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Occupation-Based Intervention Tool for Postoperative Upper Extremity Nerve Laceration

Rachel A. Bonneville
University of North Dakota

Jenna L. Meissner
University of North Dakota

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by

Rachel A. Bonneville, MOTS

Jenna L. Meissner, MOTS

Advisor: Anne M. Haskins

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Approval Page

This Scholarly Project Paper, submitted by Rachel A. Bonneville and Jenna L. Meissner in partial fulfillment of the requirement for the Degree of Master's 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.

Faculty Advisor

Dec. 11, 2017

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PERMISSION

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Signature Rachel Bonneville, OTS

Date 12/8/17

Signature Jenna Meissner, OTS

Date 12/8/17

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ABSTRACT

Purpose

The purpose of the product was to create an accessible resource for occupational therapists to implement occupation-based interventions effectively.

Methods

The results of a thorough literature review on the shared topic of interest supported the therapeutic value of occupation through education and home programming. The literature was used to justify the gap that exists in the need for the implementation of occupation-based interventions in hand therapy. The results from the literature review was synthesized into a detailed narrative that guided the formation of a patient education tool. The product was designed using concepts from the biomechanical frame of reference, Model of Human Occupation, and the Adult Learning Theory. These three theories work together to address the physical aspects of the human body, the internal factors of a person, and how to best relay information to an individual. Aspects from each of these theories were combined in order to increase the usability and effectiveness of occupation-based interventions in hand therapy settings.

Results

The literature and theoretical perspectives resulted in the formation of a collaborative patient education product. The product is meant to be used collaboratively between an occupational therapist and an individual with an upper extremity nerve laceration in an outpatient setting. The topics covered in this tool include neuroanatomy and neuroscience, common procedures, rehabilitation process, occupation-based intervention rationale, coping strategies, and

assessment and goal formation. The product includes a separate therapist manual that provides a brief summary of the research studies found that support the formation of the product.

Conclusions

It is anticipated that the patient education tool will be an efficient and effective solution to the perceived barriers that occupational therapists in hand therapy have to implementing occupation-based interventions. In addition to assisting therapists, it is the intention that this tool will improve the adherence to therapy routines, patient satisfaction, and patient outcomes.

Chapter I: INTRODUCTION

“Man, through the use of his hands, as they are energized by mind and will, can influence the state of his own health" (Reilly, 1962, p. 2). As a guiding principle for the formation of this scholarly project, this quote reflects the distinct value of occupational therapy. Occupational therapy (OT) is the client-centered, evidence-based, rehabilitative health service that addresses the therapeutic value of performing occupation (AOTA, 2014a). OT is the practice of “enhancing or enabling participation in roles, habits, and routines in home, school, workplace, community, and other settings” (AOTA, 2014a, p. S1). The therapeutic process is facilitated by the use of everyday life activities in order to achieve functional gains (AOTA, 2014a). According to the AOTA (2014b), OT is commonly indicated for people with upper extremity disabilities due to resulting disruption in their function in activities of daily living.

We first developed an interest in upper extremity and neurological conditions through our exposure to neuroanatomy coursework and experiential fieldworks. We were both assigned to a neurological rehabilitation floor in a physical disability setting of a hospital, in which we developed a passion. There has been a need for occupational therapists in this area due to the high prevalence of upper extremity ailments. According to Che Daud et al., (2016) an upper extremity nerve laceration is the most common type of upper extremity accident and its repair is the most common procedure performed by hand surgeons (Smith, 2011). Because of this, individuals with this injury were chosen as the population of interest.

Significance of the Identified Problem

Currently, the field of OT in hand therapy is dominated by the medical model and biomechanical frame of reference with little consideration of occupation (Colaianni & Provident,

2010). According to Colaianni and Provident (2010), there has been an existing dilemma for occupational therapists in this field when choosing between fundamental holistic and occupational treatment and treatment within the medical model. Occupation-based intervention (OBI) in hand therapy is defined as a treatment approach that balances biomechanical and medical principles with the value of occupation as the therapeutic method (Colaianni, Provident, DiBartola, & Wheeler, 2015). Currently, OBI is considered a solution for the disparity between the two pillars, medical and occupation as therapy, of hand treatment (Colaianni & Provident, 2010). Occupational therapists in hand therapy acknowledge the benefits of OBI in the treatment of nerve lacerations but continually face challenges in implementation (Che Daud et al., 2016; Colaianni, & Provident, 2010; Grice, 2015; Guzelkucuk, Duman, Taskaynatan, & Dincer, 2007; Toth-Fejel, Toth-Fejel, & Hedricks, 1998).

The accumulation of research suggests the lack of OBI in hand therapy is due to barriers such as time constraints, lack of therapist resources, reimbursement issues with insurance companies, and the predominant use of the biomechanical frame of reference (Grice, 2015). These obstacles in hand therapy result in low frequency usage of OBI and a reduction of client-centered care, which are two core components of occupational therapy (AOTA, 2014a). This has caused a decrease in client-centeredness, a loss for potential functional benefits from occupation, a lack of comprehensive treatment, and also a loss of cohesion for the professional identity of occupational therapy (Turner & Knight, 2015).

Product Proposal

In consideration of benefits and obstacles of OBI, we proposed a patient education tool as an intervention to be used in an outpatient, one-on-one setting. This tool will guide therapists to

demonstrate the therapeutic value of occupation to individuals with an upper extremity nerve laceration. Additionally, this tool includes holistic assessment tools that will facilitate the formation of occupation-based goals. The product also includes an occupation-based home program template that will be based on the individual's meaningful goals and pertinent occupation. In order to complete the formation of this product, the Model of Human Occupation (MOHO) and the Biomechanical Frame of Reference were used to build and guide the included educational components in this tool. Principles from the Adult Learning Theory were also implemented throughout the entire tool in order to maximize efficiency and facilitate optimal adult learning.

Key Terms

Biomechanical Frame of Reference: Addresses functional deficits through treatment of impairment of body structures. In this frame of reference, the principles of kinetics and kinematics are applied to the joint and skeletal muscle movements of the body (Turpin & Iwama, 2011).

Certified Hand Therapist: Health care practitioners that provide therapeutic intervention to prevent dysfunction, restore function and reverse the progression of pathology of the upper limb in order to enhance an individual's ability to execute tasks and to participate fully in life situations (Dimick et al., 2009).

Client: Persons, groups, and populations (AOTA, 2014a). Interchangeable with "patient".

Hand Therapy: The art and science of rehabilitation of the upper limb, which includes the hand, wrist, elbow and shoulder girdle. It is the merging of occupational and physical therapy theory

and practice that combines comprehensive knowledge of the structure of the upper limb with function and activity (Dimick et al., 2009).

Intervention: A plan that will guide actions taken and that is developed in collaboration with the client. It is based on selected theories, frames of reference, and evidence (AOTA, 2014a).

Model: A guiding set of principles for occupational therapists to guide their practice by providing terms that describe the practice and tools for evaluation and intervention (Boyt Schell, Gillen, & Scaffa, 2014).

Nerve Laceration: A lesion to the peripheral nerve, either partial or complete, that is caused by a sharp instrument or bone fragment (Smith, 2011).

Occupation-Based Intervention: A client-centered approach in OT in which an individual's performance is addressed and restored using meaningful activities, while a therapist maintains full awareness of the anatomical and neurological components involved in the deficit.

Occupational Being: By virtue of the human biological endowment, people of all ages and abilities require occupation to grow and thrive; in pursuing occupation, humans express the totality of their being, a mind–body–spirit union. (Hooper & Wood, 2014)

Occupational Therapy: An allied health profession that utilizes the therapeutic use of everyday life activities (occupations) with individuals or groups for the purpose of enhancing or enabling participation in roles, habits, and routines in home, school, workplace, community, and other settings. (AOTA, 2014a)

Occupational Therapist: Health care practitioners that are responsible for all aspects of occupational therapy service delivery (see “Occupational Therapy”) and are accountable for the safety and effectiveness of the occupational therapy service delivery process. (AOTA, 2014a)

Occupational Performance: The accomplishment of the selected occupation resulting from the dynamic transaction among the client, the context and environment, and the activity or occupation. (AOTA, 2014a)

Occupations: Meaningful everyday life activities, including activities of daily living (ADLs), instrumental activities of daily living (IADLs), work, sleep and rest, play, leisure, social participation, and education. (AOTA, 2014a)

Patient: The actual term used for clients or groups of clients receiving occupational therapy varies among practice settings and delivery models. For example, when working in a hospital, the person or group might be referred to as a patient or patients (AOTA, 2014a). Interchangeable with client.

Theory: A system of occupational therapy concepts and principles that guide and support practice, occupation-based models, and frames of references (Lee, Taylor, Kielhofner, & Fisher, 2008).

Treatment: For the purposes of this scholarly project, treatment has been defined as therapist-driven care administered to a patient based on physician-prescribed protocol, the medical model, and the biomechanical frame of reference.

Introduction to Chapters

This project is divided into several sections that outline the steps of the formation of the product. The following chapter contains a summary of the literature review that was conducted as the initial stages of this scholarly project. Following the literature review, the methodology is summarized, and the product is then introduced. This scholarly product then is summarized in a conclusion chapter, and following are the references and the appendix.

Chapter II: REVIEW OF LITERATURE

Introduction

Nerve Injuries

There are two nervous systems in the human body, the central nervous system (CNS) and the peripheral nervous system (PNS) (Bathen & Gupta, 2011). The CNS is composed of the brain and the spinal cord. The PNS is made up of the nerves that extend from the spinal cord (Bathen & Gupta, 2011). These nerves are also referred to as peripheral nerves (Bathen & Gupta, 2011). There are many mechanisms that lead to peripheral nerve injury. Internal pressure from tumors, fracture, or callus as well as forces from external sources can lead to peripheral nerve injury (Smith, 2011). Peripheral nerves are also vulnerable to chronic compression from low-grade, high-frequency activities that produce strong torque forces on the small joints of the upper extremity (Smith, 2011). Other causes include overstretch, electrical injuries, ischemia, traction, radiation, injection injury, and nerve laceration (Smith, 2011). Nerve laceration is commonly caused by internal bone fragments in the event of a closed fracture or a sharp external instrument, such as a knife or metal tool (Smith, 2011).

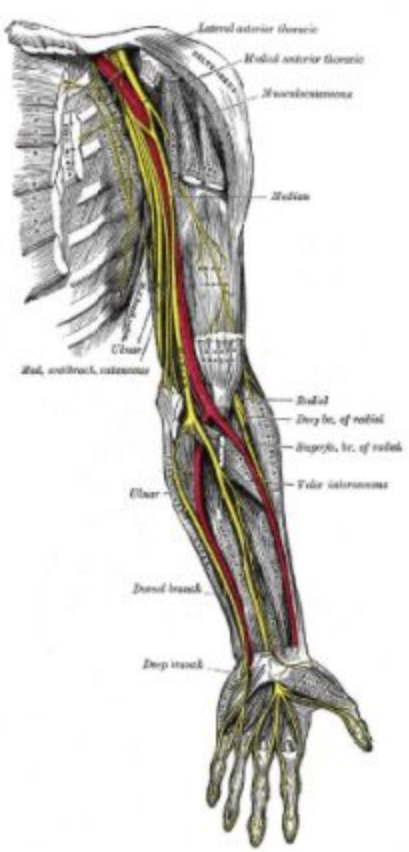

Figure 1: Nerves of the left upper extremity. (2015). Adapted from *Wikimedia Commons, the free media repository.* Retrieved 12:13, September 28, 2017 from https://commons.wikimedia.org/w/index.php?title=File:Nerves_of_the_left_upper_extremity.gif&oldid=152114389.

Surgical intervention is indicated for all nerve laceration injuries, whether the laceration is partial or complete (Smith, 2011). Most nerve laceration injuries involve a component of a crush injury, making reconstruction more complex (Smith, 2011).

Nerves of the upper extremity are particularly susceptible to injury due to their superficial position within the internal anatomy (Smith, 2011). Vulnerability to injury increases from the proximal aspect of the upper extremity toward the distal aspect (Smith, 2011). There are three major nerves of the upper extremity: the median, ulnar, and radial nerve (see Figure 1).

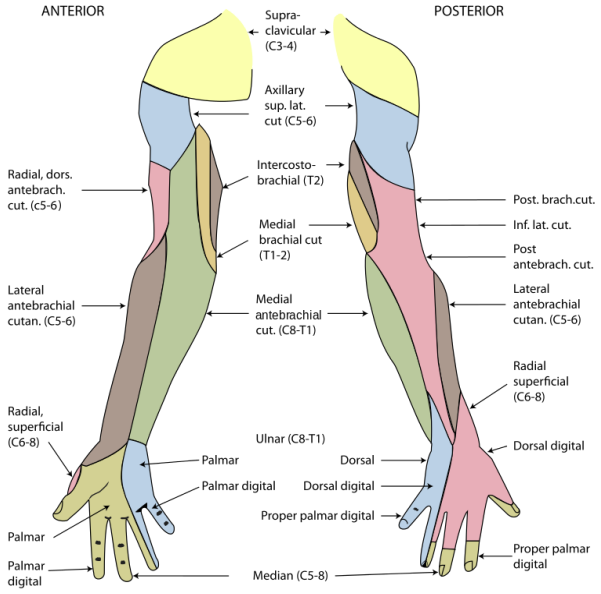

Figure 2: Nerves dermatomes of the upper extremity. (2016). Adapted from *Wikimedia Commons, the free media repository.* Retrieved 12:23, September 28, 2017 from https://commons.wikimedia.org/w/index.php?title=File:Gray812and814.svg&oldid=185364119.

Injury to any of these nerves or their distal branches can yield different prognoses, affecting different muscles, dermatomes, and function of the hand (Smith, 2011). The radial nerve supplies motor and sensory input to the posterior and dorsal aspect of the arm and hand (Smith, 2011). The ulnar nerve supplies the anteriomedial and palmar aspect of the arm and hand, and the median nerve supplies the anteriolateral and midline of the arm and hand (see

Figure 2) (Duff & Estilow, 2011). Although there are many types of nerve injuries, the scope of this literature review is specific to upper extremity peripheral nerve laceration.

Nerve Laceration

Injuries to the hand and arm resulting from accidents are the second most common after injuries to the head and neck (Che Daud, Yau, Barnett, Judd, Jones, & Nawawi, 2016). Injuries to the hand and finger are the most common non-fatal occupational injuries in the Emergency Room (ER) departments (Che Daud et al., 2016). Laceration, also referred to as a lesion, is the most common type of upper extremity accident and its repair is the most common procedure performed by hand surgeons (Che Daud et al., 2016; Smith, 2011). Hand injuries have a significant influence on physical function, ability to perform daily living activities, and on social, psychological, and financial aspects of life (Che Daud et al., 2016). Work is also significantly impacted by hand injuries, especially for those who operate machinery (Che Daud et al., 2016).

A nerve laceration results in immediate and progressive changes to the central and peripheral nervous systems (Novak & von der Heyde, 2015; Smith, 2011). Taylor, Anastakis, and Davis (2009) studied the connection between a peripheral nerve injury and the effect it has on the function, structure of the brain, and the peripheral extremities that are supplied by the nerves. Their results showed that due to lack of input to the nerve, there is both functional plasticity and structural abnormalities in several cortical areas following upper limb peripheral nerve transection and surgical repair (Taylor et al., 2009)

Laceration injuries to the median, ulnar, and radial nerve, as well as the brachial plexus account for the majority of nerve traumas of the upper extremity (Adelsberger & Bickhart, 2016; Aeillo, 2016; Pitts, Umansky, and Foister, 2016). Laceration of the median nerve can result in

paralysis or dysfunction of the thenar muscles, hypersensitivity or sensory loss of the thumb, second, third finger, and radial portion of the fourth finger (Barbosa, Fonseca, Elui, Mazzer, & Barbieri, 2012). Laceration at more proximal areas of the median nerve will affect muscles that move the thumb, which can lead to difficulties manipulating and grasping objects (Barbosa et al., 2012). Laceration of the ulnar nerve causes dysfunction or paralysis in the intrinsic hand muscles (Barbosa et al., 2012). Deficits from this injury can lead to ulnar claw hand, hypersensitivity or loss of sensation in 4th and 5th digits, and hyperabduction of the 5th digit (Barbosa et al., 2012). Functional deficits due to trauma include reduction in grip strength which affects one's circumduction ability, or the prehensile circular force around an object (Barbosa et al., 2012). Trauma to the radial nerve affects the extensor muscles of the upper extremity, which results in weakness in supination, wrist extension, finger and thumb extension (Barbosa et al., 2012). Paralysis of these extensor muscles leads to the deformity known as radial wrist drop (Barbosa et al., 2012). A brachial plexus traction injury occurs due to a direct trauma to the shoulder or cervical spine and can result in high levels of irritability, hyperpathia or, paresthesia of the distal muscles and extremity (Luca & Anthony, 2016).

Post-surgical nerve regeneration is never expected to reach complete clinical recovery (Lohmeyer, Sommer, Siemers, & Mailander, 2009). However, surgical reinnervation along with postoperative therapy centered around cortical reorganization can yield excellent functional outcome that can progress for 3-5 years after the injury (Lohmeyer et al., 2009; Novak & von der Heyde, 2015). Functional return predictors include a person's age, time between transection and surgical resection, and how well protected the coaptation site remains between nerve endings (Lohmeyer et al., 2009).

Etiology and Surgical Physiology of Nerve Trauma

Trauma to a nerve not only can result in associated paresthesias of the extremity, but also discomfort, aching, and sensory loss or hypersensitivity. (Neal & Fields, 2010). Nerve laceration reconstruction is performed in order to achieve coaptation (Smith, 2011). Coaptation is defined as the drawing together of the separated nerve tissue (Smith, 2011). The goal of surgery is to restore nerve continuity so that an optimum number of nerve fibers can reach their appropriate sensory or motor insertions (Luca, 2016). There are two types of direct repair techniques.

A primary nerve repair is used when there is a clean cut to the nerve and both ends can be sewn back together (Luca, 2016). The most common primary procedure is the epineurial repair technique (Smith, 2011). In this technique, a completely lacerated nerve is is realigned, end to end, and sutures are placed on the inner and outer epineurium of either side of the lesion (Smith, 2011). A perineural repair is the second most common primary procedure for this injury (Smith, 2011). In this procedure, outer and inner epineurium are dissected back, the fascicles are aligned, and the fascicular perineurium from both nerve stumps are sutured together (Smith, 2011). A secondary nerve repair is used after a crush injury or avulsion trauma when the injured portion of the nerve must be removed and the remaining uninjured nerve is sewn back together (Luca, 2016). If there is a significant gap between nerve endings in this kind of laceration, either extensive stretching or nerve grafting may be indicated (Smith, 2011). Tension at the coaptation site yields many risks, such as scar tissue buildup, anatomical contractures, limited axonal regeneration, and traction injuries (Smith, 2011). Stretching of the shortened nerve has shown to be ineffective in functional reinnervation (Smith, 2011). Because in a nerve transfer the

reinnervated muscle is motored from a new proximal nerve source, the patient must establish and relearn new motor patterns (Novak & von der Heyde, 2015).

The timeline of recovery for clients with upper extremity nerve traumas can be a tiring and long-term process. According to Luca (2016), postoperative nerve lacerations recover at a rate of 1-3 millimeters per day, 1 inch per month after the initial three week immobilization period. Depending on the type and severity of the injury, functional improvements are likely, but can take a year or more to achieve after the onset of the injury and can continue to progress for up to 5 years (Rosén & Lundborg, 2001; Sabapathy et al., 2007). As a result of the injury and lengthy recovery time, people with nerve trauma experience impaired occupational performance.

Occupational Therapy

"Occupation" is defined as meaningful everyday life activities, including activities of daily living (ADLs), instrumental activities of daily living (IADLs), work, sleep and rest, play, leisure, social participation, and education (American Occupational Therapy Association [AOTA], 2014a). ADLs include self-care, functional mobility, and eating and feeding (AOTA, 2014a). IADLs include community mobility, child care, and home care, among others (AOTA, 2014a). Successful participation in one's valued occupations has shown to be therapeutic, promote health and wellbeing, and increase overall life satisfaction (AOTA, 2014a). Many individuals, with or without a disability, experience difficulty with successfully engaging in meaningful occupations.

Occupational therapy (OT) is the client-centered, evidence-based, rehabilitative health service that addresses the therapeutic value of performing occupation (AOTA, 2014a). OT is the practice of "enhancing or enabling participation in roles, habits, and routines in home, school,

workplace, community, and other settings" (AOTA, 2014a, p. S1). The therapeutic process is facilitated by the use of everyday life activities in order to achieve functional gains (AOTA, 2014a). Practitioners in this field pursue body function remediation as well as adaptations and environmental modifications, all for the purpose of facilitating engagement and function in one's meaningful activities (AOTA, 2014b). Occupational performance is achieved "when a person engages in purposeful activities out of personal choice and they are valued" (AOTA, 2014a, p. S6). Occupational therapists commonly work in hospitals, clinics, homes, and schools and see a variety of client populations, including people with a cognitive disability, mental illness, or physical disability (AOTA, 2014a).

Hand Therapy

According to the AOTA (2014b), OT is commonly indicated for people with upper extremity disabilities due to resulting disruption in their function in activities of daily living. The upper extremity and the hand are extremely important for fine-motor tasks required in daily activities (AOTA, 2014b). Many occupational therapists treat and specialize in the upper extremity and hand and may eventually work toward obtaining their statuses as a Certified Hand Therapist (CHT) (Hand Therapy Certification Commission [HTCC], n.d.). According to Dimick, Caro, Kasch, Muenzen, Fullenwider, Taylor, Landrieu and Walsh (2009):

> Hand therapy is the art and science of rehabilitation of the upper limb, which includes the hand, wrist, elbow and shoulder girdle. It is the merging of occupational and physical therapy theory and practice that combines comprehensive knowledge of the structure of the upper limb with function and activity. Using specialized skills in assessment, planning and treatment, hand therapists provide therapeutic intervention to prevent

> dysfunction, restore function and/or reverse the progression of pathology of the upper limb in order to enhance an individual's ability to execute tasks and to participate fully in life situations (p. 374).

Eighty-five percent of certified hand therapists are occupational therapy professionals (Dimick et al., 2009). To become a CHT, either an OT or physical therapist must work for a minimum of three years in hand therapy and pass a national board exam (HTCC, n.d.). As with any population, including those people with upper extremity ailments, the role of occupational therapy is to facilitate a person's functional gains in order to return to valued activities of daily living (Dimick et al., 2009).

OTs are thoroughly equipped with the skills and abilities to provide intervention for people with injuries to the upper extremity. OTs are able to exercise prescription and application of physical agent modalities while also enabling clients through the use of occupation (Robinson, Brown, & O'Brien, 2016). They focus on the unique occupational needs of each individual by acknowledging each client as an occupational being. OTs working within hand therapy must incorporate the duality of anatomy and occupation by recognizing the benefits of existing evidence-based methods in conjunction with occupation as a therapeutic mechanism. Because the upper extremity is vital in performing activities of daily living, occupational therapists assist the client to refine skills and abilities that are needed to interact with the environment (Robinson et al., 2016).

