

Cody Brekken

Parent or Guardian Signature

12/29/14

Date

## Consent to be Photographed and Published

I, Emily Graff, give my consent for my child to be photographed by Taryn Wagner and Maranda Myrold for the purposes of their scholarly project. I further authorize that the photographs may be published for the same purposes. I understand neither my nor my child's name will be included with the photographs, and will only be on this consent form.

Emily Graff

Parent or Guardian Signature

12/1/2014

Date



## Consent to be Photographed and Published

I, Jenna Prudhomme give my consent for my child to be photographed by Taryn Wagner and Maranda Myrold for the purposes of their scholarly project. I further authorize that the photographs may be published for the same purposes. I understand neither my nor my child's name will be included with the photographs, and will only be on this consent form.

Jenna Prudhomme  
Parent or Guardian Signature

12/2/2014  
Date

## APPENDIX B

feedback <feedback@cchmc.org>

Wed 12/3/2014 3:50 PM

To:  
Wagner, Taryn;

Thank you for contacting Cincinnati Children's Hospital Medical Center. The image can be used as long as an image credit to "Cincinnati Children's Hospital Medical Center" is given underneath (or alongside).

Thank you,  
Web Team  
Marketing and Communications  
Cincinnati Children's Hospital Medical Center  
feedback@cchmc.org  
[www.cincinnatichildrens.org](http://www.cincinnatichildrens.org)

-----Original Message-----

From: taryn.wagner.2@my.und.edu [<mailto:taryn.wagner.2@my.und.edu>]  
Sent: Wednesday, December 03, 2014 11:38 AM  
To: feedback  
Subject: 5729 : Online Comment regarding Others...

Page Title: Contact Us  
Page URL: contact/us/  
Name: Taryn Wagner  
E-mail: taryn.wagner.2@my.und.edu  
Telephone:  
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Regarding: Others...

Comment: Hello, my name is Taryn Wagner and I am currently a 3rd year student in the Master's of Occupational Therapy program at the University of North Dakota. A fellow classmate and I are currently working on creating an occupational therapy manual for caregivers of infants with brachial plexus injuries for our final scholarly project. We were wondering if you would be willing to grant us permission to use the image of the brachial plexus on this web page in our manual:

<http://www.cincinnatichildrens.org/health/b/brachial-plexus/>

The image would serve to help explain the brachial plexus to caregivers. If you have any questions, please email me at taryn.wagner.2@my.und.edu. I look forward to hearing from you. Thank you.

Taryn Wagner, MOTS