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Pediatric Hand Therapy & Development of Resources for Brachial Plexus Injuries

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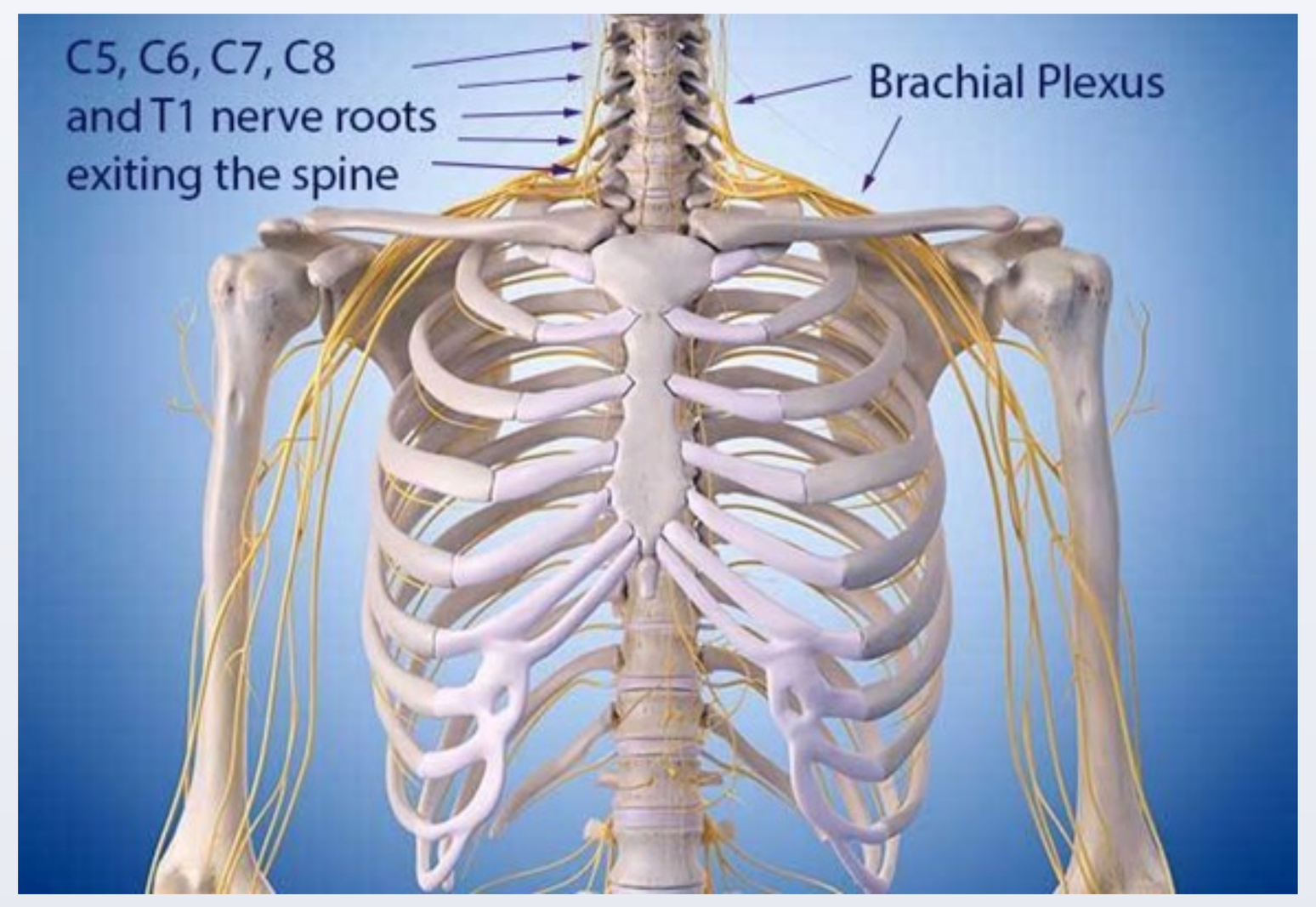