Deficits Experienced

Occupations Affected

For individuals with a nerve laceration, a variety life occupations are negatively affected by their injury. This can include ADLs, IADLs, work, and other occupations. Changes can include significant pain sensation, hypersensitivity, and the development of non-adaptive movement. Non-adaptive movements are inefficient, substitute movement patterns that develop after an injury (Toth-Fejel, Toth-Fejel, and Hedricks, 1998). As an example, an individual might use his or her uninjured hand to both hold an item and open a drawer while holding his or her injured hand in a protective position due to fear of pain or injury (Toth-Fejel et al., 1998). Postoperative pain is expected initially for this population and is treated with analgesics, edema control, and early motion as permitted by the surgeon (Novak & von der Heyde, 2015). However, chronic, neuropathic pain has a likelihood of developing due to changes in sensation (Novak & von der Heyde, 2015). Individuals that develop chronic pain are typically referred to a multidisciplinary pain management team (Novak & von der Heyde, 2015). The development of chronic pain secondary to a nerve laceration creates further difficulty and potential dependence on regular pain medication (Novak & von der Heyde, 2015; Van Huet, Innes, & stancliffe, 2013). According to Bailey et al.,

> Pain has been shown to affect attention, memory, and manual dexterity negatively, resulting in poor physical performance, which can influence participation in meaningful activities and result in diminished quality of life (2009, p. 1687).

In addition to pain, protective positions can prevent therapeutic activity and effective participation in one's occupations. According to Rostami, Akbarahimi, Mehraban, Akbarinia,

and Samani (2016), “functional recovery following peripheral nerve injuries is often poor because of different factors especially bilateral cortical reorganization due to the lack of input from the injured nerve” (p. 2). Disuse of the injured hand leads to further inhibition and disability due to lack of sensory stimulation.

Cederlund, Thoren-Jonsson, and Dahlin (2010) found that subjects with nerve lacerations avoided many activities, including leaving the house, driving, and sexual activities due to either fear of causing more damage to their injury or cosmetic insecurity. One’s employment can also be affected by a nerve laceration, as some individuals may lose their employment status due to inability to complete work tasks (Cederlund et al., 2010; Che Daud et al., 2016). In some cases, this may lead to significant financial insecurity compounded with the cost of medical care (Che Daud et al., 2016).

Bailey, Kaskutas, Fox, Baum, and Mackinnon (2009) explored the effect that a nerve injury has on a person’s activity participation and quality of life. After a traumatic nerve injury, there was a 30 percent loss of participation in IADLs such as yard work, household chores, and shopping (Bailey et al., 2009). The highest activity loss was physical leisure activities, in which 48 percent of participants reported losing this activity(Bailey et al., 2009). The inability to participate in meaningful daily activities correlated with a lower measure of quality of life, higher levels of depression, and higher levels of pain (Bailey et al., 2009). The results from the study supported that nerve trauma affects an individual’s participation in meaningful activities, quality of life, and mental health (Bailey et al., 2009).

Psychological Considerations

The upper limbs, especially the hands, are a significant part of perceived body image and functional role of the body (Che Daud et al., 2016). A nerve laceration significantly impacts an individual's function and way he or she goes about daily life activities (Che Daud et al., 2016). Even after the initial injury, patients experience ongoing psychological distress that is usually not considered in rehabilitation (Miller, Peek, Power, & Heneghan, 2016). This psychological distress includes increased stress, frustration, loss of confidence, discouragement, and fear of reinjuring (Che Daud et al., 2016). The development of pain associated with the injury has been shown to affect emotional functioning more than physical functioning (Bailey et al., 2009). Clinical depression has been reported following this trauma as well as anxiety, post-traumatic stress disorder (PTSD), and avoidance of valued activities, which can further attenuate one's resilience and coping strategies (Che Daud et al., 2016). Cederlund et al. (2009) also emphasized the high probability of psychological and social impairments in individuals after upper extremity nerve injury. Bailey et al. (2009) found that participants with an upper extremity nerve injury reported a significantly lower psychological quality of life when compared with standardized norms. Although psychological distress is strongly associated with upper extremity nerve injury, it is not commonly considered in treatment for this patient population (Cederlund et al., 2010). According to Cederlund et al., (2010), "many patients with a hand injury may not get enough advice on how to cope in daily occupations. This may be due to a heavy workload at specialized hand surgery departments"(p. 7). Many consequences of trauma go undetected during clinical assessment, which can affect clinical outcomes, quality of life, and ability to return to work or

normal functioning (Miller et al., 2016). Bailey et al. (2009) emphasized the importance of psychological consideration of this population.

> Not only should hand surgeons and therapists understand our patient's pain and upper extremity symptoms, we should explore the effect of these symptoms on their psychological health and activity participation and help our patients learn alternative strategies to managing their symptoms through cognitive and behavioral approaches, in addition to pharmaceutical management (p. 1687).

Current Practice in Occupational Therapy

Medical Model & Biomechanical Frame of Reference

Models of practice are the philosophical base of the occupational therapy profession. Models are a way for occupational therapists to guide their practice by providing terms that describe the practice and tools for evaluation and intervention. (Boyt Schell, Gillen, & Scaffa, 2014). There are a multitude of models that can be used in a variety of practice settings with differing populations.

The medical model is a way to categorize disease and disability into objective measures of anatomy and physiology (Colaianni & Provident, 2010) and has historically guided health care in the U.S. It has been criticized for being reductionistic in its view of human health and wellness (Lohman & Peyton). The biomechanical frame of reference, commonly used with the medical model, addresses functional deficits through treatment of impairment of body structures (Turpin & Iwama, 2011) In this frame of reference, the principles of kinetics and kinematics are applied to the joint and skeletal muscle movements of the body (Turpin & Iwama, 2011). Equilibrium and movement are core concepts of these mechanical principles and are affected by forces that

act on bodily structures (Turpin & Iwama, 2011). The biomechanical frame of reference assumes that joint range of motion, muscle strength, and physical endurance result in voluntary movement and control (Turpin & Iwama, 2011). Like the medical model, the biomechanical frame of reference has been described in occupational therapy literature as being limited in its scope of holistic evaluation and intervention (Turpin & Iwama, 2011). According to Colaianni and Provident (2010), there has been an existing dilemma for occupational therapists in this field when choosing between fundamental holistic and occupational treatment and treatment within the medical model. Despite documented criticism, the medical model and biomechanical frame of reference together have been the basis for the rehabilitation process in hand therapy (Colaianni & Provident, 2010).

The biomechanical frame of reference is essential to evaluate the client's occupational performance within the physical disability setting (Cole & Tufano, 2008). This makes possible the remediation of skills and abilities and modification of tasks that are necessary to assist people towards independence (Cole & Tufano, 2008). Occupational therapists in hand therapy are guided by the biomechanical principles in splint designs, prosthetics use, and exercise regimes (Cole & Tufano, 2008). The biomechanical frame of reference is incorporated into the occupational therapy evaluation and intervention process as a means of objective data and frame for which the human body should function (Cole & Tufano, 2008).

The medical model is a foundation on which doctors and therapists have based protocols after surgery in order to enhance the recovery of the patient (Warren, 1993). A protocol is a record or plan that describes a specific procedure (Warren, 1993). Protocols are used as a framework for patient programmes to guide therapists on how to conduct their therapy and what

outcomes are to be expected (Warren, 1993). Occupational Therapists use protocols that are evidenced by research to ensure effectiveness and best practice for clients (Warren, 1993). There are specific protocols in place for the intervention process after the surgical repair of a nerve laceration.

The occupational therapy process is broken up into the evaluation, intervention, and outcomes of therapy (AOTA, 2014a). First, the occupational profile is taken which consists of the person's wants and needs, roles, occupations, and analysis of occupational performance (AOTA, 2014a). With the use of clinical reasoning, theoretical principles and models, and knowledge about the condition, occupational therapists engage the client in meaningful interventions that address their performance deficits (AOTA, 2014a). Throughout this process, occupational therapists are continually re-evaluating and modifying the interventions and plans based on the client's needs (AOTA, 2014a). The last phase is to evaluate the outcomes of the intervention process (AOTA, 2014a). Outcomes are directly connected to the methods that were used in intervention and the performance skills and patterns that were targeted during therapy (AOTA, 2014a). In order to evaluate the amount of improvement or change that occurred, occupational therapists rely on outcome measures (AOTA, 2014a).

Assessment

Upper extremity outcome measures are commonly used after an injury or trauma. There are many tests that measure the outcomes for lower extremity injuries, but there is a shortage of reliable tests that measure the outcomes for upper extremity injuries (Dowrick, A., Gabbe, B., Williamson, O., Cameron, P. (2005). It is crucial to understand the impact that an injury can have on the functional use and sensation of the upper extremity in order to plan interventions and

treatment. The following tests are specifically used for the upper extremity (Dowrick et al., 2005).

The Disabilities of the Arm, Shoulder and Hand (DASH) is a self-report questionnaire. This outcome measure determines upper-extremity disability and symptoms in specific regions according to what the patient believes. The DASH consists of a 30-item disability and symptom scale that ranges from 0, severe disability, to 100, no disability. (Dowrick et al., 2005).

The Jebsen Hand Function Test (JHFT) uses simulated activities of daily living in order to provide a standardized and objective evaluation of fine and gross motor hand function. This test is a performance-based measure that assess weighted and unweighted hand functions. According to Guzelkucuk, Duman, Taskaynatan, and Dincer (2007), the assessment includes "writing; turning over 3 by 5 inch cards; picking up small common objects; simulated feeding; stacking checkers; picking up large objects; and picking up large heavy objects" p 1431. Each task is completed with both the left and right hands and timed to assess performance (Guzelkucuk, et al., 2007, p. 1431).

The Semmes Weinstein Monofilament Test uses monofilaments of varying lengths and diameter for measuring touch-pressure threshold detection levels (Bell-Krotoski & Fess, 2016). This measurement gives a clear understanding of which area and to what degree a return of sensation has occurred after a nerve has been repaired (Bell-Krotoski & Fess, 2016). The practitioner can follow a standardized protocol starting with the lightest filaments.

Static two-point discrimination tests is one of the most frequently used test of sensibility (Bell-Krotoski & Fess, 2016). This test assesses an individual's ability to distinguish between one or two points of stimuli using an instrument with preset distances between two tips. There is

also a moving two-point discrimination test that can be used for early return after a nerve repair (Bell-Krotoski & Fess, 2016).

These tests and tools assist the therapist with providing objective data that they can use to guide their therapy interventions and treatment. They can also use this information as outcome measures to determine the effectiveness of their interventions and amount of return from a nerve.

Intervention Methods

The initial intervention for most postoperative upper extremity nerve injuries include rest and anti-inflammatory medications (Neal & Fields, 2010; Novak & von der Heyde, 2015; Slutsky, 2011). Between treatment sessions, protection and rest can be achieved through the use of splint to immobilize the injured nerve and associated muscle group (Neal & Fields, 2010; Novak & von der Heyde, 2015). Splinting is common after a repair in order to protect the repaired nerve from stretch and protect the hypersensitive extremity from being over stimulated (Vipond, Taylor, & Rider, 2007). External electrical stimulation may be indicated in order to reduce muscle atrophy due to prolonged periods of denervation (Novak & von der Heyde, 2015). The focus of therapy at this point is to maintain joint range of motion (ROM) and facilitate strength of surrounding structures (Slutsky, 2011).

The postoperative therapy treatment protocol is typically the same for primary and secondary nerve repair and nerve grafts (Luca, 2016). However, after a nerve graft, the immobilization period can be shorter because there is usually minimal tension on the nerve (Luca, 2016). After surgery, it is important to educate the patient regarding nerve regrowth, sensory reeducation, and surgical precautions (Luca, 2016). The goal of treatment after surgery is to maximize functional recovery, restore motor function, restore sensibility, and provide

adaptations and compensatory strategies for daily use (Luca, 2016). Additionally, joint mobilization to promote longitudinal nerve excursion is important once the immobilization stage has occurred (Slutsky, 2011).

During the first three weeks of recovery after a nerve repair, Luca (2016) stated that therapy is primarily for educating the client about sensitivity and pain, suggesting modifications and adaptations for ADLs, and movement of uninvolved joints. At this phase of healing, the focus is on immobilization with orthosis, wound management, edema management, and sensory substitution (Luca, 2016). Active range of motion (AROM) on uninvolved joints and protective AROM on joints within orthosis is encouraged (Luca, 2016). After the initial healing stage, the therapist can perform scar management through use of massage as tolerated (Luca, 2016). A baseline sensory evaluation and Tinel's sign should be completed for each nerve to assess the amount of sensory deficits experienced (Sharma-Abbott & Larson, 2016). Desensitization techniques are used at this time if hypersensitivity is occurring (Sharma-Abbott & Larson, 2016). The therapist should reinforce education of the protection of the sensitive areas and compensatory strategies for coping with pain (Sharma-Abbott & Larson, 2016). Orthosis or splints are adjusted throughout the stages as the doctors clear the joint for increased motion (Luca, 2016). It is important to educate the patient on expected sensations that are associated with sensory return (Sharma-Abbott & Larson, 2016). The sequence of sensory return is as follows: deep pressure and pinprick, then moving touch, then static light touch, and then discriminative touch (Duff & Estilo, 2015). Accurate localization of touch is typically last to return (Duff & Estilo, 2015).

Depending on client progress, the succession of movement should go from range of motion exercises to active-assisted ROM and then passive ROM if needed (Luca, 2016). When the client has reached week five or six, orthosis should only be worn at night except for use during functional activities or performing activities that could potentially harm the area (Luca, 2016). At this time, reevaluation of sensibility should be administered to assess progress and begin the first phase of sensory reeducation (Sharma-Abbott & Larson, 2016). Once reinnervation has occurred, the therapist will test grip and pinch strength and perform manual muscle testing to assess possible areas of muscle weakness (Luca, 2016). After these assessments are completed the therapist will have a better understanding for the need for further adaptations or equipment needed for ADLs (Luca, 2016). A home exercise program should be in place that continues strengthening and sensory re-education of the affected extremity (Luca, 2016).

Cortical Reorganization

Because the cortical representation of the hand becomes disorganized immediately after nerve injury, cortical reorganization is important to consider for occupational therapists (Rosen & Lundbord, 2015). A lack of input from the injured nerve causes structural changes in cortical regions (Taylor et al., 2009). The occupational therapist is challenged with the task of activating the cortical area that represents the damaged nerve in order to either maintain or reorganize the cortical representation of the affected body part (Lohmeyer et al., 2009). Prolonged denervation and lack of input from the injured nerve are associated with greater cortical change and disorganization, making functional recovery more difficult (Lohmeyer et al., 2009). Although difficult to achieve, cortical reorganization is an important consideration within occupational therapy and can be achieved through a variety of treatment methods (Lohmeyer et al., 2009).

Sensorimotor reeducation and strengthening become the focus in the later stages of postoperative nerve recovery (Novak & von der Heyde, 2015). Motor reeducation is a relatively new focus in hand therapy. It has recently been shown to greatly facilitate cortical remapping, more than sensory reeducation alone (Novak & von der Heyde, 2015). The use of both motor and sensory reeducation together is increasingly recognized as optimal care for people with nerve lacerations (Novak & von der Heyde, 2015).

Motor Re-Education

The motor re-education technique is used in order to relearn patterns of movement and facilitate cortical remapping of muscle activation (Novak & von der Heyde, 2015). After a motor or sensory nerve injury, the connection from the brain to the target muscle has been disrupted, which alters the motor patterns produced by the muscle, even after reconstructive surgery (Novak & von der Heyde, 2015). If this disruption exists for a longer time period, an individual may learn non-adaptive movement patterns to compensate for the loss of function (Novak & von der Heyde, 2015). In order to achieve motor and sensory functional gains, activity-based training with repetition and feedback is used (Novak & von der Heyde, 2015).Studies have shown that this method enhances cortical remapping following nerve reconstruction surgery and is crucial for sensorimotor relearning (Novak & von der Heyde, 2015).

Sensory Reeducation

It is also important to address sensory changes after a nerve injury and reconstruction. Novak and von der Heyde (2015) explained that sensation can be intensified in the associated area, causing hyperesthesia in many cases. Sensation can also be decreased or lost, which causes significant dysfunction in a person's daily life (Novak & von der Heyde, 2015). Sensory

reeducation is used to facilitate cortical reorganization and training of the nerve to achieve appropriate and functional sensation in the associated area (Novak & von der Heyde, 2015). Some practitioners believe that early sensory re-education can enhance cortical reorganization (Novak & von der Heyde, 2015). Sensory reeducation can be performed with mirror therapy, visuo-tactile training, and audio-tactile training (Novak & von der Heyde, 2015). In the case of hyperesthesia, desensitization can be achieved through introductions to different textures and tactile sensations (Novak & von der Heyde, 2015). This can include low-intensity vibration, which blocks nociceptor transmission according to the gate theory of pain (Novak & von der Heyde, 2015). Mirror therapy has shown to be effective for hyperesthesia (Novak & von der Heyde, 2015). With the injured hand occluded from sight and covered with a mirror reflecting the non-injured limb, stimulation is applied to the non-injured limb as the person perceives stimulation to the injured limb through the reflection (Novak & von der Heyde, 2015). This allows an individual to recognize a stimulus as non-painful by activating the contralateral cortex (Novak & von der Heyde, 2015).

Strengthening

Because a nerve injury disrupts regular muscle use, atrophy and loss of muscle strength is common (Novak & von der Heyde, 2015). Motor control within the re-innervated muscle must occur before strengthening begins (Novak & von der Heyde, 2015). If motor control is not achieved, non-adaptive movement patterns are more likely to develop (Novak & von der Heyde, 2015). Once strengthening begins, the muscle will be weak and cannot tolerate excessively high intensity (Novak & von der Heyde, 2015). Novak and von der Heyde (2015) recommend to start strengthening with slow onset isometric contractions 10-15 times.

Electrical Stimulation

In earlier stages of nerve reconstruction recovery, electrical stimulation is used to maintain integrity of the muscle fiber while it may otherwise atrophy (Novak & von der Heyde, 2015). Poorer outcomes are associated with longer durations of muscle denervation, which can possibly be counteracted by the use of electrical stimulation (Novak & von der Heyde, 2015). However, there is little evidence for the use of electrical stimulation with muscle that has been denervated for a long duration. According to Novak and von der Heyde (2015), electrical stimulation should be used as an adjunct to sensory and motor reeducation. Transcutaneous electrical nerve stimulators are sometimes used to manage pain (Sharma-Abbott & Larson, 2016). These electrodes are placed at the spinal cord to stimulate an endorphin release (Sharma-Abbott & Larson, 2016).

Physical Agent Modalities

In addition to other treatment methods, physical agent modalities (PAMs) are commonly indicated to treat pain and manage sensitivity (Sharma-Abbott & Larson, 2016). These modalities can include fluidotherapy, ultrasound, massage, paraffin wax, and moist heat for relaxation (Sharma-Abbott & Larson, 2016). Fluidotherapy involve the submersion of an extremity into water to elicit sensory stimulation and increase extensibility of the tissue (Sharma-Abbott & Larson, 2016). PAMs are used best as an adjunctive treatment to sensory and motor reeducation techniques (Novak & von der Heyde, 2015).

Based off of themes observed in research on this topic, the current intervention methods for individuals with nerve laceration appear primarily therapist-driven rather than truly client-centered. The surgeon prescribes a protocol and the occupational therapist then

administers rehabilitation techniques. There is a lack of client involvement and client-centeredness in current hand therapy practices.

Occupation-Based Interventions

Definition

Occupation-based intervention (OBI) in hand therapy is defined as a treatment approach that balances biomechanical and medical principles with the value of occupation as the therapeutic method (Colaianni, Provident, DiBartola, & Wheeler, 2015). Currently, OBI is considered a solution for the disparity between the two pillars, medical and occupation as therapy, of hand treatment (Colaianni & Provident, 2010). In this type of treatment, a person's functional performance is addressed and restored using meaningful occupations, while a therapist maintains full awareness of the anatomical and neurological components involved in the biomechanical frame of reference (Colaianni et al., 2015). As an example, a strictly biomechanical treatment session may include guided strengthening with theraputty. An OBI may include buttoning, writing, or the use of a key and lock to achieve strengthening, all while biomechanical considerations are being implemented (Colaianni & Provident, 2010). Some hand clinics using OBI reported regular therapeutic use of cooking, food preparation, sewing, cutting food, laundry, handling money, cleaning cabinets, and origami (Grice, 2015).

Client-Centeredness

Client-centered approach to therapy "incorporates respect for and partnership with clients as active participants in the therapy process" (Boyt Schell, Gillen, & Scaffa, 2014, p. 1230). In other words, client-centered therapy involves a client's specific experiences, strengths, and choices within treatment (AOTA, 2014a). According to Toth-Fejel et al. (1998), a client's

environment, context, and psychosocial factors are often excluded from treatment for this population. Research shows that successful treatment, especially in people with cumulative trauma cases, requires inclusion of these aspects within the intervention (Toth-Fejel et al., 1998) In one study, a woman with medial epicondylectomy and history of shoulder arthroscopic surgery was undergoing occupational therapy with a client-centered approach (Toth-Fejel et al., 1998). The occupational therapist implemented this client's valued role as a mother and interest in sewing into her therapy (Toth-Fejel et al., 1998). This client was asked to use her home sewing machine for various projects, including making a sports bag for her daughter and mending her son's pants (Toth-Fejel et al., 1998). Upon review of outcome measures, all of her physical measures had improved significantly, particularly grip strength (Toth-Fejel et al., 1998). The client in Toth-Fejel's et al. (1998) case study exemplifies the therapeutic and objective benefits of client-centeredness with this population.

Benefits of Occupation-Based Intervention

OBI for people with nerve laceration allows for improved objective measurements, considers a person's specific context, and facilitates functional skill generalizability (Colaianni & Provident, 2010). Because of this, occupational therapists have an important and progressive role with this population in focusing on overall function.

Improved Outcomes. Colaianni and Provident (2010) compared OBI with a traditional exercise program with this population and found the OBI group to have increased repetition and interest, faster rate of recovery, improved quality of movement, ROM and AROM, and improved motor learning over the traditional exercise program. Similarly, Maciel, Taylor, and McIlveen (2005) studied individuals with distal radius fractures who participated in an activity-focused

therapy program or an exercise-focused program. Both groups showed significant improvement on all outcomes (Maciel, Taylor, & McIlveen, 2005). Although there was no a difference between groups, this study showed the therapeutic role of activities with this population and its potential for implementation (Maciel et al., 2005). Researchers of two separate studies found that upper extremity treatment with activities that mimic ADLs resulted in significantly improved grip and pinch strength and range of motion when compared to therapeutic exercise alone (Guzelkucuk et al., 2007; Toth-Fejel et al., 1998). The ADL groups also scored significantly higher on the Jebsen Hand Function Test and the Disabilities of the Arm, Shoulder, and Hand questionnaire (DASH) than the exercise group and also eliminated the development of non-adaptive movement patterns (Guzelkucuk et al., 2007; Toth-Fejel et al., 1998). During these functional tasks, participants are beginning to automatize their movements and use desired weaker muscles to perform the activity without realizing they are exercising (Colaianni & Provident, 2010). Changing exercise from cortical to subcortical is a method to facilitate the beginning of muscle reeduction (Colaianni & Provident, 2010).

Toth-Fejel et al. (1998) also found that games used in treatment reduced pain, sped up recovery, and improved hand function for people with injured upper extremities. This increase in hand function was also seen in a randomized control trial with hand injuries comparing therapeutic exercise (TE) and TE combined with OBI (Che Daud et al., 2016). TE combined with OBI demonstrated significantly greater outcomes (Che Daud et al., 2016). Specifically, grip strength, pain scores, pinch strength, and purdue pegboard test scores were all higher in the OBI group (Che Daud et al., 2016).

Increased Motivation. In many OBI sessions in the studies by Toth-Fejel et al. (1998), Che Daud et al. (2016), and Guzelkucuk et al. (2007), participants were using scissors, sewing blankets, putting money into a wallet, and tying shoelaces in their treatment sessions. "We observed that the patients were more motivated while performing therapeutic activities rather than exercises" (Guzelkucuk et al., 2007, p. 1434). Toth-Fejel et al. (1998), Che Daud et al. (2016), and Guzelkucuk et al. (2007) attributed this motivation to perceived improvement in ADLs. Patients began to observe their ability to perform activities they were previously unable to do, and they subsequently achieved confidence in their ability to improve (Guzelkucuk et al., 2007, p. 1434). One occupational therapist reported on the increased motivation experienced by patients when using OBI. " When I... incorporate a functional task (usually more demanding than a rote exercise), the client always comments that they find it uniquely challenging, and most beneficial" (Grice, 2015, p. 304).

Toth-Fejel et al. (1998) compared an OBI group with a traditional exercise group for people with traumatic upper extremity fractures. The OBI group reported significantly higher levels of engagement and motivation in treatment sessions. Che Daud et al. (2016) conducted a similar study and found therapy satisfaction ratings were significantly higher in the OBI group.

In many of these studies, higher motivation and satisfaction scores correlated with higher objective measurements (Che Daud et al., 2016; Guzelkucuk et al., 2007; Toth-Fejel et al., 1998). When participants experienced motivation due to OBI, they were more likely to fully attend and participate in the therapy, and thus more likely to experience objective gains in function (Che Daud et al., 2016; Guzelkucuk et al., 2007; Toth-Fejel et al., 1998).

Involvement of Psychological Strategies. OBI includes the consideration of the whole person during assessment and intervention, including psychological distress experienced by individuals with upper extremity nerve laceration. "Treatment and solutions concerning psychosocial problems, such as anxiety and avoidance, should be a focus in routine care of patients" (Cederlund et al., 2010, p. 7). In one research study, a variety of emotional coping strategies were considered with people with nerve lacerations that were found to be effective (Cederlund et al., 2010). Many of these strategies were practical modifications that facilitate activity performance while simultaneously serving as a coping mechanisms for the stress associated with this injury. Coping strategies can include informational handouts, active involvement of family and friends, continued, modified involvement in valued activities, planning sufficient time for each task, and allowing for assistance when necessary. Informational handouts provided patients with education on what to expect, proper care, and recommended activity level for their injury (Cederlund et al., 2010). This helps to prevent excess stress, fear, and frustration during recovery. Additionally, information regarding ideas for routine modifications has been shown to decrease stress and frustration during recovery (Cederlund et al., 2010). This includes adaptive equipment and task or environmental modifications. For example, one practical coping strategy was using mechanical tools rather than manual tools that require higher levels of dexterity (Cederlund et al., 2010).

Emotional coping strategies were also found to be important during this recovery process, as well (Cederlund et al., 2010). Participants in one study reported that allowing oneself to thoroughly process the trauma was crucial. This was achieved by thinking about the incident many times and sharing thoughts and feelings with a support network, thus normalizing the

trauma and reducing the associated emotional pain. Participants found emotional relief through joining support groups (Cederlund et al., 2010).

Inclusion of the psychological components through the identification of these coping strategies strengthens patient's ability to achieve progress and self-efficacy in meaningful occupations and activities of daily living (Cederlund et al., 2010). Coping strategies can be identified and explored through patient education, written handouts, website links, and client-identified methods (Cederlund et al., 2010).

Disparities in Current Hand Treatment

The notable conclusions upon a review of the literature for people with nerve lacerations includes a low frequency of use in practice but high benefit of OBI, implementation difficulties, and lack of addressing psychosocial needs as a part of holistic intervention. There is a need for implementing an occupation-based approach in upper extremity OT that focuses on the whole person within his or her context and with consideration of each person's individual needs (Colaianni & Provident, 2010).

Low Usage Frequency

Overall, there are only few studies that primarily focus on occupation-based intervention implementation with this population (Che Daud et al., 2016; Colaianni & Provident, 2010). Hand therapy and rehabilitation has been dominated by the biomedical approach, making occupation-centered approaches uncommon and difficult to implement (Toth-Fejel et al., 1998). Colaianni and Provident (2010) found that occupational therapists reported use OBI with only 41-50% of their clients, even though benefits of OBI were found to be more functional than traditional therapies. Powell and Von Der Hyde (2013) found that a majority (97.5%) of hand

therapists feel that ADL performance is an important part of hand therapy practice but less than half (45.5%) actually provide a formal assessment of ADL performance.

Implementation Difficulties

There are some obstacles to OBI with this population. **"**Given the current influence of reimbursement-driven practice, implementing an occupation-centered practice may be difficult" (Toth-Fejel et al., 1998, p.384). In one study, twenty-nine percent of occupational therapists reported difficulty with reimbursement of occupation-based care, reporting that Medicare does not pay for valued occupations as therapeutic method (Colaianni & Provident, 2010). Colaianni and Provident (2010) described that physical agent modalities and basic exercise are easier to implement and reimburse. Lack of time, limited access to natural environments, and lack of resources also make OBI difficult to use and implement in a hand clinic (Grice, 2015). However, many occupational therapists practicing in hand therapy affirm the value of and would like to incorporate more OBI in their practice, but are unsure of how to do so (Colaianni & Provident, 2010; Grice, 2015).

Summary

The professional identity and distinct value of occupational therapy involves the therapeutic use of occupation as a means to and outcome of the therapy process. Occupational therapist in all types of settings have an obligation to prioritizing client-driven performance in meaningful occupation while considering physical and psychological components of a person and their injury. However, in the field of hand therapy for upper extremity nerve lacerations, current treatment standards have navigated from true OBI. Current methods are predominantly biomechanical and include therapist-driven modalities, such as motor reeducation, sensory

re-eduction, strengthening, and physical agent modalities. The biomechanical frame of reference and physical agent modalities are necessary for recovery and remain an effective aspect of the therapy process. However, increasingly more research has shown the improved outcomes and therapeutic value of personalized, occupation based intervention as well as the need for addressing psychological considerations for individuals with and upper extremity nerve laceration.

Problem Statement. Occupational therapists in hand therapy acknowledge the benefits of OBI in the treatment of nerve lacerations but continually face challenges in implementation. The accumulation of research suggests the lack of OBI in hand therapy is due to barriers such as time constraints, lack of therapist resources, reimbursement issues with insurance companies, and the predominant use of the biomechanical frame of reference. These obstacles in hand therapy result in low frequency usage of OBI and a reduction of client-centered care, which are two core components of occupational therapy.

Purpose. The purpose of this scholarly project is to create an accessible resource for occupational therapists to implement occupation-based intervention in the currently biomechanical-dominated topic of upper extremity nerve laceration. Additionally, this project was created to effectively navigate the documented obstacles of occupation-based treatment. These obstacles include a lack of time, therapist resources, and reimbursement. Patient education is a frequently used and reimbursable mode of therapy. This mode was strategically chosen in order to address obstacles, and also to enable individuation of treatment. The Model of Human Occupation (MOHO) was used to guide the formation and elements included in this patient education tool. Additionally, several principles of Adult Learning Theory were implemented

throughout the entirety of the tool in order to facilitate optimal and long term learning. This tool provides areas for individualization, and occupational therapists still need to consider the client's individual physical status, cognition, perception, affect, and motivation, and environments.

Chapter III will consist of descriptive methodological approaches taken in the development of the literature review, the gathering of information, and the development of a resource for hand therapists to use in practice.

Chapter III: METHODOLOGY

Chapter III Methodology is comprised of detailed, chronological description of our methodology of the processes used to conceptualize, design, and build this scholarly project. The first step that was taken was to explore American Occupational Therapy Association's (AOTA's) emerging fields of practice in Occupational Therapy. This was completed with consideration of our mutual special interest in physical disability rehabilitation. Specifically, we shared an interest in neurological rehabilitation potential, the neuroplasticity of the brain, and cortical reorganization in achieved through occupational therapy. The sections most congruent with our interests were "New Technology in Rehab" and "Bionic Limbs and Transplants". Some of the broad topic ideas included information regarding populations who had sustained either a stroke, spinal cord injury, or peripheral nerve injury.

Throughout this initial process, we met with our graduate advisor weekly to discuss the scholarly project formation and decisions regarding the product direction. Upon initial discussion with the project advisor, we concluded that there is well established research in the areas of stroke and spinal cord injury populations, but less occupational therapy projects related to peripheral nerve injuries. Initial literature searches and discussions with the project advisor resulted in the acknowledgement of a lack of occupation-based interventions (OBI) in the field of upper extremity and hand therapy, where peripheral nerve injuries are common and occupational therapists facilitate the intervention. Research informed us of the current domination of the biomechanical and medical model in this occupational therapy practice area (Che Daud et al., 2016; Colaianni, & Provident, 2010; Grice, 2015; Guzelkucuk, Duman, Taskaynatan, & Dincer, 2007; Toth-Fejel, Toth-Fejel, & Hedricks, 1998).

Based on the aforementioned literature search, we set out with ambitions to create a product for occupational and hand therapy with an emphasis on occupation-based methods. We wanted to focus on injuries to the upper extremity due to the demand on upper extremities in occupation. After researching the numerous types of injuries, it was decided to specifically focus on the most common peripheral nerve injuries, including injuries to the median, ulnar, or radial nerves (Che Daud, Yau, Barnett, Judd, Jones, & Nawawi, 2016). We then narrowed our focus further to a specific category of injury. These categories included chronic compression conditions, crush injuries, dislocation, and laceration, and all yield extremely different processes of rehabilitation and recovery (Che Daud et al., 2016; Smith, 2011). To further narrow our topic and enable us to provide a high-quality product, who chose to focus on clients with postsurgical nerve laceration.

Next, we began the processes of a focused literature review, which included searches in PubMed, Cumulative Index of Nursing and Allied Health Literature (CINAHL), Occupational Therapy (OT) Search, American Journal of Occupational Therapy (AJOT), and Clinical Key through access of the University of North Dakota Health Sciences' online library. These databases enabled access to a large variety of journals, such as the *Journal of Hand Therapy* and the *Journal of Hand Surgery*. Textbooks were also used during the literature review. Keywords used included *nerve, laceration, rehabilitation, occupational therapy, occupation-based, intervention, treatment*, and other minor variations of these terms. Upon initial insights from the literature review, we began to identify areas of need for rehabilitation with this population, relating to occupation. After researching the rehabilitation protocols for nerve laceration injuries, it was clear that the splinting and immobilization phase should not be changed due to the

integrity of the surgical intervention. Other documented research indicated lack of time, resources, and reimbursement for the implementation of occupation-based intervention in hand therapy (Grice, 2015). Because of this, we sought to identify an intervention method that would fit the current frame of the hand therapy process. We wanted to use the term "intervention" instead of "treatment" to show the collaborative approach that this product would exemplify. Also, we thought it would be necessary to create our own definition of OBI, since there were so many variations found in the literature. For the purpose of this scholarly project, OBI is defined as a client-centered approach in OT in which an individual's performance is addressed and restored using meaningful activities, while a therapist maintains full awareness of the anatomical and neurological components involved in the deficit.

We had both shadowed occupational therapists in hand therapy clinics and were exposed to a typical treatment session and noticed that education was a common method of therapy. Upon reflection of this observation, we sought to further understand the value of education. Research was identified that indicated the value of a client understanding their diagnosis and the rationale for therapy methods (Ullrich & Vaccaro, 2002). Specifically, education increases the likelihood of adherence to the therapy regime, willingness to participate, and is documented to be therapeutic itself (Ullrich & Vaccaro, 2002). Simultaneously, we were identifying studies that compared traditional exercises to functional tasks, the latter resulting in improved outcome measures than the former (Che Daud et al., 2016; Colaianni, & Provident, 2010; Grice, 2015; Guzelkucuk, Duman, Taskaynatan, & Dincer, 2007; Toth-Fejel, Toth-Fejel, & Hedricks, 1998).

Assimilating these two branches of research (the value of both education and occupation), we decided that a patient education resource that explained the value of occupation

to patients would fit the needs of this field. Additionally, this mode of therapy addresses many of the obstacles faced by therapists, such as reimbursement difficulty, a lack of resources, and time limitations. The collaboration and explanation with the client would make an education tool occupation based and relevant to the life of the client. When patients are more motivated to participate in therapy, it results in improved outcomes (Chen, Neufeld, Feely, & Skinner, 1998; Ullrich & Vaccaro, 2002). The consideration and implementation of pertinent, meaningful occupations lead to greater adherence to home programming and ultimately greater functional improvement (Che Daud et al., 2016; Colaianni, & Provident, 2010; Grice, 2015; Guzelkucuk, Duman, Taskaynatan, & Dincer, 2007; Toth-Fejel, Toth-Fejel, & Hedricks, 1998).

In order to gain further guidance as we conceptualized the formation of the product, we then met with an occupational therapist and certified hand therapist to discuss the real world application and usability of our product idea. The therapist explained that there are many available patient education resources for this injury but few interactive tools and none that emphasize occupation. He further provided examples of analogies he uses with this population to help educate them. He then identified that the presented product would be a valuable addition to occupational therapy with this population.

The education tool was initially thought to be printed as laminated cards and gathered in a key ring for ease of flipping pages. Looking for examples, we searched online to find presentation easels the size of a three-ring binder that folds into a standing table tent. This would enable the therapist to sit on one side and have the patient across from him or her, such is typical in an occupational therapy practice setting. A page of information would simultaneously be presented to both the therapist and the patient on either side of the triangular easel. We

envisioned the therapist's page would have detailed therapist cues and descriptions, while the patient's side of the product would present simplified graphics and keywords. We wanted this tool to be aesthetically pleasing and easy to read for all individuals. We wanted short increments of words on each page so that individuals would not feel overwhelmed when they were looking at the page. Common words were used to avoid medical and occupational therapy jargon so that people at most literacy levels could easily understand the content. Pictures were used as anecdotes to assist the therapist in explaining more complex ideas. We decided to maintain the lamination idea and incorporate interactive activities as much as possible with use of a dry erase marker. After deciding on this format, we decided to use Google slides through our personal gmail accounts for assembling the slide content due to the ease of viewing and it's slide-specific note making features. This website allowed us both to work collaboratively in real time on different devices. As we began to assemble images for the slides, we recognized the need for legally accessible images available for reprinting and modification. In order to do this, we met with Devon Olson, the School of Medicine and Health Science's librarian, who proposed free image and stock photo websites such as Pixabay and Wikimedia commons. We also used Windows Paint and Windows Paint 3D application on our computers to construct our own images to use.

For the slide contents, we primarily used information from the literature review. During the process of the literature review, we simultaneously compiled a list of education topics that we thought would be helpful to include. As we progressed on the formation of the slides, this list was revised several times to include six major categories. We continued to meet with our advisor throughout this process, who assisted in solving obstacles, such as advice for readability, graphic

analogies, and citation problems. After the patient slides were created, a therapist cue slideshow was created. We decided that the therapist cue slides should include specific references where we obtained the information, a small image copy of the patient side in the upper right hand corner for reading ease, and both verbal and nonverbal cues and recommendations. We thought that a separate therapist manual with a more detailed description would be helpful to the therapist. In this manual, we included an introduction, purpose of the product, a summary of the supporting literature, and a copy of the recommended home program worksheet. This worksheet, titled "Your Homework", is available for the therapist to photocopy and write on when working with the patient. One side of the homework sheet is for the occupational exercise to be completed between therapy sessions and the other side of the sheet includes coping strategies and room for reflection. We thought it would be helpful to have these written down so the patient can remember them and use them after the session.

For the slide shows and the therapist manual, a copyright of the pages was put on to protect our original work. Regarding formatting and the look of the product, a pastel color was designated to each section to identify the different sections and make it easier to use. Pastel colors were used based on recommendations from the Adult Learning Theory regarding readability and patient education formatting (Bastable, Gramet, Jacobs, & Sopczyk, 2011). A thick line was inserted across the bottom of each page with each unique color for aesthetics and to easily distinguish slides within their categories.

The theoretical foundation of the product was generated from the Model of Human Occupation (MOHO), the biomechanical frame of reference, and the Adult Learning Theory. We realized the biomechanical frame of reference is essential to hand therapy in order for the

therapists to maintain the integrity of the injury and surgical site (Cole & Tufano, 2008). The knowledge of the musculature and bodily structures will assist the therapist in intervention planning and rehabilitation process. This frame of reference is applied throughout the entirety of the product, especially regarding topics such as splint care, motor and sensory reeducation, and rehabilitation expectations. The initial derivation of the product idea was from aspects of MOHO (Chen, Neufeld, Feely, & Skinner, 1998). We hypothesized that education about an individual's injury would motivate the client to follow through with the therapy process. This motivational aspect aligns congruently with MOHO (Chen, Neufeld, Feely, & Skinner, 1998), thus instigating further investigation into this model. Roles, habits, and volition are all strategically addressed throughout the tool. Terminology from MOHO was not specifically used in the product in order to adhere to the concepts of Adult Learning Theory for the understanding of all literacy levels. The Adult Learning Theory was chosen to use due to the fact that the populations that are going to be using this tool are adults. Adult learning principles include viewing the patient as a problem-based learner, internally motivated to learn, and learn on a need to know basis (Bastable et al., 2011).

As a way to assess the difficulty clients are having at home with their occupations, we decided to incorporate the Quick Disabilities of the Arm, Shoulder, and Hand (DASH) Assessment. The Quick DASH is specific to injuries of the upper extremities. This assessment is occupation-based because it asks specific questions on aspect of people's daily lives and occupations that are affected after an injury (Institute for Work & Health, 2006). The providers of Quick DASH were contacted via email and permission was gained in order to use this assessment in our education tool (Refer to Appendix D). In consideration of the guiding MOHO,

we thought gathering information about patient's roles was extremely important to this tool. The Role Checklist is a MOHO assessment tool that gathers information about an individual's frequency and value of each of his or her roles (Oakley, 1984). This assessment will help create the client-specific goals in the home program worksheet. The providers of The Role Checklist were contacted via email and permission was gained in order to use this assessment in our education tool (Refer to Appendix D).

We then met with our advisor after completing a majority of the product. It was advised to us to create a method to measure this product's effectiveness in a clinical setting. We discussed the value of a therapist reflecting on his or her own use of the product as well as the client submitting some form of feedback in order to measure if this product is doing what it was created to do. In order to create this, we developed our own therapist and client OBI self-reflection survey based on principles of MOHO and focused on the use of occupation. This survey is to be completed after the administration of part or all of the education product. This survey will be available in the therapist manual for clinical use.

The final product consists of a fifty-one page patient education tool that is laminated and three hole punched to fit in a 3 ring easel binder. A therapist manual complements the product in order to guide the use of the product and explain in detail the components of the patient education tool.

To assess the first formal draft of the product, we completed a practice trial with the education portion of this project in order to receive feedback and test its usability. The product was presented to an able-bodied, non-affiliated, non-medical member of the community. This individual provided informal, constructive feedback regarding quality of concept delivery,

recommendations for images and graphics, and topic areas that would benefit from further clarification. Changes were made to the final product based on these recommendations.

Chapter III Methodology consisted of the entirety of how our scholarly project was developed and the reasoning for each decision made. The process started with the first initial literature search and advanced as we began to narrow our topic and gain more knowledge. Chapter IV is comprised of the upper extremity nerve laceration patient education tool that was created through our scholarly project.

Chapter IV: PRODUCT

Introduction to the Product

According to the AOTA (2014b), occupational therapy (OT) is commonly indicated for people with upper extremity disabilities due to resulting disruption in their function in activities of daily living. The upper extremity and the hand are extremely important for fine-motor tasks required in daily activities (AOTA, 2014b). Many occupational therapists treat and specialize in the upper extremity and hand and may eventually work toward obtaining their statuses as a Certified Hand Therapist (CHT) (Hand Therapy Certification Commission [HTCC], n.d.). Upon a review of the literature for this population and occupational therapy and hand therapy, many key notes were made. Current treatment of this population includes a reductionist, therapist-driven and strictly biomechanical series of protocols (Colaianni & Provident, 2010). Several recent research studies have observed the benefit and improved outcome measures with use of a holistic, occupation-based intervention in this population as opposed to a strictly biomechanical treatment (Che Daud et al., 2016; Colaianni, & Provident, 2010; Grice, 2015; Guzelkucuk, Duman, Taskaynatan, & Dincer, 2007; Toth-Fejel, Toth-Fejel, & Hedricks, 1998). Occupation-based intervention is a holistic approach to treatment that addresses and utilizes the therapeutic value of an individual's meaningful occupation in the rehabilitation process (Che Daud et al., 2016). This process includes the identification of an individual's priorities and routine and subsequently practicing the functional activities they may typically perform (Che Daud et al., 2016). For example, an individual may complete tying shoes, sewing, and writing letters rather than rote repetitive hand exercises (Che Daud et al., 2016). These activities in therapy with this population lead to increased satisfaction, increased compliance in home

programing, and improved functional outcomes (Che Daud et al., 2016; Colaianni, & Provident, 2010; Grice, 2015; Guzelkucuk, Duman, Taskaynatan, & Dincer, 2007; Toth-Fejel, Toth-Fejel, & Hedricks, 1998). However, this population continues to receive strictly biomechanical treatment and very low frequency of occupation-based intervention (Colaianni & Provident, 2010). This is due to a variety of factors, such as implementation difficulties, productivity standards, limitations on time, and reimbursement challenges (Grice, 2015). There is a need for implementing an occupation-based approach in upper extremity OT that focuses on the whole person within his or her context and with consideration of each person's individual needs (Colaianni & Provident, 2010). Additionally, consideration must be made for the documented obstacles hindering current therapists from implementing occupation-based intervention.

Because of these reasons, a patient education tool was chosen that emphasizes the therapeutic value of occupation through education and home programming formation. The purpose of this product is to create an accessible resource for occupational therapists to implement occupation-based intervention effectively. Patient education is a frequently used and reimbursable mode of therapy. This mode was strategically chosen in order to navigate the obstacles, and also to enable individuation of treatment. Additionally, according to Ullrich and Vaccaro (2002), information is simply therapeutic in itself and leads to more realistic outcome expectations, better treatment compliance, and improved outcomes. This tool provides areas for individualization, and occupational therapists still need to consider the client's individual physical status, cognition, perception, affect, and motivation, and environment.

Description of the Product

This product is a patient education tool that is meant to be used collaboratively between

an occupational therapist and an individual with an upper extremity nerve laceration in an outpatient setting. There is a variety of topics covered in this tool. These topics include neuroanatomy and neuroscience, common procedures, rehabilitation process, occupation-based intervention, coping strategies, and assessment and goal formation. The assessment portion includes the Role Checklist and the Disabilities of the Arm, Shoulder, and Hand assessment tools, which were obtained with permission from the assessment creators and the copyright information was displayed throughout the product. This information is all presented with varying levels of detail, which the therapist will be able to tailor to the individual.

The product is designed to be propped on a table in an easel format, one side facing the patient and one side facing the therapist. On the side facing the therapist, there are detailed therapist cues in order to facilitate the education process. The cues include suggestions and verbal prompts, as well as citations for where the information was obtained. The pages are laminated and are meant to be used with a dry-erase marker to increase the collaboration and interaction between the therapist and the patient. The product includes a separate therapist manual that provides a brief summary of the research studies found that support the formation of the product. The therapist manual also includes an occupation-based home program worksheet as well as a coping strategy worksheet for this population to use after the treatment session. These worksheets are available for photocopy and are customizable based on the patient and their goals.