Figure 1. *The brachial plexus*. From John Hopkins Medicine. (n.d.) *Brachial Plexus Injuries* [Photograph]. https://www.hopkinsmedicine.org/health/conditions-and-diseases/brachial-plexus-injuries

Introduction

- The brachial plexus is a bundle of nerves that originates from cervical and thoracic sections of the spinal cord, C5-T1
- It provides movement and sensation to the shoulder, elbow, wrist, and hand
- A brachial plexus injury (BPI) has an incidence ranging from 0.4-5.0 per 1,000 live births
- Fortunately, 60% to 90% of infants born with BPI recover spontaneously within the first six months
- Functional impact depends on the type and severity of the injury
  - Type: Upper, Lower, or Complete Palsy
  - Severity: Stretch, Compression, Rupture, or Avulsion

Figure 2. *Nemours Children's Logo*. From Nemours Children's Health. (2023). *Nemours Children's Hospital, Florida* [Photograph]. https://Nemours.org

Site Description

Nemours Children's Health – Orlando, Florida

- A pediatric health system with over 70 locations in four different states
- Capstone location: outpatient clinic inside main hospital in Orlando, FL
- Services include physical therapy, occupational therapy (OT), speech language therapy, and feeding therapy
- Target population: children from birth to age 18 with various conditions and diagnoses
- Capstone clinical experience diagnoses consisted of various orthopedic conditions

Literature Review Summary

- Children who are born with BPI are at risk for developing contractures, loss of sensation, muscle weakness, or flaccidity in the affected arm (Delioglu et al., 2021; Raducha et al., 2017; Zielinksi et al., 2019)
  - Limits a child's ability to engage in ability to perform in daily activities, including play skills and self-care (Zielinski et a., 2019)
- Conservative treatment is the first choice in managing BPI (Aguiar de Matos et al., 2019; Zielinski et al., 2019)
  - *Goal*: to reduce stiffness, maintain passive range of motion, improve active range of motion, and improve sensation to affected arm, as well as overcome developmental disregard (Raducha et al., 2017; Sicari et al., 2021; Zielinski et al., 2019)
- Modified constraint-induced movement therapy (mCIMT) can be a promising treatment for BPI (Zielinski et al., 2021)
  - Evidence-based treatment approach
  - Involves constraining the non-affected arm and repetitive, task-oriented training with the affected arm
- Bimanual therapy (BIT) also assists with increasing the awareness to use both arms in daily activities

Summary of Needs Assessment

- Therapists do not have the time to conduct high-quality literature reviews regarding BPI and treatment
- There is a high-volume caseload of children with BPI at Nemours and not enough therapists with experience to treat them
- A lack of an evidence-based protocol for mCIMT and BPI to have a loosely-based resource for all therapists to follow
- A lack of a useable educational handout for caregivers to assist with treatment at home