Theoretical Application

Biomechanical Frame of Reference

This product was created with a combination of current theoretical perspectives in occupational therapy. The biomechanical frame of reference addresses an individual's functional deficits through treatment of impairment of body structures (Turpin & Iwama, 2011). In this frame of reference, the principles of kinetics and kinematics are applied to the joint and skeletal muscle movements of the body (Turpin & Iwama, 2011). Equilibrium and movement are core concepts of these mechanical principles and are affected by forces that act on bodily structures (Turpin & Iwama, 2011). The biomechanical frame of reference is essential to evaluate the client's occupational performance within the physical disability setting (Cole & Tufano, 2008). This makes possible the remediation of skills and abilities and modification of tasks that are necessary to assist people towards independence (Cole & Tufano, 2008). Occupational therapists in hand therapy are guided by the biomechanical principles in splint designs, prosthetics use, and remediating intervention techniques (Cole & Tufano, 2008). The biomechanical frame of reference is incorporated into the occupational therapy evaluation and intervention process as a means of objective data and frame for which the human body should function (Cole & Tufano, 2008). This frame of reference is applied throughout the entirety of the product, especially regarding topics such as splint care, motor and sensory reeducation, and rehabilitation expectations.

Model of Human Occupation

Along with the implementation of the biomechanical FOR, the Model of Human Occupation (MOHO) was used to guide the overarching and foundational elements of this

patient education tool. The MOHO was also used to conceptualize the components of a person. Regarding these components, the primary pillars of the MOHO include habituation, volition, performance capacity, and the environment (Chen, Neufeld, Feely, & Skinner, 1998). According to Chen et al., (1998), the inclusion of these MOHO components in intervention can influence the compliance with therapy, which is especially important for outpatient settings and home programs. From the perspective of this model, beliefs and interests can influence one's ability to follow through with a home program (Chen et al., 1998). Additionally, the educational component of the product is aimed to elicit increased motivation, a key element of MOHO, for the completion of one's planned home program. When an individual understands his or her injury and mechanisms for coping and rehabilitation, they will be motivated to follow their home programing and have an improved rehabilitation process (Chen et al., 1998). Using MOHO is expected to lower perceived barriers to carrying out the home program (Chen et al., 1998). MOHO's consideration of one's routine is another strength of this tool. Instead of changing someone's routine, this home program emphasizes the continuation of someone's routine all while recovering from the injury. "If the home exercise program does not fit into the patient's routines, it is less likely to be performed (Chen et al., 1998, p. 177). For example, an individual with a child care role is more likely to follow through with a home program that includes prescribed upper-extremity child-care occupations (Chen et al., 1998).

MOHO was also used to construct the therapist and client OBI self-reflection survey. These surveys are included for the therapist to gauge the effectiveness of the tool. There is a survey for both the client and the therapist. The components of the survey gauge the quality of the overall understanding of the education and how well the therapist addresses the client's

volition (written as motivation), habituation (written as roles and routines), environment, and performance capacity (written as abilities).

Adult Learning Theory

Additionally, several principles of Adult Learning Theory were implemented throughout the entirety of the tool in order to facilitate optimal and long-term learning. For example, Adult Learning Theory uses the term andragogy, which is the practice of learning for adult (Papadakos, C., Papadakos, J., Catton, Houston, Mckernan, & Friedman, 2014). Andragogy differs from pedagogy, the practice of learning for children, in the aspect that adult learners establish their own learning agenda rather than another person establishing the agenda for them (Papadakos et al., 2014). Adults choose to participate in educational activities due to internal or external incentives. Other adult learning principles include viewing the patient as a problem-based learner, internally motivated to learn, and learn on a need to know basis (Bastable et al., 2011). In the healthcare context, the healthcare providers must present the information in a way that shows the patient the relevance of the information. This product allows the provider to highlight functional aspects of the information that pertains to the patient's everyday life.

Learning for adults is based on if the information is needed to be known, the learner's self-concept, the role of the learner's experiences, readiness to learn, and the learner's motivation to learn (Papadakos et al., 2014). The assumptions of roles, experiences, and motivation to learn align with the core concepts of MOHO. In order for learning to occur, adults must participate in the learning process. Patient education materials that are collaborative allow for the patient to be involved in his or her care (Papadakos et al., 2014).This collaborative tool gives the patient the opportunity to understand more about their injury so that they are able to make informed choices

about their health. In the product, the pages are laminated and are meant to be used with a dry-erase marker to increase the collaboration and interaction between the therapist and the patient, which addresses this adult learning concept.

Another concept used from the Adult Learning Theory is the prevalence of low literacy levels in the populations served. Individuals who are accessing the healthcare system are at a greater risk of low health literacy due to the stress that can impair the ability to process information (Papadakos et al., 2014). The Adult Learning Theory suggests in order to simplify educational material, present only essential information and put key information first (Papadakos et al., 2014). Common words were used in the product to avoid medical and occupational therapy jargon so that most literacy levels can easily understand the content. A variety of methods for teaching should also be used in order to appeal to individuals with different learning styles (Papadakos et al., 2014). The product utilizes auditory, visual, and kinesthetic teaching methods in order to be effective for a wide variety of individuals. This media can be seen through the use of pictures and written words, the therapist speaking information, and cues given for the therapist to draw or enact information.

Overall, this product was designed using concepts from the biomechanical frame of reference, MOHO, and the Adult Learning Theory. These three theories work together to address the physical aspects of the human body, the internal factors of a person, and how to best relay information to an individual. Aspects from each of these theories were combined in order to increase the usability and effectiveness of occupation-based interventions in hand therapy settings.

Chapter V: SUMMARY

The purpose of this scholarly project is to create an accessible resource for occupational therapists to implement occupation-based intervention in the currently biomechanical-dominated realm of upper extremity nerve laceration. Additionally, this project was created to effectively navigate the perceived obstacles of occupation-based treatment. These obstacles include a lack of time, therapist resources, and reimbursement. The end product of this scholarly project is a patient education tool that is meant to be used collaboratively between an occupational therapist and an individual with an upper extremity nerve laceration in an outpatient setting. Patient education is a frequently used and reimbursable mode of therapy. This mode was strategically chosen in order to address obstacles, and also to enable individuation of treatment. This product was designed using concepts from the biomechanical frame of reference, MOHO, and the Adult Learning Theory. These three theories work together to address the physical aspects of the human body, the internal factors of a person, and how to best relay information to an individual. Aspects from each of these theories were combined in order to increase the usability and effectiveness of occupation-based interventions in hand therapy settings.

Limitations to the usability of this product include that it's effectiveness has not been tested, it requires writing ability, and it is written in English only. A trial run was conducted on an able-bodied, non-medical participant who was able to provide constructive feedback for changes that could be made to increase the understanding of complex concepts. This product requires the therapist to use his or her skill of clinical reasoning to distinguish what information is important for each individual client to understand. Because there is no standardized way to use the information, patient outcomes could differ depending on the therapist that uses it. Also, the

interactive nature of the pages and home program requires the patient to be able to write. If a patient's dominant hand is injured or the patient suffers from a bilateral injury, he or she would require someone to write for them which in turn would make the patient more dependent. Additionally, this product was created in an area that English is the dominant language. An interpreter would be required to interpret the written and verbal educational components. The education tool was created to be accessible for low literacy levels which consists of short words and phrases and the use of pictures. This type of information would be easier for an interpreter to relay to a patient who does not speak English.

In consideration of the limitations of this product, we propose that this product would be a beneficial addition to the intervention process in hand therapy rehabilitation. Before a therapist administers this product to a patient, he or she should read through the education tool in its entirety and practice concepts on able-bodied personnel that could give feedback. It is crucial that the therapist understand the benefits of education for a patient and the impact that occupation has on rehabilitation. An OBI self-reflection survey was created for the therapist and the patient in order to measure the effectiveness of the product. The therapist will be able to reflect on his or her own implementation methods and compare with the feedback received from the patient. This will allow the therapist to adjust his or her intervention strategies in order to be more client-centered and effective in implementing the tool.

In conclusion, this product was created with the intention to increase the availability of occupation-based interventions to patients with upper extremity nerve lacerations with anticipation that these people will have better outcomes in postoperative rehabilitation. It was also the intention to create a product with consideration of the perceived barriers to

implementation and effectively and efficiently incorporate an occupation-based and holistic intervention approach that is true to occupational therapy. Additionally, the product was designed to incorporate current evidence based research, facilitate client-centeredness, and be easy to use for occupational therapists working as hand therapists.

We recommend in the future that an independent research study be completed on the usability and effectiveness of this patient education tool. Additionally, it was recommended to utilize this product's template for additional upper extremity ailments, such as thoracic outlet syndrome, compression injuries, chronic pain, tendon lacerations, or multi-trauma injuries.

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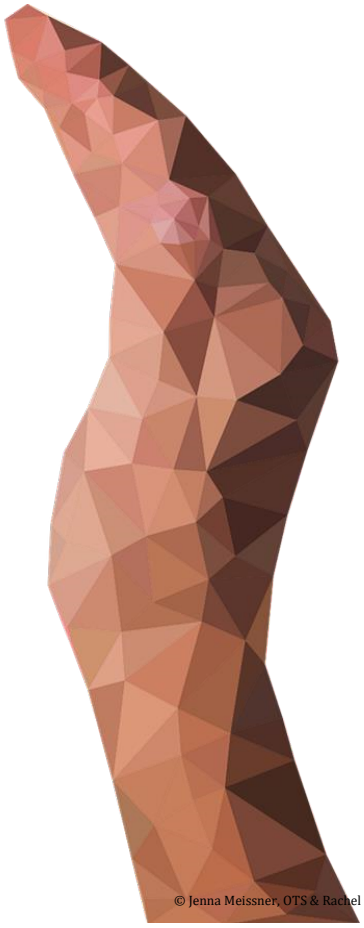
Appendices

Appendix A

Upper Extremity Nerve Laceration: Patient Education Tool

Rachel A. Bonneville, OTS
Jenna L. Meissner, OTS
Anne M. Haskins, PhD, OTR/L



Introduction

- This resource was created to help guide you through your rehabilitation process and answer questions you may have.
- Research shows that learning about your injury is very therapeutic and leads to better outcomes.
- Taking an active role in your rehabilitation process has also shown to improve your outcomes.
- Ask questions and be prepared to learn!

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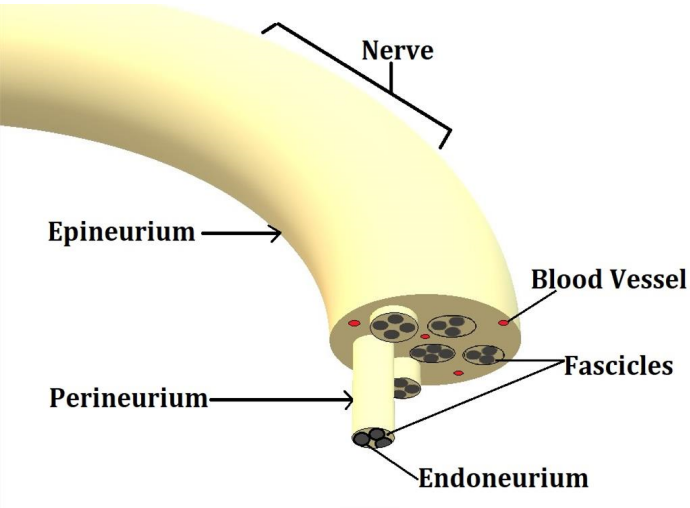
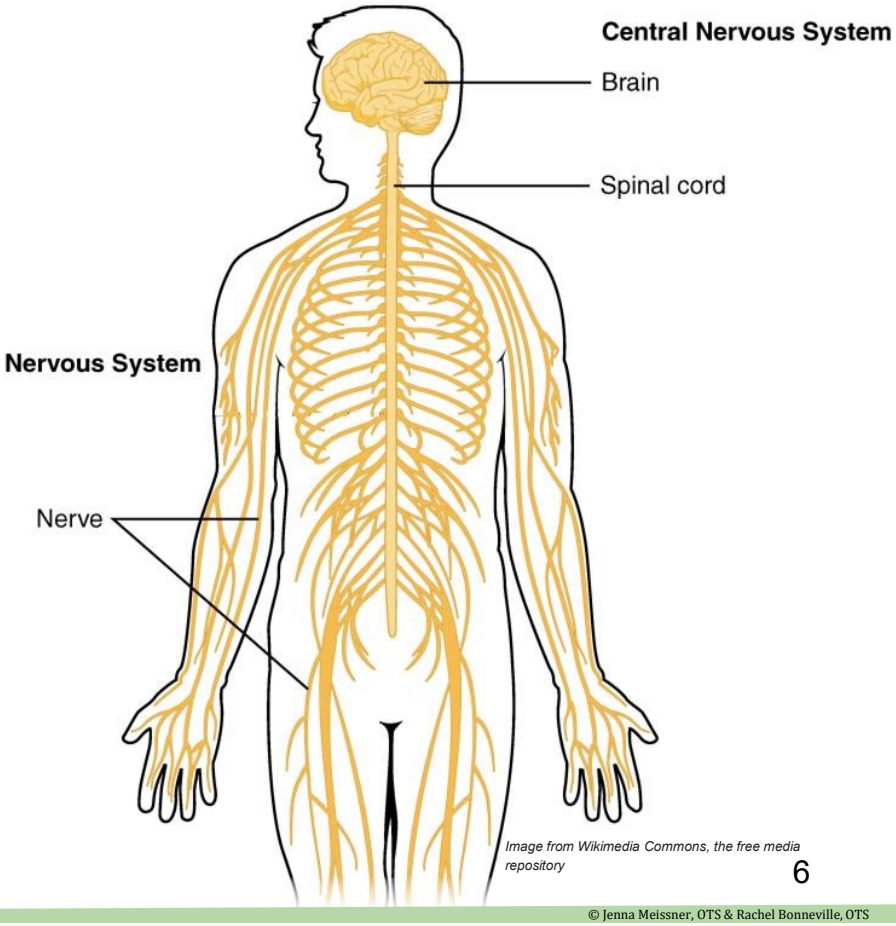
Neuroanatomy & Neurophysiology

Intro to Your Nervous System





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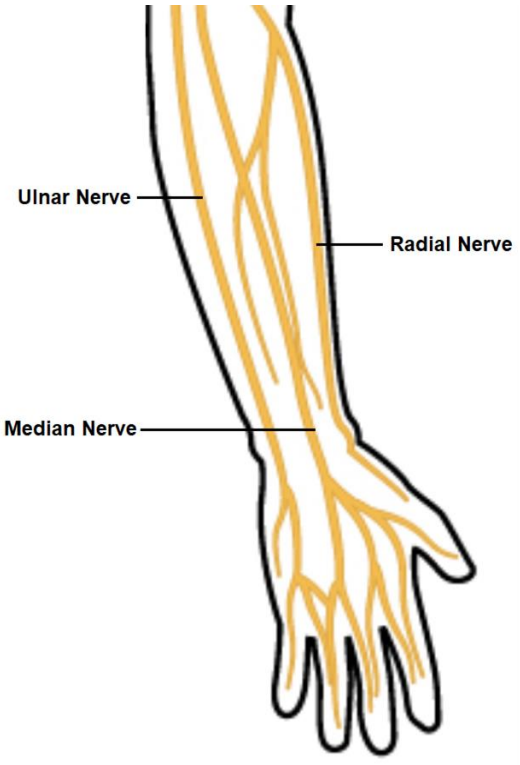
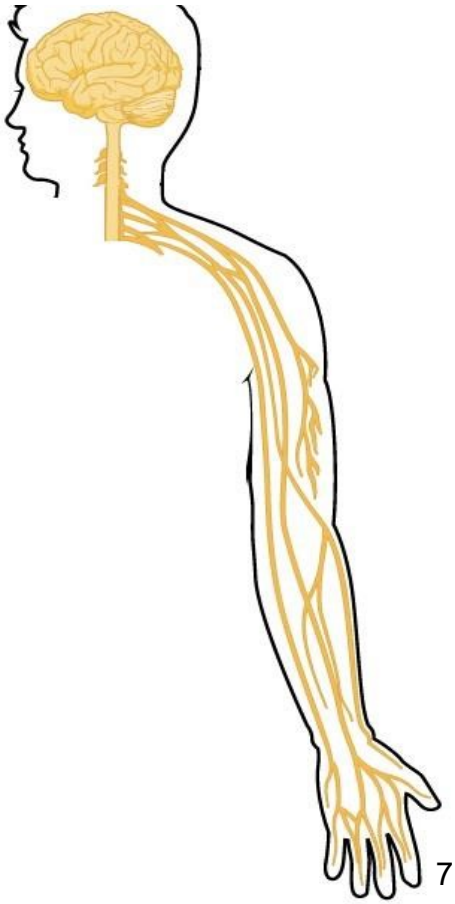
Your Nerve





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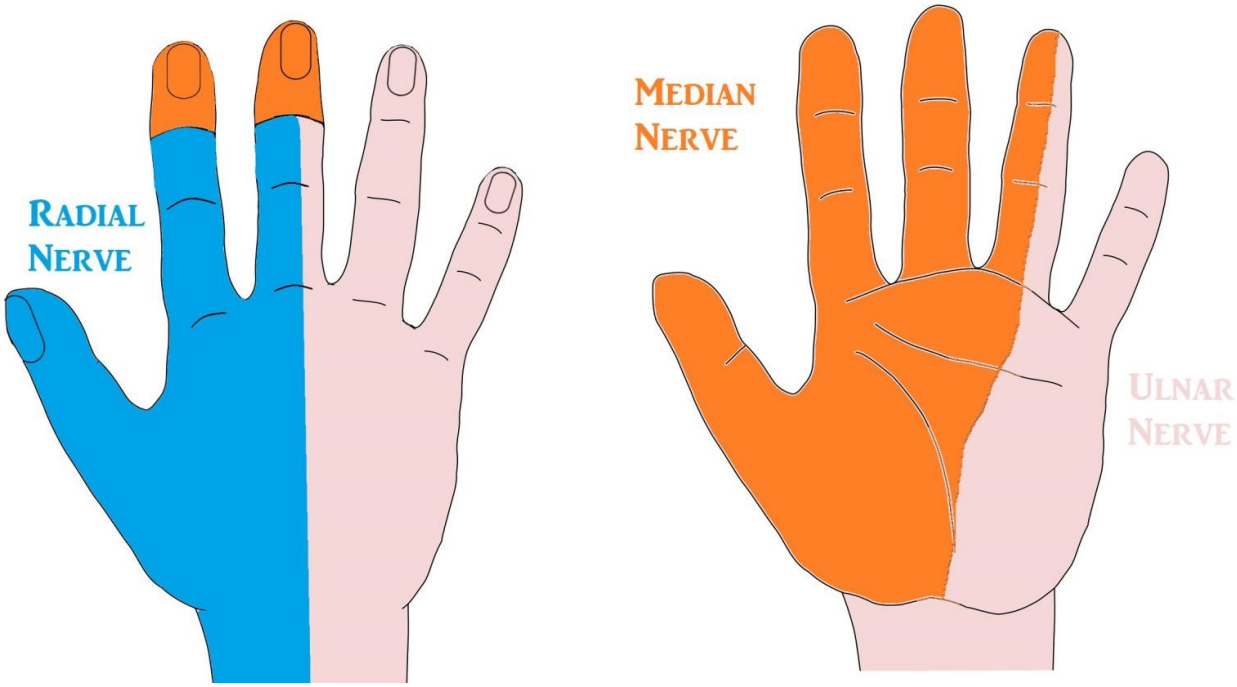
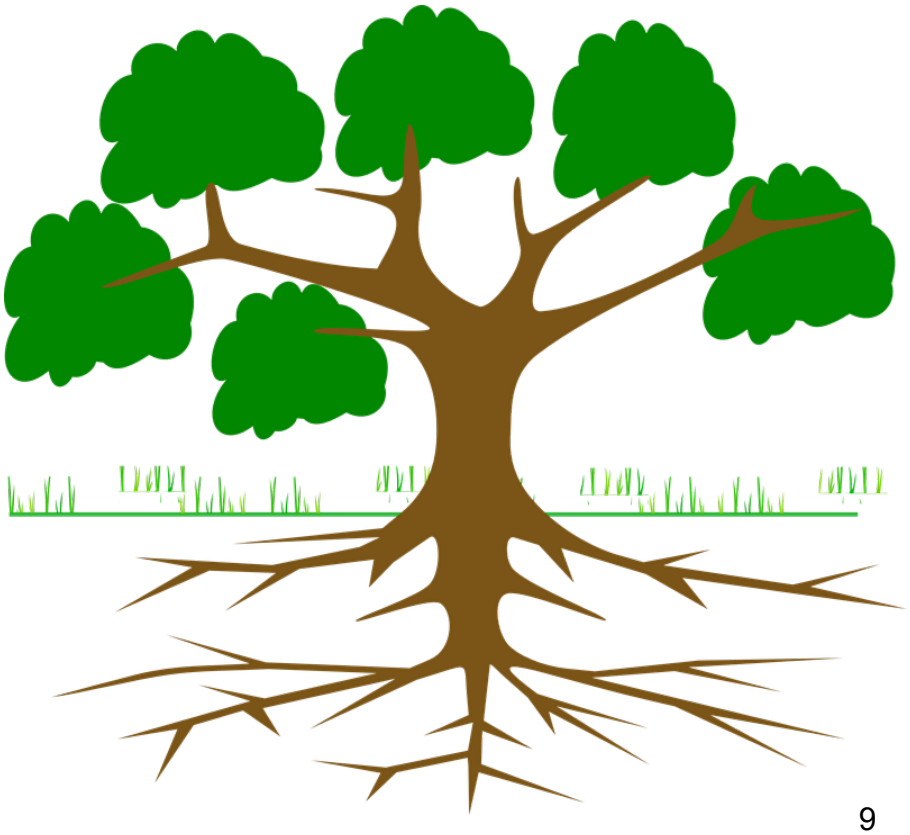
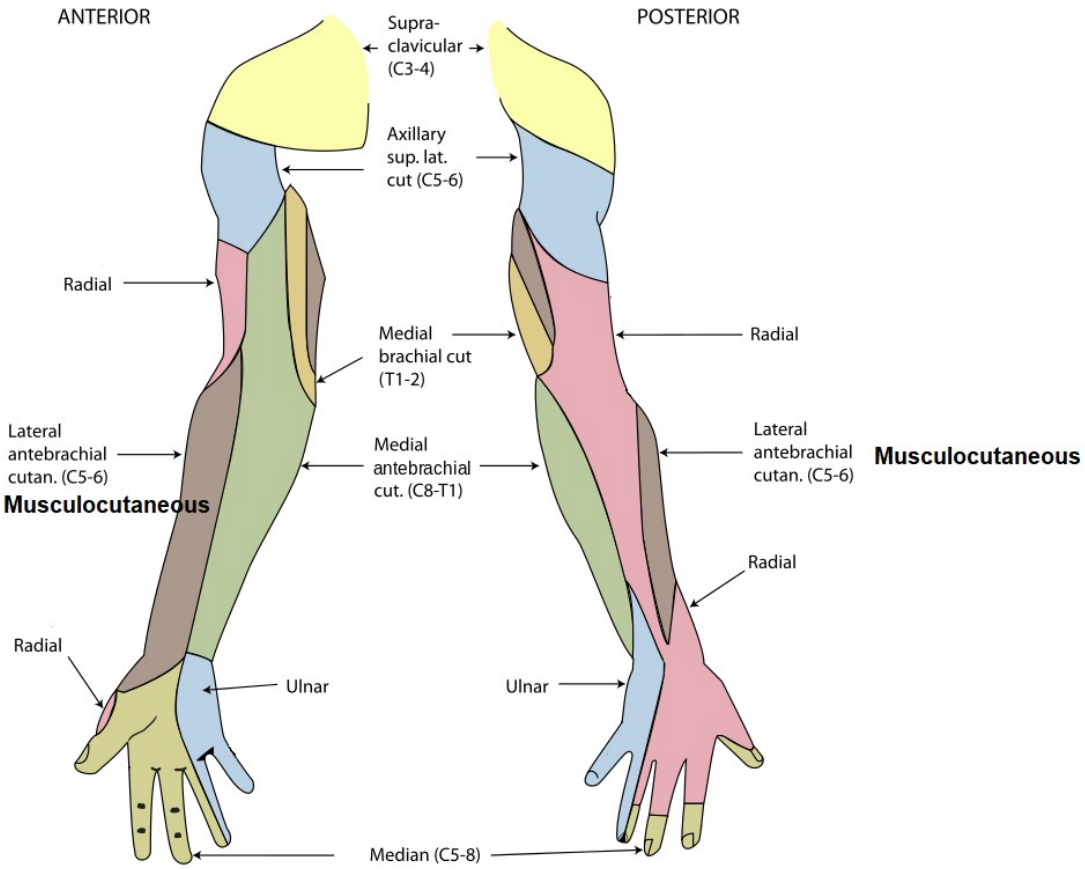
Your Nerve



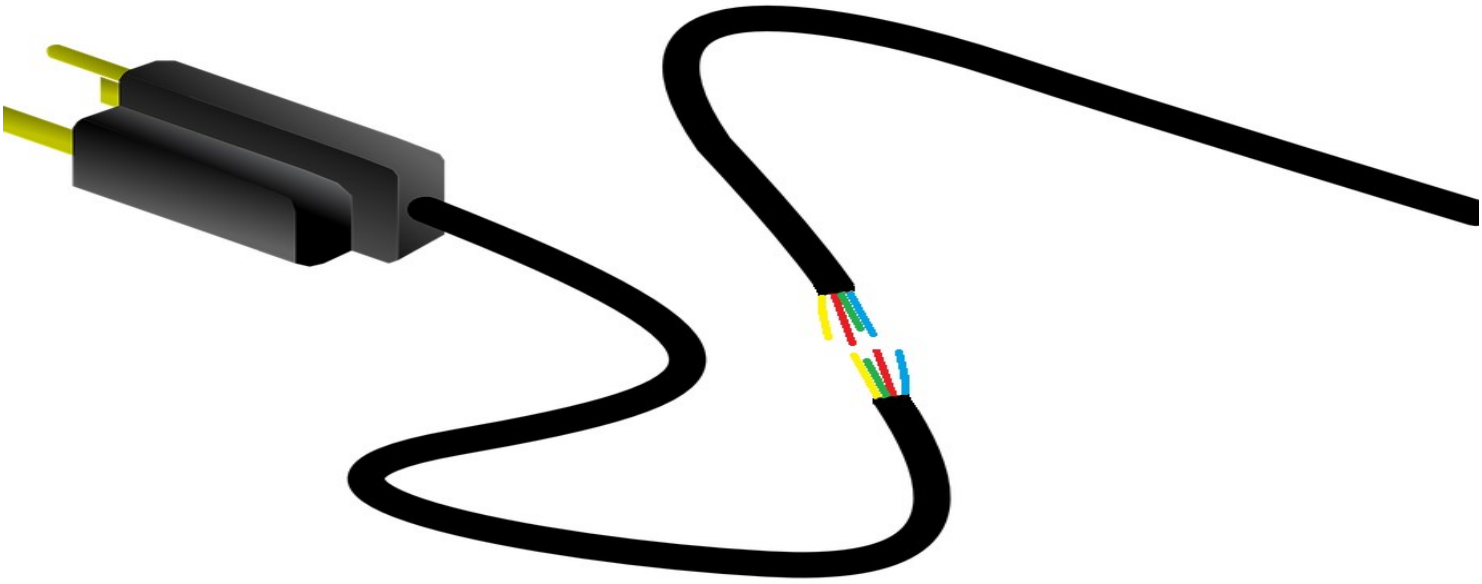
Real life example



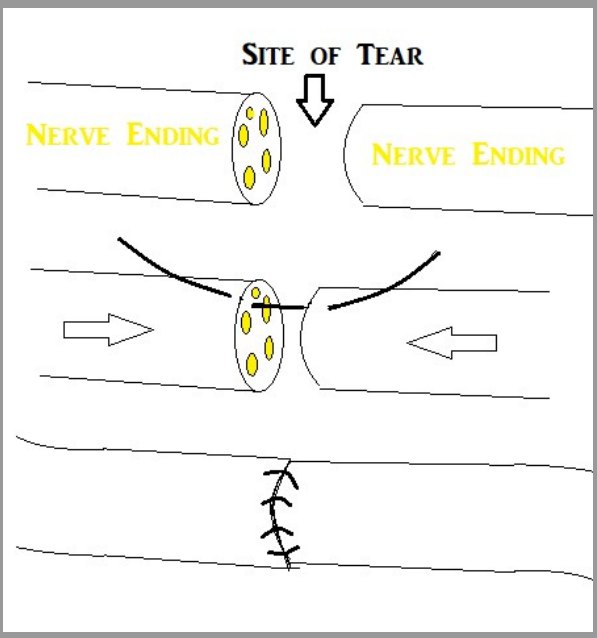


Common Procedures

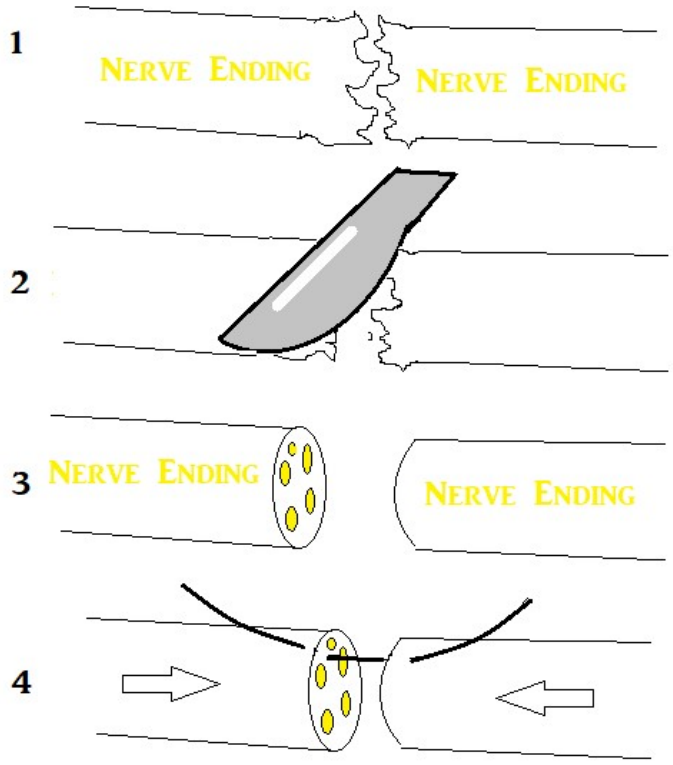
Nerve Repair



Nerve Repairs



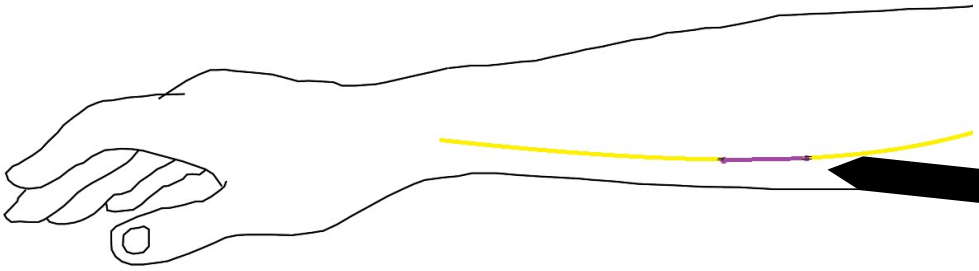
Primary Repair

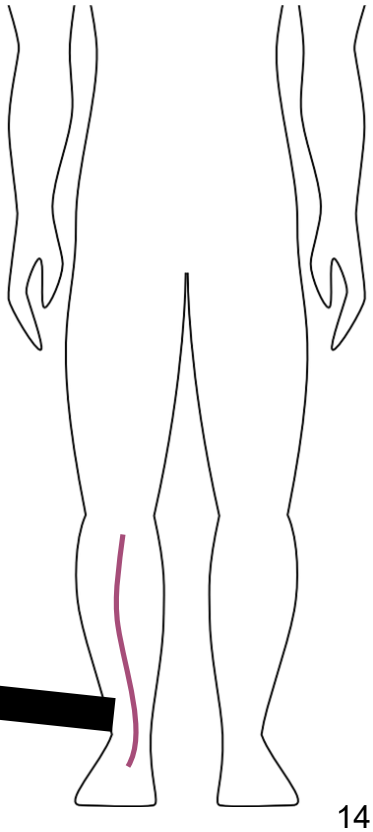


Secondary Repair

Nerve Graft

- **Graft:** Surgically taking a portion of a nerve from one part of your body and placing it in your arm or hand at your injury site
- **Donor Site**: Where your doctor harvested your nerve graft, typically the sural nerve in your leg





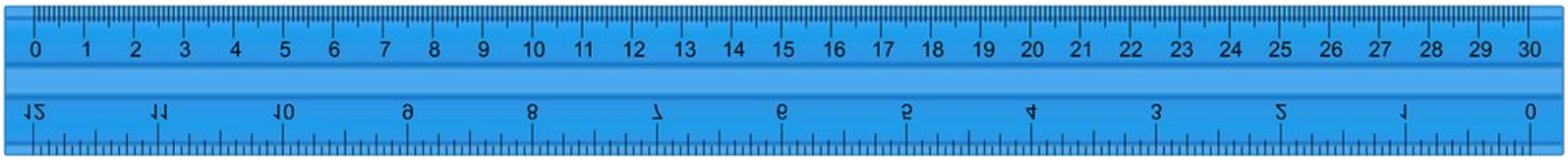
Rehabilitation Process

You had surgery. Now what?

- Initial Injury Phase
- Immobilization Phase
- Rehabilitation
  - **Occupational Therapy**: To get you back to performing your valued activities of daily living (occupations)

Recovery Expectations

- Everyone is different
- 1-3 millimeters per day
- 1 inch per month once you are able to move
- Recovery continues for 1-5 years after injury



Recovery Expectations

First Second Third Fourth

Your hand is more at risk of accidents and re-injury because of the changes in sensory and motor abilities

What situations/activities are you most concerned about?

_____

How are you going to keep your hand safe in these situations/activities?

_____

Splint Care

General Care

- Keep your splint dry
- Avoid dirt
- Padding
- Itching
- Trimming
- Skin
- Inspect the splint regularly

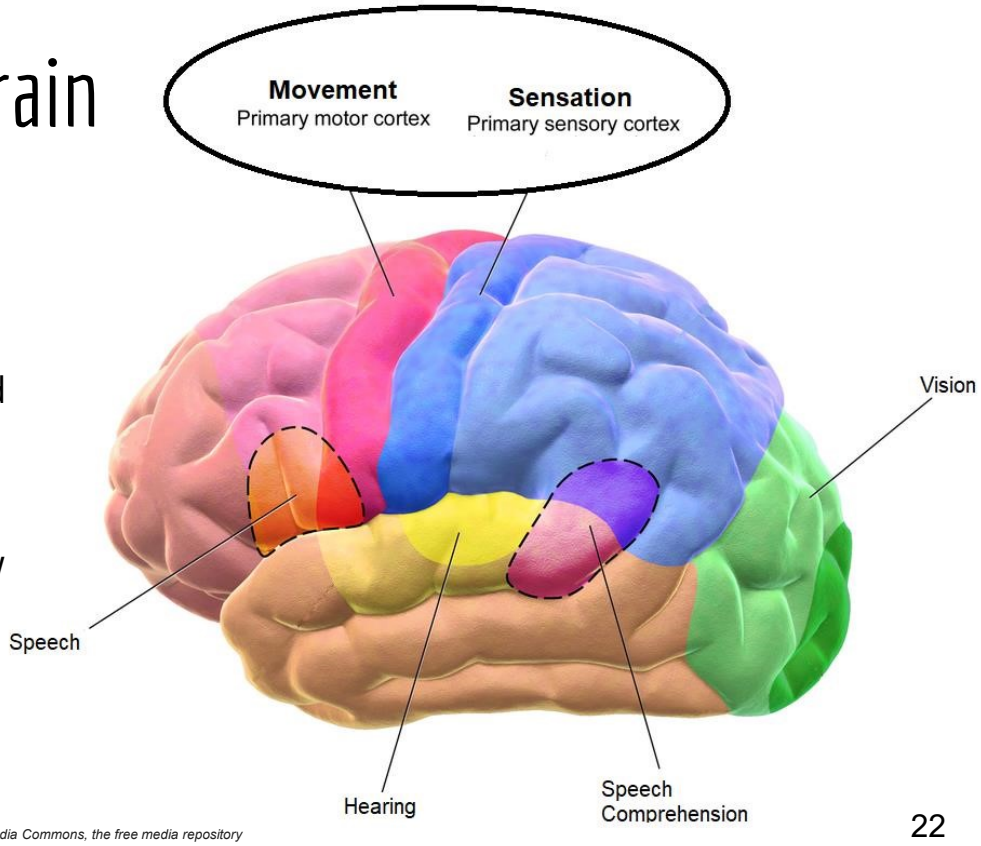
Warning Signs

- Increased pain and the feeling that the splint is too tight
- Numbness and tingling in your hand
- Burning and stinging
- Excessive swelling around the splint
- Loss of active movement of fingers

Occupation-Based Intervention

Changes in Your Brain

- Your nerves send constant messages to your brain
- The moment the nerve is injured, the messages stop and your brain begins to change
- Your brain becomes "disorganized" and forgets how to send messages properly
- In OT, we help retrain your brain



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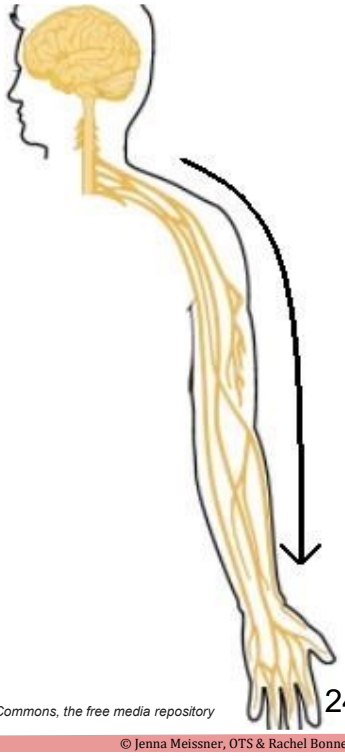
Sensory Reeducation

- Hypersensitivity
  - Need to calm your nerves
- Decrease or loss of sensation
  - Return of feeling

In therapy, we will reorganize how your brain interprets feelings

Sensory Reeducation - Order of return

1. Deep pressure and pinprick
2. Moving touch
3. Light touch
4. Discriminating touch
5. Accurate localization of touch



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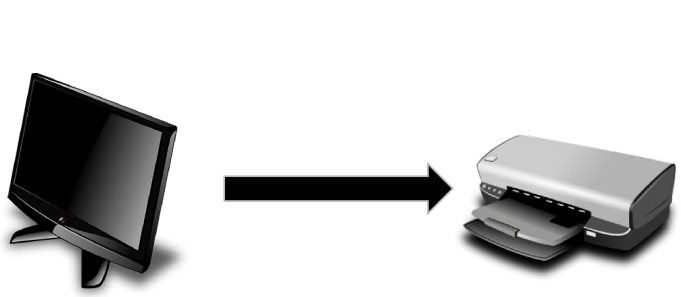
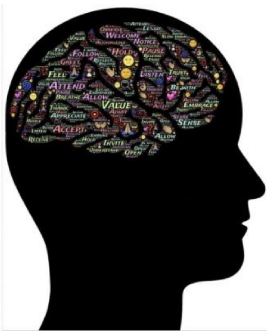
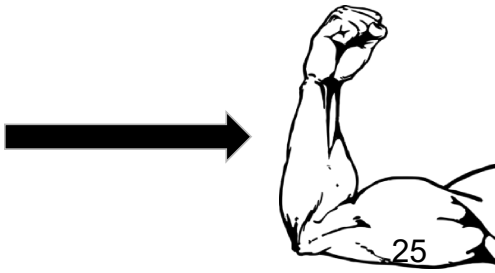
Motor Reeducation

- Your muscles can't move until your brain tells them to move
- The loss of messages causes muscles to forget how to move

In therapy, we will work on reconnecting your brain to your muscles and relearning your normal patterns of movement



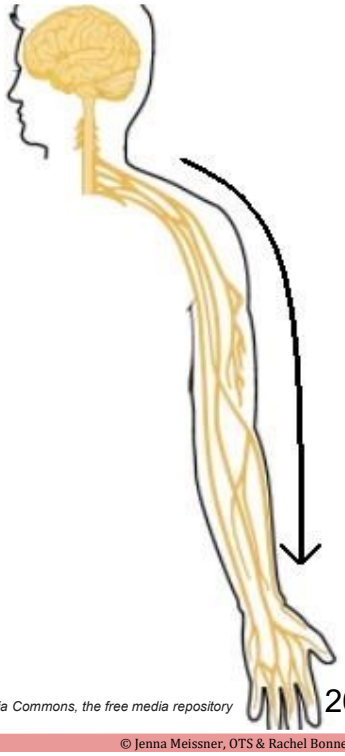




Motor Reeducation - Order of return

1. Proximal to distal
2. Big “mover” muscles
3. Smaller “coordination” muscles

Muscles will be weak at first, must relearn patterns of movement and then strengthen



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Occupation

The therapist will help restore your function through meaningful occupations

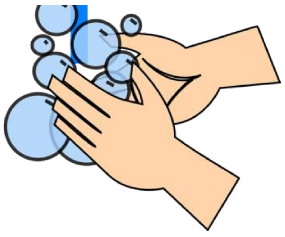
Exercises vs. Occupation

vs.

Occupation in Research

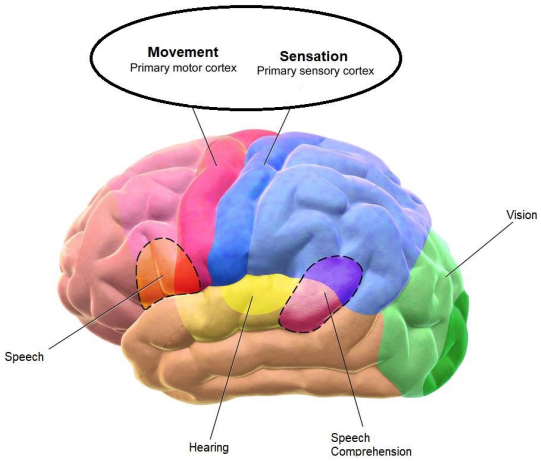
The use of **occupation** in hand therapy leads to:

- Increased repetition ability
- Faster rate of recovery
- Improved quality of movement
- Improved range of motion
- Improved motor learning
- Reduced pain
- Higher satisfaction in therapy
- More motivation
- Higher scores on hand tests
- Improved grip and pinch strength



What makes Occupation work so well?

- More **motivating** than simple exercises
- It already fits into your daily routine
- Meaningful
- More stimulating and challenging than simple exercise
    - It makes your brain work harder and **relearn** how to send messages



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Coping Strategies

Coping Strategies Related to the Injury

- Involve family and friends in your care
- Talk about the injury and your recovery process
- Plan enough time for your daily tasks
- Ask for help
- Continue valued activities with modifications
- Familiarize yourself with your injury
- Use adapted utensils & tools

Coping Strategies for Anxiety or Stress

- Maintain a positive attitude
- Limit alcohol and caffeine
- Get enough sleep
- Take deep breaths
- Accept that you cannot control everything
- Welcome humor
- Exercise daily
- Get involved
- Learn what triggers your anxiety
- Distract yourself
- Set small daily goals
- Take a time out

Which strategies would be the most helpful for you to use in your life?

Adaptive devices: Kitchen




Adaptive devices: Self Cares

Assessment & Goal Formation

QuickDASH Assessment

QuickDASH

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

	NO DIFFICULTY	*MILD DIFFICULTY*	*MODERATE DIFFICULTY*	*SEVERE DIFFICULTY*	*UNABLE*
1. Open a tight or new jar	1	2	3	4	5
2. Do heavy household jobs (e.g. wash windows, clean floors)	1	2	3	4	5
3. Cary a shopping bag or briefcase	1	2	3	4	5
4. Wash your back	1	2	3	4	5
5. Use a knife to cut food	1	2	3	4	5
6. Recreational activities which require you to take some force or impact through your arm, shoulder or hand (e.g. golf, hammering, tennis etc)	1	2	3	4	5

	NOT AT ALL	SLIGHTLY	MODERATELY	QUITE A BIT	EXTREMELY
7. During the past week, *to what extent* has your arm, shoulder or hand problem interfered with your normal social activities with family. friends, neighbours or groups? *(circle number)*	1	2	3	4	5
	NOT LIMITED AT ALL	**SLIGHTLY LIMITED**	**MODERATELY LIMITED**	**VERY LIMITED**	**UNABLE**
8. During the past week, were you limited in your work or other regular daily activities as a result of your arm, shoulder or hand problem? *(circle number)*	1	2	3	4	5
Please rate the severity of the following symptoms in the last week *(circle number)*	**NONE**	**MILD**	**MODERATE**	**SEVERE**	**EXTREME**
9. Arm, shoulder or hand pain	1	2	3	4	5
10. Tingling (pins and needles) in your arm, shoulder or hand	1	2	3	4	5
	NO DIFFICULTY	**MILD DIFFICULTY**	**MODERATE DIFFICULTY**	**SEVERE DIFFICULTY**	**SO MUCH DIFFICULTY THAT I CAN'T SLEEP**
11. During the past week, how much difficulty have you had sleeping because of the pain in your arm, shoulder or hand? *(circle number)*	1	2	3	4	5

QuickDASH

WORK MODULE (OPTIONAL)

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

Please indicate what your job / work is: _____

❑ I do not work (you may skip this section).

Please circle the number that best describes your physical ability in the past week.

Did you have any difficulty:	*NO DIFFICULTY*	*MILD DIFFICULTY*	*MODERATE DIFFICULTY*	*SEVERE DIFFICULTY*	*UNABLE*
1. Doing your work in your usual way?	1	2	3	4	5
2. Doing your usual work because of arm, shoulder or hand pain?	1	2	3	4	5
3. Doing your work as well as you would like?	1	2	3	4	5
4. Spending your usual amount of time doing your work?	1	2	3	4	5

SPORTS/PERFORMING ARTS MODULE (OPTIONAL)

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

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

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

Please circle the number that best describes your physical ability in the past week.

Did you have an difficulty:	*NO DIFFICULTY*	*MILD DIFFICULTY*	*MODERATE DIFFICULTY*	*SEVERE DIFFICULTY*	*UNABLE*
1. Playing your instrument or sport in your usual way?	1	2	3	4	5
2. Playing your musical instrument or sport because of arm, shoulder or hand pain?	1	2	3	4	5
3. Playing your instrument or sport as well as you would like?	1	2	3	4	5
4. Spending your usual amount of time practising or playing your instrument or sport?	1	2	3	4	5

Role Checklist: Introduction

NAME_____ AGE_____ DATE_____

SEX: ❑ MALE ❑ FEMALE ARE YOU RETIRED? ❑ YES ❑ NO

MARITAL STATUS: ❑ SINGLE ❑ MARRIED ❑ SEPARATED ❑ DIVORCED ❑ WIDOWED

The purpose of this checklist is to identify the major roles in your life. The checklist, which is divided into two parts, presents 10 roles and defines each one.

Role Checklist: Part 1

Role	Past	Present	Future
STUDENT: Attending school on a part-time or full time basis.			
WORKER: Part-time or full-time paid employment			
VOLUNTEER: Donating services, at least once a week, to a hospital, school, community, political campaign, and so forth.			
CAREGIVER: Responsibility, at least once a week, for the care of someone such as a child, spouse, relative, or friend			
HOME MAINTAINER: Responsibility, at least once a week, for the upkeep of the home such as housecleaning or yard work.			

Role Checklist: Part 1

Role	Past	Present	Future
FAMILY MEMBER: Spending time or doing something, at least once a week, with a family member such as a child, spouse, or other relative			
RELIGIOUS PARTICIPANT: Involvement, at least once a week, in groups or activities affiliated with one's religion (excluding worship).			
HOBBYIST/AMATEUR: Involvement, at least once a week, in a hobby or amateur activity such as sewing, playing a musical instrument, woodworking, sports, the theater, or participation in a club or team.			
PARTICIPANT IN ORGANIZATIONS: Involvement, at least once a week, in organizations such as the American Legion, National Organization for Women, Weight Watchers, and so forth.			
OTHER: A role not listed which you have performed, are presently performing, and/or plan to perform. Write the role on the line above and check the appropriate column(s).			

Role Checklist: Part 2

Role	Not at all valuable	Somewhat valuable	Very valuable
STUDENT: Attending school on a part-time or full time basis.			
WORKER: Part-time or full-time paid employment			
VOLUNTEER: Donating services, at least once a week, to a hospital, school, community, political campaign, and so forth.			
CAREGIVER: Responsibility, at least once a week, for the care of someone such as a child, spouse, relative, or friend			
HOME MAINTAINER: Responsibility, at least once a week, for the upkeep of the home such as housecleaning or yard work.			

Role Checklist: Part 2

Role	Not at all valuable	Somewhat valuable	Very valuable
FAMILY MEMBER: Spending time or doing something, at least once a week, with a family member such as a child, spouse, or other relative			
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PARTICIPANT IN ORGANIZATIONS: Involvement, at least once a week, in organizations such as the American Legion, National Organization for Women, Weight Watchers, and so forth.			
OTHER: A role not listed which you have performed, are presently performing, and/or plan to perform. Write the role on the line above and check the appropriate column(s).			

Pinching

- Zipping
- Buttoning
- Tying Shoes
- Flossing
- Managing medication bottles
- Managing contacts
- Plugging electronics into outlets
- Opening food packages
- Turning a key in a lock
- Playing cards, video games

Grasping

- Pulling on clothing
- Shaving
- Holding eating utensils
- Combing and washing hair
- Writing
- Opening a door handle
- Handling money
- Holding a bicycle handle
- Stirring during meal prep
- Laundry
- Cleaning windows

Finger Extension

- Drinking from a cup
- Tuck in shirt
- Tie shoes
- Button shirt
- Open a pop can
- Washing face
- Managing contacts
- Typing, pressing buttons
- Handling money
- Wiping the table
- Use of computer mouse

Wrist Flexion & Extension

- Applying deodorant
- Flossing
- Transfers
- Typing at a computer
- Writing
- Sweeping, dusting
- Stirring contents in a bowl
- Cutting vegetables
- Folding laundry
- Opening & closing medications bottle

Pronation & Supination

- Opening shampoo bottle
- Turning on a faucet
- Washing hair
- Toilet hygiene
- Tying shoes
- Combing hair
- Shaving
- Bringing food to mouth
- Turning a page in a book
- Stirring, pouring, scooping
- Using a screwdriver

Shoulder Flexion

- Brushing hair
- Shaving
- Pulling clothing over head
- Hanging clothing
- Washing windows
- Grocery shopping
- Opening the refrigerator
- Reaching into a cupboard
- Putting dishes away
- Shaking one’s hand
- Reaching

Elbow Flexion

- Bringing food/drink to mouth
- Brushing teeth, hair
- Washing hair, face
- Pulling clothing up
- Changing a lightbulb
- Carrying objects
- Washing dishes
- Wiping counters
- Grooming
- Wiping counters or tables
- Pet care

Elbow Extension

- Wiping counters
- Getting up from a chair
- Dressing
- Holding wheel while driving
- Reaching up or down
- Toilet hygiene
- Making the bed
- Pulling a shirt over arm
- Washing dishes
- Hanging laundry
- Changing a diaper

Before the injury, I used my arm and/or hands for:

Work / Leisure Activities / Activities of Daily Living / Home Cares / Other

_____

Now, I especially have difficulty with:

_____

My main priorities for occupational therapy is:

_____

Your Homework

At home this week, I will:

wash the dishes How often: once per day

Sunday:

What went well? I was surprised with how many dishes I was already about to do.

How long did it take? I only washed about 4 plates, so it took about 5 minutes

How did you feel? It felt good to help clean the kitchen again, but I was very frustrated with how difficult it was.

Appendix B

Therapist Cues
Opposite Side: Front Cover

Introduction- Therapist Information

- This product was intended to be used as a tool for a one-on-one patient education session for patients with upper extremity nerve lacerations.
- **Directions:** Set up binder to form an easel with the patient side facing the patient and the therapist side (this side) facing the therapist. Use the dry-erase marker whenever possible to increase the interaction during education.
- Each patient page has a correlating therapist page to assist with the education process
- See table of contents for specific topics; this tool does not need to be used in its entirety. Use clinical reasoning to select relevant topics for each patient
- See The Therapist Manual for detailed information regarding this product and its use, including self-reflection surveys

For information on image sources, see reference list in The Therapist Manual

Therapist Cue Example

Preview of patient side

Written here will be recommended education, gestures, and techniques to facilitate learning

- It may include in-depth anatomical information that a patient may or may not want to learn about.
- *Italicized information will indicate gestures and recommendations, but* normally written font will indicate information to be verbally spoken to patient.

Written here will be the references and sources used for each slide's information.

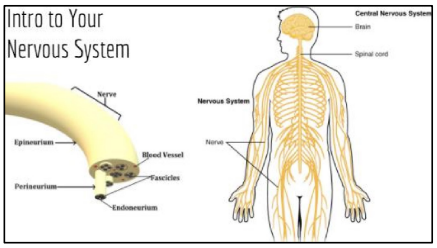
Therapist Cues- Patient Information

Verbatim from Patient Side

1. This resource was created to help guide you through your rehabilitation process and answer questions you may have.
2. Research shows that learning about your injury is very therapeutic and leads to better outcomes.
3. Taking an active role in your rehabilitation process has also shown to improve your outcomes.
4. Ask questions and be prepared to learn!

Neuroanatomy & Neurophysiology

Therapist Cues- Your Nerve



Introduction to the Nervous System

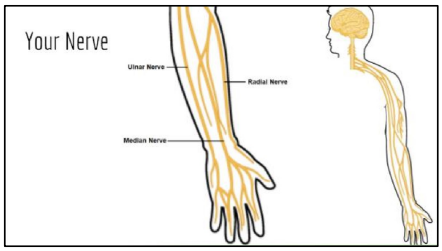
- Nerves relay messages to and from your brain, up and down your spinal cord, and through various areas in your body.
- *(While pointing on the image)* For example, when you feel something with your hand, your nerve carries that message up to the spinal cord and to the brain to process.
- The brain then sends a message down the spinal cord and to a specific nerve to move your hand.

Optional: For patients who want to learn more about the details of the nerve

- Epineurium: Outermost layer of tissue around a nerve
- Perineurium: Layer of tissue surrounding a fascicle (or, a bundle of nerve fibers/axons)
- Endoneurium: Layer of tissue around each fiber/axon within a fascicle.
- Fascicle: A bundle of nerve fibers within a nerve. There are 6 fascicles pictured. Larger nerves can contain much more. Smaller nerves can have as little as one.

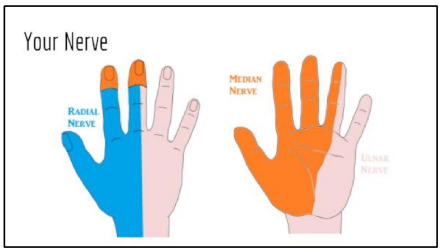
Sources:
Bathen, M. & Gupta, R. (2011). Basic science of peripheral nerve injury and repair. In Skirven, T. M., Osterman, A. L., Fedorczyck, J. M., & Amadio, P. C. (Eds.), *Rehabilitation of the Hand and Upper Extremity* (6th ed.). (pp. 591-600). Philadelphia, PA: Elsevier Mosby.
Smith, K. L. (2011). Nerve response to injury and repair. In Skirven, T. M., Osterman, A. L., Fedorczyck, J. M., & Amadio, P. C. (Eds.), *Rehabilitation of the Hand and Upper Extremity* (6th ed.). (pp. 601-610). Philadelphia, PA: Elsevier Mosby.

Therapist Cues- Your Nerve



- *Using the dry-erase marker, highlight the patient's affected nerve*
- *Draw a line from the brain to the nerve, demonstrating the connection between the hand nerves and the brain*
- Nerves are connected to your brain.

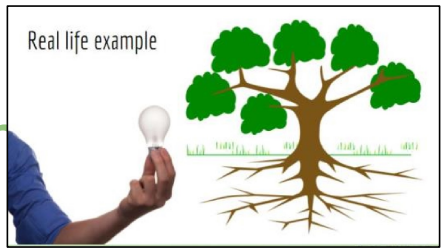
Therapist Cues- Your Nerve



- *Indicate relevant dermatome to patient*
- Each nerve serves a different part of your hand
- *Pointing or drawing to area,* This area is where you can expect to experience sensation changes

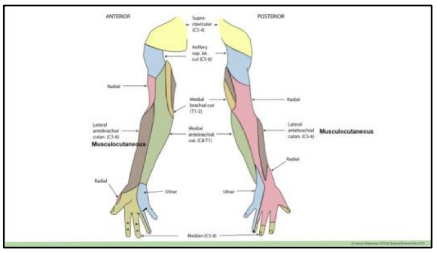
Sources:
Bathen, M. & Gupta, R. (2011). Basic science of peripheral nerve injury and repair. In Skirven, T. M., Osterman, A. L., Fedorczyck, J. M., & Amadio, P. C. (Eds.), *Rehabilitation of the Hand and Upper Extremity* (6th ed.). (pp. 591-600). Philadelphia, PA: Elsevier Mosby.

Therapist Cues- Real Life Exam



- *Explain aspects of nerve using real-life examples*
- There are **motor nerves** that help move your body **and sensory nerves** that help you feel things. If a **sensory nerve** is injured, you will have trouble feeling things, and if a **motor nerve** is injured, you will have trouble moving your hand/arm. Sometimes the nerves are both
- *Pointing to picture of person's arm,* your nerves are like electric wires. If there is an injury/cut to the wire, the electricity would not be able to get through to turn on the light bulb.
- *Pointing to the tree*, because an injury happened to one part of your body, it will affect the rest of your body. So if a tree's root is damaged, it will affect the stability and water supply to the rest of the tree

Therapist Cues- Your Nerve



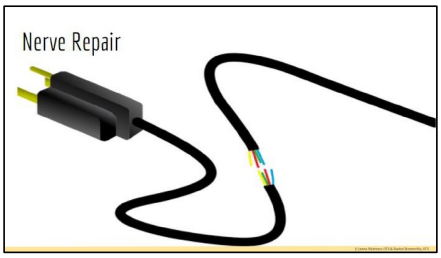
Understanding what nerves do:

- *This image displays the areas that each nerve serves.*
- *Musculocutaneous Nerve: Relays messages from the brain to the muscles
- *Lateral Antebrachial Cutaneous Nerve: Sensory nerve- sends messages about sensation to the brain
- Radial, Ulnar, and Median nerves supply both sensory and motor information to their associated regions

Sources:
Bathen, M. & Gupta, R. (2011). Basic science of peripheral nerve injury and repair. In Skirven, T. M., Osterman, A. L., Fedorczyck, J. M., & Amadio, P. C. (Eds.), *Rehabilitation of the Hand and Upper Extremity* (6th ed.). (pp. 591-600). Philadelphia, PA: Elsevier Mosby.
Smith, K. L. (2011). Nerve response to injury and repair. In Skirven, T. M., Osterman, A. L., Fedorczyck, J. M., & Amadio, P. C. (Eds.), *Rehabilitation of the Hand and Upper Extremity* (6th ed.). (pp. 601-610). Philadelphia, PA: Elsevier Mosby.

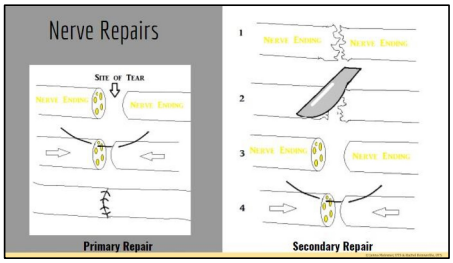
Common Procedures

Therapist Cues - Wire



- *Explain nerve repair using example of a wire*
- *Pointing to the cut in wire*
- A nerve is like a wire or a cord. When it is cut, there are many tiny wires within that become separated. The surgeon attempts to line the wires back up together as best as they can in order to allow the “message” to flow through the “wire” again. However, it is impossible to line everything back up perfectly. Time will tell how well the surgery went and therapy will help reteach the nerves how to send the message.

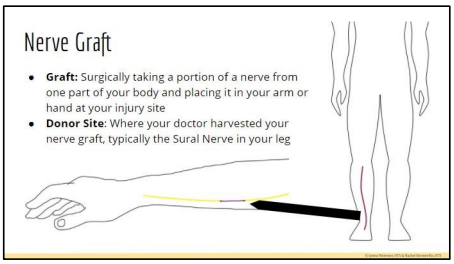
Therapist Cues- Nerve Repair



- *Indicate which type of nerve repair they received (nerve graft on next slide).*
- *Pointing at first picture:* A primary nerve repair is used when there is a clean cut to the nerve and both ends can be sewn back together.
- *Pointing at second picture:* A secondary nerve repair is used after a crush injury or avulsion trauma when the injured portion of the nerve must be removed and the remaining uninjured nerve is sewn back together. Sometimes during this procedure the remaining nerve will be tight so we will take extra precautions not to overstretch this nerve.
- *Pointing or drawing to cut area,* These are the areas that need to grow back together to complete the connection.

Sources: Luca, L. (2016). Nerve repair. In Saunders, R. J., Astifidis, R. P., Burke, S. L., Higgins, J. P., & McClinton, M. A. (Eds)., Hand and Upper Extremity Rehabilitation: A Practical Guide (4th ed.). (pp. 95-101). St Louis, MO. Elsevier.
Bathen, M. & Gupta, R. (2011). Basic science of peripheral nerve injury and repair. In Skirven, T. M., Osterman, A. L., Fedorczyck, J. M., & Amadio, P. C. (Eds.), *Rehabilitation of the Hand and Upper Extremity*

Therapist Cues- Nerve Graft



- *Explain what happens in a nerve graft repair.*
- Grafts are done to bridge the gap between the ends of your injured nerve.
- Donor nerves are nerves that are expendable, or much less important, than the function being restored in your arm.
- This includes the sural nerve in the leg, which gives sensation to the side of the foot, or the medial antebrachial cutaneous nerve, which provides sensation to the inner arm. You may experience loss of sensation in your donor area. The numbness area may decrease in size over time.
- *Pointing or drawing to the donor area,* this is where the nerve is taken from and used in your arm

Sources: Luca, L. (2016). Nerve repair. In Saunders, R. J., Astifidis, R. P., Burke, S. L., Higgins, J. P., & McClinton, M. A. (Eds)., Hand and Upper Extremity Rehabilitation: A Practical Guide (4th ed.). (pp. 95-101). St Louis, MO. Elsevier.
Bathen, M. & Gupta, R. (2011). Basic science of peripheral nerve injury and repair. In Skirven, T. M., Osterman, A. L., Fedorczyck, J. M., & Amadio, P. C. (Eds.), *Rehabilitation of the Hand and Upper Extremity* (6th ed.). (pp. 591-600). Philadelphia, PA: Elsevier Mosby.

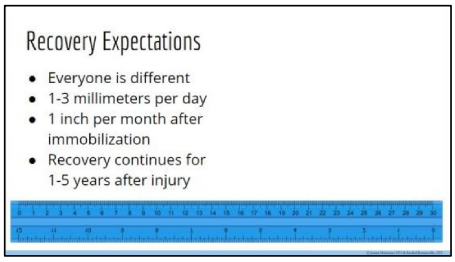
Rehabilitation Process

Therapist Cues- Therapy Overview

Overview of their timeline

- *Explain that timelines will be different for each doctor and every injury and will be dependent on the rate of recovery*
- Your surgeon ordered immobilization to last _____ weeks.
- After the immobilization phase, you are able to _____.
- You will be seeing occupational therapy in order to help you return to your valued activities of daily living, otherwise known as occupations (Hence 'occupational' therapy).
    - Occupations include
        - Self-care, child care, Leisure, work and productivity, Sleep & Rest

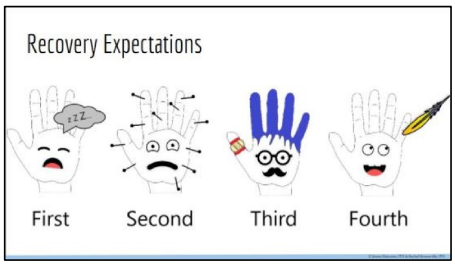
Therapist Cues- Recovery Expectations



- Recovery is different for each patient.
- The rate of recovery can vary for everyone depending on the use of the extremity and the severity of the injury.
- Nerve lacerations recover at a rate of 1-3 millimeters per day, 1 inch per month after the initial three week immobilization period.
- Depending on the type and severity of the injury, functional improvements are likely, but can take a year or more to achieve after the onset of the injury and can continue to progress for up to 5 years.
- *The rehabilitation process can be frustrating: if patient appears stressed or anxious about recovery, refer to coping strategies.*

Source: Sharma-Abbott, R. & Larson, R. N. (2016). Sensory reeducation and desensitization. In Saunders, R. J., Astifidis, R. P., Burke, S. L., Higgins, J. P., & McClinton, M. A. (Eds)., Hand and Upper Extremity Rehabilitation: A Practical Guide (4th ed.). (pp. 103-110). St Louis, MO. Elsevier.

Therapist Cues- Recovery Expectations



Explain that recovery stages have no exact time period but will last depending on the rate of healing of the nerve

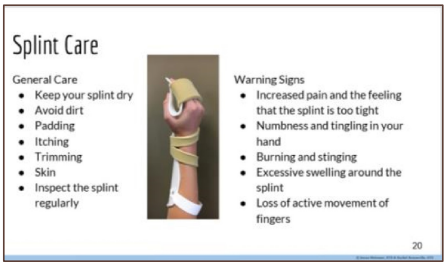
1. Right after surgery, expect the affected area to feel **numb.**
2. Approximately 6 weeks after surgery you can expect to feel **signs of nerve regeneration**. This can feel like a **tingling** sensation, **pins and needles, or shooting pain**. During this stage, it is important to retrain your brain to feel and move your affected area.
3. Pins and needles sensation continues and gradually intensifies. This may be uncomfortable but a **normal step** in the recovery process. It is important to touch and use your hand at this stage. You will start to develop **pain and cold sensation**. There will be a lack of ability to sense heat - use your judgement that if something does not feel cold, it is probably hot. This can last from 6 months to two years.
4. You will eventually be able to localize a stimulus- you will be able to tell where a sensation happens on your hand!

Source: Sharma-Abbott, R. & Larson, R. N. (2016). Sensory reeducation and desensitization. In Saunders, R. J., Astifidis, R. P., Burke, S. L., Higgins, J. P., & McClinton, M. A. (Eds)., Hand and Upper Extremity Rehabilitation: A Practical Guide (4th ed.). (pp. 103-110). St Louis, MO. Elsevier.

Therapist Cues- Safety

- *Address how, due to the loss of sensation and mobility, the hand/arm is now more susceptible to injury*
- It is important to be aware of and have safety strategies for your extremity so that you are not afraid to use your hand and will not disrupt the healing process with re-injury.
- *Allow the patients to identify areas of their lives that they are concerned about using their hand in and let them problem solve to come up with solutions to these situations.*
- *Collaborate with patient to think of strategies specific to their everyday life.*
- Here are some general safety strategies to suggest:
  - Be aware of where your hand is in space.
  - When in crowded area, place hand in pocket for protection.
  - Avoid extreme temperatures
  - Wear mittens in the cold to avoid frostbite
  - Test temperatures with other extremities

Therapist Cues- Splint Care



This is most pertinent in the immobilization stage after surgery

- **Keep your splint dry.** Moisture weakens plaster and damp padding next to the skin can cause irritation.
- **Avoid dirt.** Keep dirt, sand, and powder away from the inside of your splint.
- **Itching.** Do not stick objects inside the splint to scratch itching skin. Do not apply powders or deodorants to itching skin.
- **Trimming.** Do not break off rough edges of the cast or trim the cast before asking your doctor or therapist.
- **Skin.** Inspect the skin around the splint, If your skin becomes red or raw, contact your doctor or therapist.
- **Inspect the splint regularly.** If it becomes cracked or develops soft spots, contact your therapist. .

Warning Signs

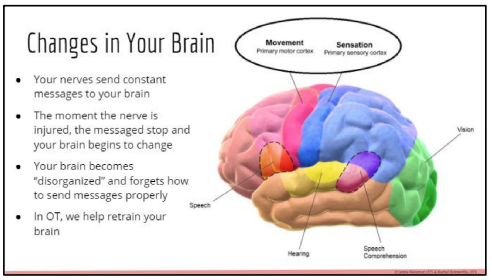
Swelling can create a lot of pressure under your cast. This can lead to problems. If you experience any of the following symptoms, contact your therapist or doctor:

- **Increased pain and the feeling that the splint is too tight.** This may be caused by swelling.
- **Numbness and tingling in your hand.** This may be caused by too much pressure on the nerves.
- **Burning and stinging.** This may be caused by too much pressure on the skin.
- **Excessive swelling below the splint.** This may mean the cast is slowing your blood circulation.
- **Loss of active movement of fingers.** This requires an urgent evaluation by your doctor.

Sources: Stuart J. Fischer, S. (2017). OrthoInfo. The American Academy of Orthopaedic Surgeons. Retrieved from: http://orthoinfo.aaos.org/topic.cfm?topic=a00095

Occupation-Based Intervention

Therapist Cues- Changes in Your Brain



Explanation of cortical reorganization and neuroplasticity. ***Refer to page 6 for additional visual aid or use the "Tree" and "Wire" analogy (regarding brain-nerve connection),***

- Your nerves send constant messages to your brain, which is constantly learning and growing. Your brain has the ability to change all the time, which is known as "plasticity".
- The moment the nerve is injured, the messaged stop and your brain begins to change. A lack of input from the injured nerve causes structural changes in cortical regions.
- Your brain becomes "disorganized" and forgets how to send messages properly
- In OT, we help retrain your brain by activating the part of the brain that was affected.

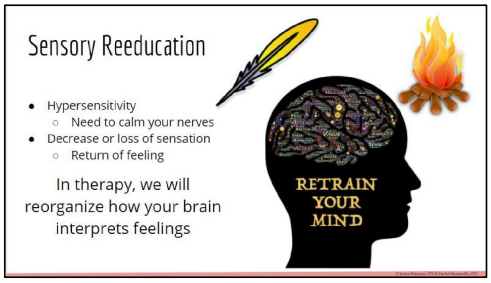
Optional: Point to the motor and sensory cortex in the image to explain how these areas are responsible for movement and sensation, and that these are the structural areas that are susceptible to change

Other pertinent notes:

- Prolonged denervation and lack of input from the injured nerve are associated with greater cortical change and disorganization, making functional recovery more difficult

Sources:
Lohmeyer, J., Sommer, B., Siemers, F., Mailander, P. (2009). Nerve injuries of the upper extremity – Expected outcome and clinical examination. Plastic Surgical Nursing, 29(2), 88-93. doi: 10.1097/01.PSN.0000356867.18220.73.
Rosen, B. & Lundborg, G. (2011). Sensory reeducation. In Skirven, T. M., Osterman, A. L., Fedorczyck, J. M., & Amadio, P. C. (Eds.), Rehabilitation of the Hand and Upper Extremity (6th ed.). (pp. 635-645). Philadelphia, PA: Elsevier Mosby.
Taylor, K., Anastakis, D., Davis, K. (2009) Cutting your nerve changes your brain. *Journal of Neurology, 132*, 3122-3133. doi:10.1093/brain/awp231

Therapist Cues- Sensory Reeducation



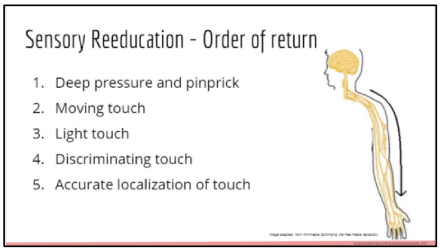
Explain what sensory deficit/side effect that the patient is experiencing

- Sensation can be **intensified** in the affected area. This means that everything that you touch feels more painful or more sensitive than it should.
- Sensation can also be **decreased or lost.** This means when you touch things, your hand may feel dull, numb, or be unable to feel at all.

  -Reassure that these are both normal effects of a nerve laceration.
- **Sensory reeducation** is used to retrain the brain to perceive the correct sensations.
- *For hypersensitivity:* desensitization occurs with exposure to different textures and tactile sensation in order for you to recognize the stimulus as non-painful.
- *For Loss of sensation:* we will train your brain to recognize touch in the affected area. We will do this by "tricking" your brain to perceive feeling.

Sources:
Novak, C. T. & von der Heyde, R. L. (2015). Rehabilitation of the upper extremity following nerve and tendon reconstruction: When and How. Seminars in Plastic Surgery, 29(1), 73-80. doi: 10.1055/s-0035-1544172.

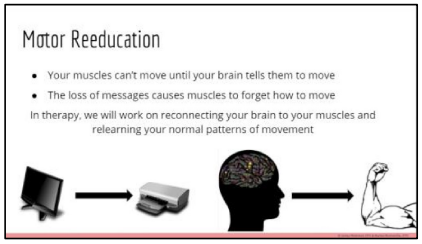
Therapist Cues- Order of Sensory Return



- As your sensation returns, you should expect to first be able to feel deep pressure and a pinprick.
- Eventually, as your nerve continues to heal, you will then be able to identify moving touch (*Demonstrate on non affected hand or on self)*
- After that, you will then be able to detect light touch *(Demonstrate)*
- Discriminating Touch: Being able to tell the difference between different textures. For example, soft velvet versus rubber.
- The highest level to return is localization. That means you can feel exactly where a stimulus is on your arm and/or hand without seeing it. *(Demonstrate)*

Sources:
Duff, S. & Estilow, T. (2011). Therapist's management of peripheral nerve injury. In Skirven, T. M., Osterman, A. L., Fedorczyck, J. M., & Amadio, P. C. (Eds.), *Rehabilitation of the Hand and Upper Extremity* (6th ed.). (pp. 619-633). Philadelphia, PA: Elsevier Mosby.

Therapist Cues- Motor Reeducation



- *Use the connection of a computer to a printer to help explain the connection of your brain to your muscles. Use other examples if necessary.*
- Because the messages between your brain and your muscles have been disrupted, your muscles are not moving like they should - just like when a printer and a computer have a bad connection.
- After a length of not receiving messages, your muscles forget how to move in the correct patterns - you will receive an error message showing that something is wrong.
- As your nerve heals, your muscles will start to "reconnect" and you must "reprogram" them to move the correct way
- In therapy we will address these movement patterns.

Sources:
Duff, S. & Estilow, T. (2011). Therapist's management of peripheral nerve injury. In Skirven, T. M., Osterman, A. L., Fedorczyck, J. M., & Amadio, P. C. (Eds.), *Rehabilitation of the Hand and Upper Extremity* (6th ed.). (pp. 619-633). Philadelphia, PA: Elsevier Mosby.

Therapist Cues- Order of Return

- *Explain to the patient what they can expect for return of their muscles*
- Your nerve heals starting at your site of injury and working its way down your arm, your muscles will return the same way.
- You will gain gross motor movements back before you gain the smaller more coordinated movements.
- Because of the loss of regular muscle use, atrophy (gradual decline) and loss of muscle strength is common.
- We will work to gradually strengthen these muscles and increase your function in your every-day life.

Sources:
Duff, S. & Estilow, T. (2011). Therapist's management of peripheral nerve injury. In Skirven, T. M., Osterman, A. L., Fedorczyck, J. M., & Amadio, P. C. (Eds.), *Rehabilitation of the Hand and Upper Extremity* (6th ed.). (pp. 619-633). Philadelphia, PA: Elsevier Mosby.

Therapist Cues- Occupation

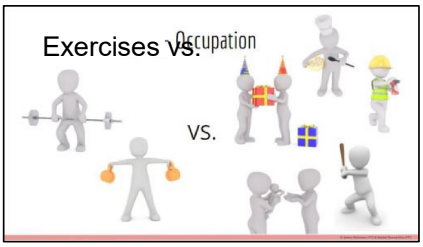
Explain what occupations are and how it pertains to therapy

Occupations: meaningful everyday life activities

1. Activities of daily living (ADL): self-cares, functional mobility, eating and feeding
2. Instrumental activities of daily living (IADL): community mobility, child care, home care, money management etc.
3. Work
4. Sleep and rest
5. Play
6. Leisure
7. Social Participation
8. Education

Sources:
American Occupational Therapy Association [AOTA]. (2014a). Occupational therapy practice framework: Domain and process (3rd ed.). *American Journal of Occupational Therapy, 68*(Suppl. 1), S1– S48. doi: 10.5014/ajot.2014.682006

Therapist Cues-Exercises vs. Occupation



Explanation of the therapeutic benefits from occupations:

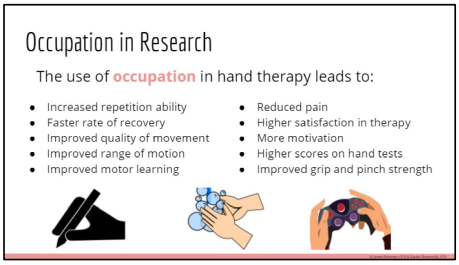
Exercises are an important part of therapy. However, they aren't your only tool for rehabilitation.

- Occupation-based interventions incorporate exercises inside real activities
- Instead of only using rote exercises, you exercise by using meaningful occupations.
- Example: a strictly medical treatment session may include guided strengthening with theraputty, but an occupation-based intervention session may include buttoning, writing, or use of key and lock to achieve strengthening.

*" When I incorporate a functional task (usually **more demanding** than a rote exercise), the patient always comments that they find it **uniquely challenging, and most beneficial**" (Grice, 2015, p. 304).*

Sources: American Occupational Therapy Association [AOTA]. (2014a). Occupational therapy practice framework: Domain and process (3rd ed.). *American Journal of Occupational Therapy, 68*(Suppl. 1), S1– S48. doi: 10.5014/ajot.2014.682006. Colaianni, D., & Provident I. (2010). The benefits of and challenges to the use of occupation in hand therapy. *Occupational Therapy in Health Care, 24*(2)130-146. Doi: 10.3109/07380570903349378. Colaianni, D. J., Provident, I., DiBartola, L. M., & Wheeler, S. (2015). A phenomenology of occupation-based hand therapy. *Australian Occupational Therapy Journal*, *62*(3), 177-186. doi: 10.1111/1440-1630.12192. Grice, K. O. (2015). The use of occupation-based assessments and intervention in the hand therapy setting – A survey. *Journal of Hand Therapy, 28*(3), 300-306. doi:10.1016/j.jht.2015.01.005

Therapist Cues- Research

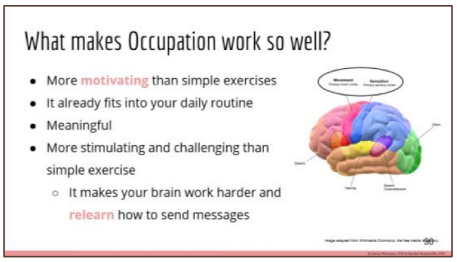


- Many research studies compared the differences between people who completed simple exercise programs and people who were assigned to perform tasks such as tying shoes, turning door handles, playing games that involved the hands, and doing other functional tasks that mimicked activities of daily living.
- Participants who completed the functional tasks demonstrated:
  - Increased repetition ability, **faster rate of recovery**
  - Improved quality of movement, improved range of motion
  - **Improved motor learning**, reduced pain
  - Higher satisfaction and **more motivation** in therapy
  - Higher scores on hand tests (Jebsen Hand Function Test, Purdue Pegboard Test Scores, DASH)
  - Improved grip and pinch strength

See therapist manual for detailed summary of the research.

Sources:
Che Daud, A. Z., Yau, M. K., Barnett, F., Judd, J., Jones, R. E., & Muhammad Nawawi, R. F. (2016). Integration of occupation based intervention in hand injury rehabilitation: A randomized controlled trial. J*ournal of Hand Therapy, 29*(1), 30–40. doi: 10.1016/j.jht.2015.09.004. Colaianni, D., & Provident I. (2010). The benefits of and challenges to the use of occupation in hand therapy. *Occupational Therapy in Health Care, 24*(2)130-146. Doi:10.3109/07380570903349378. Grice, K. O. (2015). The use of occupation-based assessments and intervention in the hand therapy setting – A survey. *Journal of Hand Therapy, 28*(3), 300-306. doi:10.1016/j.jht.2015.01.005. Guzelkucuk, U., Duman, I., Taskaynatan, M. A., & Dincer, K. 2007. Comparison of therapeutic activities with therapeutic exercises in the rehabilitation of young adult patients with hand injuries. *Journal of Hand Surgery, 32A* (9), 1429-1435. doi: 10.1016/j.jhsa.2007.08.008. Toth-Fejel, G. E., Toth-Fejel, G. F., Hedricks, C. (1998). Occupation-centered practice in hand rehabilitation using the experience sampling method. *American Journal of Occupational Therapy, 52*(5), 381-385.

Therapist Cues- Occupation

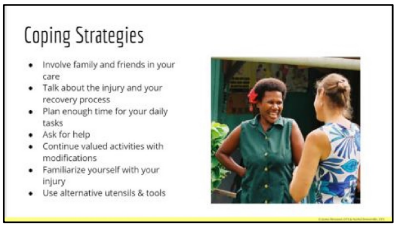


- More **motivating** than simple exercises
  - It's similar to how dancing, playing a sport, or playing games are all activities that take a lot of work, but you don't realize you're exercising while you perform them
- It already fits into your daily routine
- It's meaningful to both you and your brain- your brain is used to the particular action
- More stimulating and challenging than simple exercise
  - It makes your brain work harder and **relearn** how to send messages
  - *Facilitates cortical reorganization more readily than rote exercises*

Sources:
Grice, K. O. (2015). The use of occupation-based assessments and intervention in the hand therapy setting – A survey. *Journal of Hand Therapy, 28*(3), 300-306. doi:10.1016/j.jht.2015.01.005. Guzelkucuk, U., Duman, I., Taskaynatan, M. A., & Dincer, K. 2007. Comparison of therapeutic activities with therapeutic exercises in the rehabilitation of young adult patients with hand injuries. *Journal of Hand Surgery, 32A* (9), 1429-1435. doi: 10.1016/j.jhsa.2007.08.008. Toth-Fejel, G. E., Toth-Fejel, G. F., Hedricks, C. (1998). Occupation-centered practice in hand rehabilitation using the experience sampling method. *American Journal of Occupational Therapy, 52*(5), 381-385.

Coping Strategies

Therapist Cues- Injury Related Coping

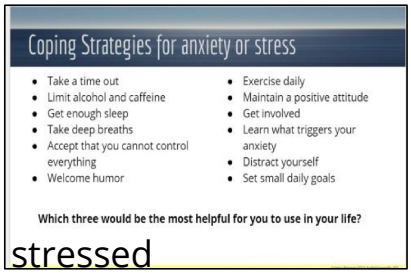


It's good to try to participate in your meaningful tasks for your therapy, but sometimes it's okay to ask for help and just cope with all that you are going through, especially on hard days. Be patient with yourself!

- Involve **family and friends** in your care. It's healthy to share your thoughts and feelings.
- Talk about the injury and your recovery process. It's been shown to help improve recovery and makes the process easier. It allows you to process the incident and reduces your emotional pain and fear associated with the injury.
    - Seek out support groups *(Identify a support group if known)*
- Plan enough **time** for your daily tasks to decrease time-related stress
- **Ask for help**
- Continue valued activities with modifications- Continue enjoying life!
- Familiarize yourself with your injury- that what this education process is for.
- Use alternative utensils & tools for especially hard tasks *(See next slides- "Adaptive Devices")*

Sources:
Cederlund R, Thoren-Jonsson, A., Dahlin, L.B. (2010) Coping strategies in daily occupations 3 months after a severe or major hand injury. *Occupational Therapy International*, *17*(1), 1-9. doi: 10.1002/oti.283

Therapist Cues- Anxiety & Stress Coping

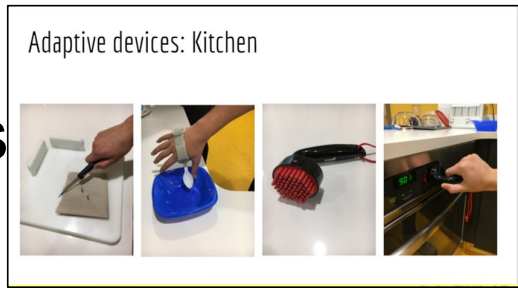


- Take a time out. Allow yourself to take a break when feeling extra stressed
- Limit alcohol and caffeine: Both heighten and worsen anxiety, leads to dependence
- Get enough sleep
- Take deep breaths, in through your nose, out through your mouth slowly.
- Accept that you cannot control everything
- Welcome humor
- Exercise daily
- Maintain a positive attitude
- Get involved
- Learn what triggers your anxiety
- Distract yourself
- Set small daily goals

See Therapist Guide for weekly homework form. Available to photocopy and personalize to patient.

Sources:
Anxiety and Depression Association of America. Retrieved from https://adaa.org/tips

Therapist Cues- Adaptive Devices



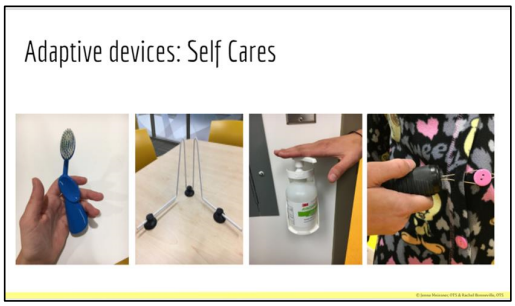
From Left to Right:

Image 1: Suction-cup bottom cutting board with two sharp prongs to hold food item. Ideal for one-handed meal preparation tasks.

Image 2: Universal cuff with inserted spoon. Ideal for flexion/grasping difficulty.

Image 3 & 4: Turning Knob Operator with spring loaded pins. Fits to most knobs on ovens, appliances, faucets, and valves. When the turner is pressed onto a knob, the pins contacting with the knob's surface retract, while the remaining pins surround the knob for a secure grip.

Therapist Cues- Adaptive Devices



From Left to Right:

Image 1: Built up handle on tooth brush. Achievable through application of built-up foam or by special purchase.

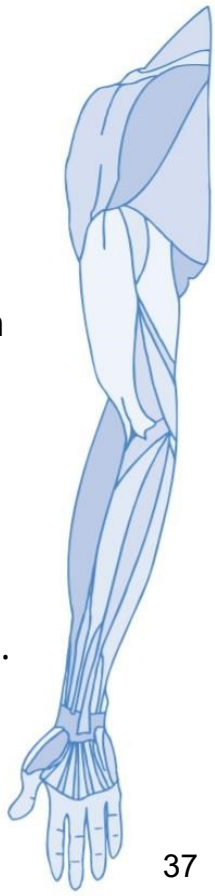
Image 2: Book prop-up. User no longer needs to hold onto a book to read.

Image 3: Spout-release of shampoos, soaps, hand sanitizers rather than squeeze bottles or those with cap tops.

Image 4: Button hook. Allows for one-handed manipulation of buttons on clothing.

Assessment & Goal Formation

The QuickDASH Outcome Measure



Instructions:

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

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

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

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

British English translation courtesy of: Prof Alison Hammond, Dr Yeliz Prior , Prof Sarah Tyson. Centre for Health Sciences Research, University of Salford; Centre for Long term Conditions Research, University of Manchester, UK.

The Quick DASH- Page 2, Scoring

See patient side

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

A *Quick*DASH score may not be calculated if there is greater than 1 missing item.

British English translation courtesy of: Prof Alison Hammond, Dr Yeliz Prior , Prof Sarah Tyson. Centre for Health Sciences Research, University of Salford; Centre for Long term Conditions Research, University of Manchester, UK.

The Quick DASH- Optional Work

See patient side

Scoring the optional modules*: add up the assigned values for each response; divide by 4 (number of items); subtract 1; multiply by 25.*
An optional module score may not be calculated if there are any missing items.

British English translation courtesy of: Prof Alison Hammond, Dr Yeliz Prior , Prof Sarah Tyson. Centre for Health Sciences Research, University of Salford; Centre for Long term Conditions Research, University of Manchester, UK.

The Quick DASH- Optional Sports

See patient side

Scoring the optional modules: add up the assigned values for each response; divide by 4 (number of items); subtract 1; multiply by 25.
An optional module score may not be calculated if there are any missing items.

British English translation courtesy of: Prof Alison Hammond, Dr Yeliz Prior , Prof Sarah Tyson. Centre for Health Sciences Research, University of Salford; Centre for Long term Conditions Research, University of Manchester, UK.

Administration of the Role Check


Role Checklist: Introduction

NAME_____ AGE_____ DATE_____

SEX: ❑ MALE ❑ FEMALE ARE YOU RETIRED? ❑ YES ❑ NO

MARITAL STATUS: ❑ SINGLE ❑ MARRIED ❑ SEPARATED ❑ DIVORCED ❑ WIDOWED

The purpose of this checklist is to identify the major roles in your life. The checklist, which is divided into two parts, presents 10 roles and defines each one.

Materials: Have marker readily available for patient use

Instruct individuals to complete the demographic information at the top of the checklist.

Remain with them until the checklist is completed.

Part 1

1) Read the instructions. (Next Page on Therapist Side)

2) Inquire if they understand the instructions and answer any questions pertaining to the administration of Part 1.

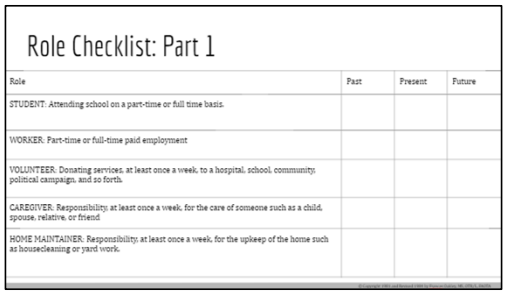
3) Define the time frames as follows:

a) “Present refers not only to today, but also includes the previous seven days.”

b) “Past refers to the period of time up until seven days ago. “

c) “Future is anytime from tomorrow onward.”

Role Checklist: Part 1


Role Checklist: Part 1

Role	Past	Present	Future
STUDENT: Attending school on a part-time or full time basis.			
WORKER: Part-time or full-time paid employment			
VOLUNTEER: Donating services, at least once a week, to a hospital, school, community, political campaign, and so forth.			
CAREGIVER: Responsibility, at least once a week, for the care of someone such as a child, spouse, relative, or friend			
HOME MAINTAINER: Responsibility, at least once a week, for the upkeep of the home such as housecleaning or yard work.			

Part 1; Page 1

Instructions: Beside each role, indicate, by checking the appropriate column, if you performed the role in the past, if you presently perform the role, and if you plan to perform the role in the future.

You may check more than one column for each role.

For example, if you volunteered in the past, do not volunteer at present, but plan to in the future, you would check the past and future columns.

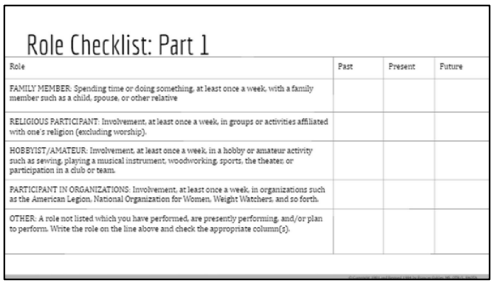
Reminder if needed:

a) “Present refers not only to today, but also includes the previous seven days.”

b) “Past refers to the period of time up until seven days ago. “

c) “Future is anytime from tomorrow onward.”

Role Checklist: Part 1



Role Checklist: Part 1

Role	Past	Present	Future
FAMILY MEMBER: Spending time or doing something, at least once a week, with a family member such as a child, spouse, or other relative			
RELIGIOUS PARTICIPANT: Involvement, at least once a week, in groups or activities affiliated with one's religion (excluding worship).			
HOBBYIST/AMATEUR: Involvement, at least once a week, in a hobby or amateur activity such as sewing, playing a musical instrument, woodworking, sports, the theater, or participation in a club or team.			
PARTICIPANT IN ORGANIZATIONS: Involvement, at least once a week, in organizations such as the American Legion, National Organization for Women, Weight Watchers, and so forth.			
OTHER: A role not listed which you have performed, are presently performing, and/or plan to perform. Write the role on the line above and check the appropriate column(s).			

Part 1; Page 2

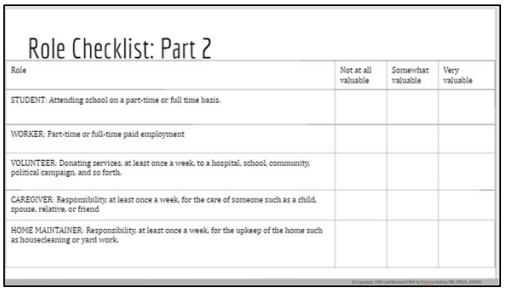
Reminder if needed:

a) “Present refers not only to today, but also includes the previous seven days.”

b) “Past refers to the period of time up until seven days ago. “

c) “Future is anytime from tomorrow onward.”

Role Checklist: Part 2



Role Checklist: Part 2

Role	Not at all valuable	Somewhat valuable	Very valuable
STUDENT: Attending school on a part-time or full time basis.			
WORKER: Part-time or full-time paid employment			
VOLUNTEER: Donating services, at least once a week, to a hospital, school, community, political campaign, and so forth.			
CAREGIVER: Responsibility, at least once a week, for the care of someone such as a child, spouse, relative, or friend			
HOME MAINTAINER: Responsibility, at least once a week, for the upkeep of the home such as housecleaning or yard work.			

Part 2; Page 1

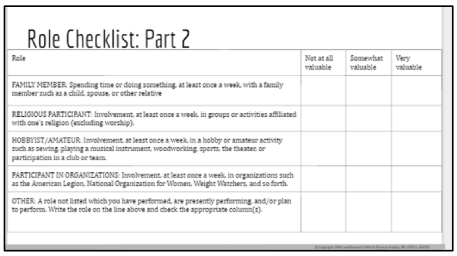
1) *When individuals have completed Part 1, read the instructions for Part 2*

Instructions: The same roles are listed below. Next to each role, check the column which best indicates how valuable or important the role is to you. Answer for each role, even if you have never performed or do not plan to perform the role

2) Inquire if they understand the instructions and answer any questions pertaining to the administration of Part 2.

3) Define "valuable" as follows:

"Valuable refers to the worth you place on each role, that is, how important or desirable the role is to you."


Role Checklist: Part 2

Role	Not at all valuable	Somewhat valuable	Very valuable
FAMILY MEMBER: Spending time or doing something, at least once a week, with a family member such as a child, spouse, or other relative			
RELIGIOUS PARTICIPANT: Involvement, at least once a week, in groups or activities affiliated with one's religion (excluding worship).			
HOBBYIST/AMATEUR: Involvement, at least once a week, in a hobby or amateur activity such as sewing, playing a musical instrument, woodworking, sports, the theater, or participation in a club or team.			
PARTICIPANT IN ORGANIZATIONS: Involvement, at least once a week, in organizations such as the American Legion, National Organization for Women, Weight Watchers, and so forth.			
OTHER: A role not listed which you have performed, are presently performing, and/or plan to perform. Write the role on the line above and check the appropriate column(s).			

Role Checklist: Part 2

Part 2; Page 2

Reminder if needed:

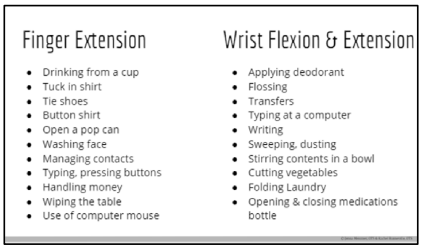
> "Valuable refers to the worth you place on each role, that is, how important or desirable the role is to you."

*Once completed, discuss **all results** with a focus on **very valuable roles** that are performed in the past but **not performed in the present or future** as indicated by the patient. Determine if these roles are affected by the upper extremity injury and/or other reasons for the change in role. This assessment data should yield both a holistic view of the patient's their priorities, and guide goal formation and intervention.*

Therapist Cues: Homework Ideas

- *Use the patient side to generate specific home program/work plan to practice between treatment sessions.*
- *Occupation-based tasks are organized by action, depending on the difficulty experienced by the patient.*
- *Instruct the patient to select relevant and/or prioritized tasks with the marker if possible.*
- *If applicable, choose tasks specific to patient that may not be listed.*

Therapist Cues: Homework Ideas



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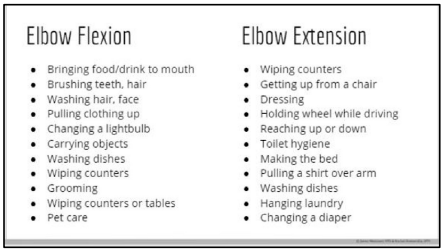
Therapist Cues: Homework Ideas



Elbow Flexion

- Bringing food/drink to mouth
- Brushing teeth, hair
- Washing hair, face
- Pulling clothing up
- Changing a lightbulb
- Carrying objects
- Washing dishes
- Wiping counters
- Grooming
- Wiping counters or tables
- Pet care

Elbow Extension

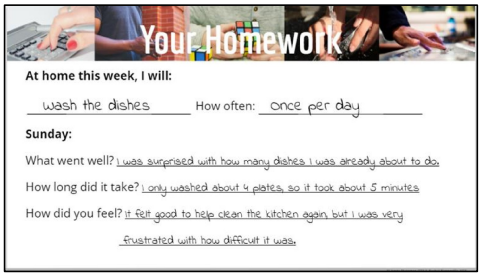
- Wiping counters
- Getting up from a chair
- Dressing
- Holding wheel while driving
- Reaching up or down
- Toilet hygiene
- Making the bed
- Pulling a shirt over arm
- Washing dishes
- Hanging laundry
- Changing a diaper

- *Use the patient side to generate specific home program/work plan to practice between treatment sessions.*
- *Occupation-based tasks are organized by action, depending on the difficulty experienced by the patient.*
- *Instruct the patient to select relevant and/or prioritized tasks with the marker if possible.*
- *If applicable, choose tasks specific to patient that may not be listed.*

Therapist Cues: Your Goals

- Think about your main roles and routines in your life.
- What is most important to you?
- *Refer to listed Homework Ideas, QuickDASH results, or Role Checklist results if needed.*

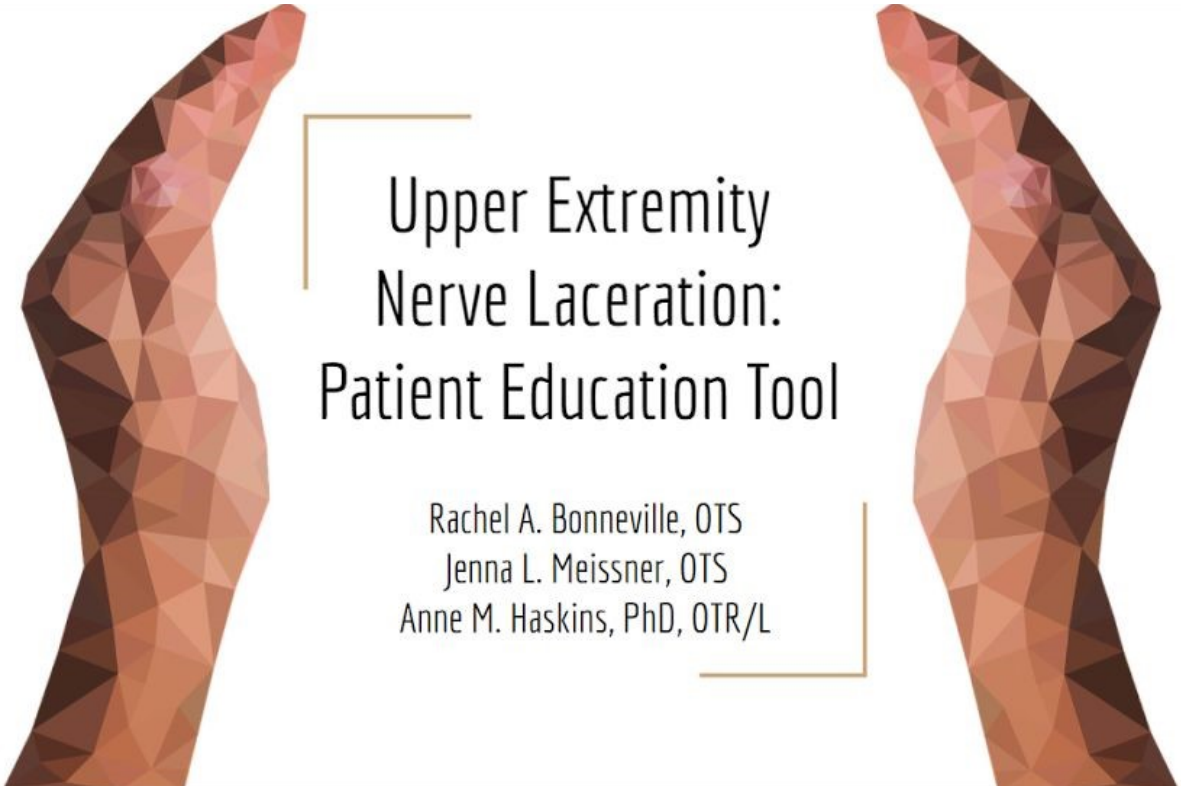
Therapist Cues: Homework Example



- *Example of an occupation-based "homework" home program.*
- *Guide patient through the example on patient side.*
- *See Therapist Guide for weekly homework form. Available to photocopy and personalize to patient.*

Appendix C

Therapist Manual



University of North Dakota
Grand Forks, North Dakota

Introduction

The *Upper Extremity Nerve Laceration: Patient Education Tool* was created for occupational therapists to use with individuals who have had an upper extremity nerve laceration. The tool is based on a thorough literature review of current practice in hand and occupational therapy for individuals with upper extremity nerve lacerations. This tool was created to enable the utilization of occupation as a therapeutic method in hand therapy with this population.

Authors: This tool was completed as a graduate scholarly project of the University of North Dakota Master's in Occupational Therapy. Authors Rachel A. Bonneville, OTS* and Jenna L. Meissner, OTS partnered under the guidance of Anne M. Haskins, PhD, OTR/L.

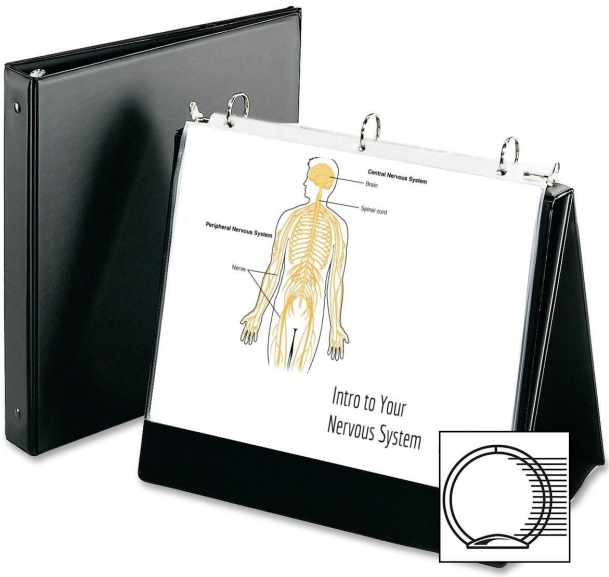
Purpose. The purpose of this scholarly project was to create an accessible resource for occupational therapists to implement occupation-based intervention in the currently biomechanical-dominated topic of upper extremity nerve laceration. Additionally, this project was created to effectively navigate and overcome the documented obstacles of occupation-based treatment. These obstacles include a lack of time, therapist resources, and reimbursement. Patient education is a frequently used and reimbursable mode of therapy. This mode was strategically chosen in order to address obstacles, and also to enable individualization of treatment. The Model of Human Occupation (MOHO) was used to guide the formation and elements included in this patient education tool. Additionally, several principles of Adult Learning Theory were implemented throughout the entirety of the tool in order to facilitate optimal and long term learning. This tool provides areas for individualization, and occupational therapists still need to consider the client's individual physical status, cognition, perception, affect, and motivation, and environments.

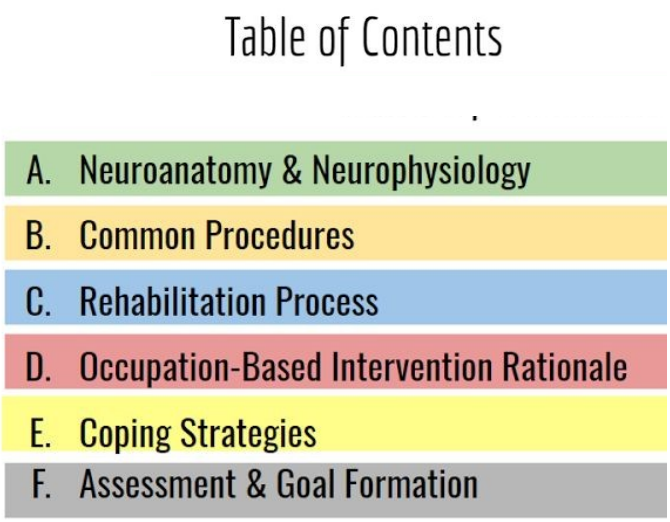
"Man, through the use of his hands, as they are energized by mind and will, can influence the state of his own health"
Mary Reilly, 1962

*OTS: Occupational Therapy Student

Directions for Use

The *Upper Extremity Nerve Laceration: Patient Education Tool* was intended to be used as a tool for a collaborative, one-on-one patient education session for upper extremity nerve lacerations. The following are steps for optimal use of this tool.





- Familiarize self with the contents of the binder prior to use
- Setup binder on a flat, table surface to form an easel with the patient side facing the patient and the therapist side facing the therapist (see image). Use the dry-erase marker whenever possible to increase the interaction during education.
- Each patient page has a correlating therapist page to assist with the education process
- See the general table of contents as well as the detailed table of contents in the tool for topics
- This tool is meant to use in segments over several sessions, and not necessarily in its entirety. Use clinical reasoning to select relevant topics for each patient.
- After the administration of the tool, it is recommended to ask the patient to complete the “Self Reflection Tool” in order to gain insights about the effectiveness of the education. Additionally, it is recommended to complete the therapist reflection worksheet for your own understanding of this tool’s effectiveness. These worksheets are included in this manual.

Summary of the Literature Review: Evidence for Occupation-Based Interventions

The purpose of this section is to summarize the relevant literature that supports the development and content included in The *Upper Extremity Nerve Laceration: Patient Education Tool*.

Occupation-based intervention (OBI) in hand therapy has been defined as a treatment approach that balances biomechanical and medical principles with the value of occupation as the therapeutic method (Colaianni, Provident, DiBartola, & Wheeler, 2015). Occupation-based interventions include the intentional use of functional activities and tasks as a means and end in the therapeutic process (Colaianni et al., 2015). Occupation-based interventions for individuals with nerve laceration allows for improved objective measurements, considers a person's specific context, and facilitates functional skill generalizability (Colaianni & Provident, 2010). Because of this, occupational therapists have an important and progressive role with this population in focusing on overall function.

Improved Outcomes

Colaianni and Provident (2010) compared OBI with a traditional exercise program with individuals with upper extremity nerve lacerations and found the OBI group to have increased repetition and interest, faster rate of recovery, improved quality of movement, range of motion (ROM) and active ROM (AROM), and improved motor learning over the traditional exercise program. Similarly, Maciel, Taylor, and McIlveen (2005) studied individuals with distal radius fractures who participated in an activity-focused therapy program or an exercise-focused program. Both groups showed significant improvement on all outcomes (Maciel, Taylor, & McIlveen, 2005). Although there was no a difference between groups, this study showed the therapeutic role of activities with this population and its potential for implementation (Maciel et al., 2005). Researchers of two separate studies found that upper extremity treatment with activities that mimic activities of daily living (ADLs) resulted in significantly improved grip and pinch strength and ROM when compared to therapeutic exercise alone (Guzelkucuk et al., 2007; Toth-Fejel et al., 1998). The ADL groups also scored significantly higher on the Jebsen Hand Function Test and the Disabilities of the Arm, Shoulder, and Hand questionnaire (DASH) than the exercise group and also eliminated the development of non-adaptive movement patterns (Guzelkucuk et al., 2007; Toth-Fejel et al., 1998).

Toth-Fejel et al. (1998) also found that games used in treatment reduced pain, sped up recovery, and improved hand function for individuals with injured upper extremities. This increase in hand function was also seen in a randomized control trial for individuals with hand injuries when comparing therapeutic exercise (TE) and TE combined with OBI (Che Daud et al., 2016). TE combined with OBI demonstrated significantly greater outcomes (Che Daud et al., 2016). Specifically, grip strength, pain scores, pinch strength, and Purdue Pegboard test scores were all higher in the OBI group (Che Daud et al., 2016).

Increased Motivation

In many OBI sessions in the studies by Toth-Fejel et al. (1998), Che Daud et al. (2016), and Guzelkucuk et al. (2007), subjects were using scissors, sewed blankets, putting money into a wallet, and tied shoelaces in his or her treatment sessions. “We observed that the patients were more motivated while performing therapeutic activities rather than exercises” (Guzelkucuk et al., 2007, p. 1434). Toth-Fejel et al. (1998), Che Daud et al. (2016), and Guzelkucuk et al. (2007) attributed this motivation to perceived improvement in ADLs. Patients began to observe an increase in ability to perform activities they were previously unable to do, and they subsequently achieved confidence in his or her ability to improve (Guzelkucuk et al., 2007, p. 1434). One occupational therapist reported on the increased motivation experienced by patients when using OBI. “ When I... incorporate a functional task (usually more demanding than a rote exercise), the client always comments that they find it uniquely challenging, and most beneficial” (Grice, 2015, p. 304).

Toth-Fejel et al. (1998) compared an OBI group with a traditional exercise group for individuals with traumatic upper extremity fractures. The OBI group reported significantly higher levels of engagement and motivation in treatment sessions. Che Daud et al. (2016) conducted a similar study and found therapy satisfaction ratings were significantly higher in the OBI group.

In many of these studies, higher motivation and satisfaction scores correlated with higher objective measurements (Che Daud et al., 2016; Guzelkucuk et al., 2007; Toth-Fejel et al., 1998). When subjects experienced motivation due to OBI, they were more likely to fully attend and participate in the therapy, and thus more likely to experience objective gains in function (Che Daud et al., 2016; Guzelkucuk et al., 2007; Toth-Fejel et al., 1998).

Summary

The professional identity and distinct value of occupational therapy involves the therapeutic use of occupation as a means to and outcome of the therapy process. Occupational therapist in all types of settings have an obligation to prioritizing client-driven performance in meaningful occupation while considering physical and psychological components of a person and his or her injury. However, in the field of hand therapy for upper extremity nerve lacerations, current treatment standards have navigated from true OBI. Current methods are predominantly biomechanical and include therapist-driven modalities, such as motor reeducation, sensory re-education, strengthening, and physical agent modalities. The biomechanical frame of reference and physical agent modalities are necessary for recovery and remain an imporant aspect of the therapy process. However, increasingly more research has shown the improved outcomes and therapeutic value of personalized, occupation based intervention as well as the need for addressing psychological considerations for individuals with and upper extremity nerve laceration.

Resources

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Image Resources

File:1201 Overview of Nervous System.jpg. (2017, September 18). *Wikimedia Commons, the free media repository*. Retrieved 13:56, November 2, 2017 from https://commons.wikimedia.org/w/index.php?title=File:1201_Overview_of_Nervous_System.jpg&oldid=259000295.

File:Gray812and814.PNG. (2015, March 6). *Wikimedia Commons, the free media repository*. Retrieved 14:02, November 2, 2017 from https://commons.wikimedia.org/w/index.php?title=File:Gray812and814.PNG&oldid=152317351

File:Blausen 0102 Brain Motor&Sensory.png. (2017, June 19). *Wikimedia Commons, the free media repository*. Retrieved 14:03, November 2, 2017 from https://commons.wikimedia.org/w/index.php?title=File:Blausen_0102_Brain_Motor%26Sensory.png&oldid=248324700.

All other images used and/or adapted in this project were obtained from Wikimedia Commons, the free image repository or www.pixabay.com. These images were labeled as “free for commercial use, no attribution required”. All other images were created by the authors of this project.

Permissions

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OBI Self-Reflection Survey

Therapist portion:

1. Do you feel like the patient had a better understanding of his or her injury and what to expect throughout the rehabilitation process?

Yes No Not Sure

*Explain:*_____

2. Was the patient more motivated to participate in therapy after administering the educational material?

Yes No Not Sure

*Explain:*_____

3. Did the educational material help the patient regain his or her roles in life?

Yes No Not Sure

*Explain:*_____

4. Did the therapy sessions align with the patient's routines in his or her every-day life?

Yes No Not Sure

*Explain:*_____

5. Was the patient's own environment utilized during the intervention process?

Yes No Not Sure

*Explain:*_____

6. Was the patient's performance capacity improved after using occupation-based intervention methods?

Yes No Not Sure

*Explain:*_____

Additional Comments:

OBI Self-Reflection Survey

Client portion:

1. Do you have a better understanding of your injury and what to expect throughout the rehabilitation process?

Yes No Not Sure

*Explain:*_____

2. Did this education motivate you to participate in therapy?

Yes No Not Sure

*Explain:*_____

3. Do you feel like therapy helped you regain your roles in your life?

Yes No Not Sure

*Explain:*_____

4. Did the interventions align with your routines in your every-day life?

Yes No Not Sure

*Explain:*_____

5. Was your own environment used during the intervention process?

Yes No Not Sure

*Explain:*_____

6. Do you feel like your abilities improved with the use of occupations?

Yes No Not Sure

*Explain:*_____

Additional Comments:

Occupational Therapy

My Weekly Homework

At home this week, I will:

_____ How often:_____

What went well?
How long did it take?
How did you feel?

Sunday	
Monday	
Tuesday	
Wednesday	
Thursday	
Friday	
Saturday	

Occupational Therapy

Coping Strategies

Emotional Strategies:

- Take time to think about the incident and discuss it with your support system
- Participation in a rehabilitation group can be a great way to share your experience of injury, trauma and rehab with others in the same situation.

What is one way that you will cope with this injury?

Seek social supports:

- Accept some dependence on others, ask for assistance.
- Family and friends can provide sympathy, help develop independence and motivation.
- Keep contact with your work and coworkers.

Who can you look to for help and support?

Daily Occupations:

- New routines should be introduced to fit your schedule
- Give yourself extra time to complete these daily tasks.
- Continue valued activities with modifications
- Use alternative utensils & tools to assist.
- Use your hand as a passive holder and use frequently in daily activities.

What are ways in which you can involve your hand in your daily tasks?

Safety:

- Be aware of where your hand is in space.
- When in crowded area, place hand in pocket for protection.
- Avoid extreme temperatures
- Where mittens in the cold to avoid frostbite

How are you going to keep your hand safe in your daily life?

Appendix D

DASH User Profile

Kristina Buccat <kbuccat@iwh.on.ca> on behalf of Dash <dash@iwh.on.ca>

Fri 10/20/2017 2:57 PM

Thank you for completing the online DASH User Profile. This will confirm that your profile has been reviewed, and the information provided qualifies your organization for free use of the DASH/QuickDASH in non-profit projects. Please be advised that the DASH/QuickDASH may not under any circumstances, be changed in any way as even minor changes may alter performance.

Kindly read our Conditions of Use prior to using the DASH: http://www.dash.iwh.on.ca/conditions-use

If you require further information, please do not hesitate to contact me.

Kristina Buccat
Communications Assistant
Knowledge Transfer & Exchange
Institute for Work & Health
800-481 University Ave.
Toronto, ON M5G 2E9
dash@iwh.on.ca
http://www.dash.iwh.on.ca/

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RE: Use of Role Checklist

Taylor, Renee R <rtaylor@uic.edu>

Tue 10/24/2017 9:06 PM

To: Meissner, Jenna <jenna.meissner@und.edu>;

Cc: Bonneville, Rachel <rachel.bonneville@und.edu>;

You have permission.
Thank you,
Renee Taylor

From: Meissner, Jenna [jenna.meissner@und.edu]
Sent: Tuesday, October 24, 2017 3:41 PM
To: Taylor, Renee R
Cc: Bonneville, Rachel
Subject: Use of Role Checklist

To whom it may concern,

I am a third year Occupational Therapy Student at the University of North Dakota Master's Degree Program. I am writing to ask permission to use the Role Checklist Assessment to include as part of my Scholarly Project. My project is a patient education tool for hand therapists to use after a peripheral nerve laceration to the upper extremity. The Role Checklist will be used as part of this education tool for the purposes of presentation of scholarly project to UND students and faculty, poster sessions, and printed version of the product that could potentially be distributed to therapists. With permission, proper citations will be in place to ensure copyright is protected. No modifications will be made to the Role Checklist.

Thank you for taking the time to read my email.

Jenna Meissner, OTS
320-491-2575
jenna.meissner@und.edu