Capstone Project Description

Focus Areas: Clinical Practice Skills; Education

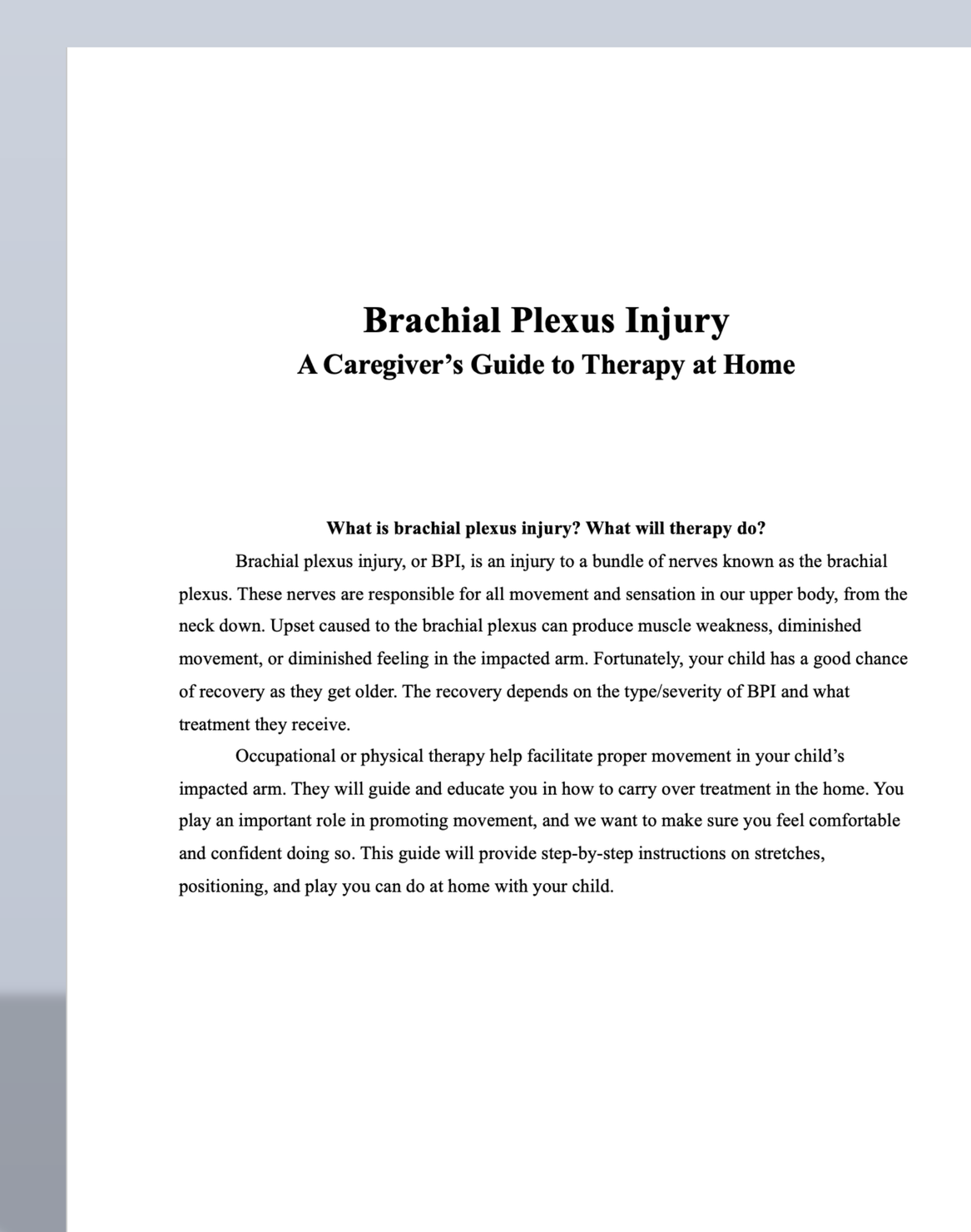
Goals: 1. Gain clinical experience in pediatric hand therapy; 2. Create educational tools for caregivers and therapists to treat BPI

Clinical Practice Skills

- The main focus of this capstone experience was to *gain clinical experience and knowledge in the specialized field of pediatric hand therapy*
- Worked under a certified hand therapist five times a week for 16 weeks to evaluate, treat, and document for children with a variety of orthopedic conditions
  - Created relevant goals and objectives
  - Challenged clinical reasoning skills to create novel and creative interventions
- Fabricated custom orthoses for children
  - Resting hand splints
  - Elbow extension orthoses

Education

- Due to the limited number of therapists with the knowledge base to treat children with BPI, *a gap in educational material was found at Nemours Children's Health*
- Researched current literature regarding BPI and mCIMT/BIT
- Composed protocol and educational handout during weeks five through 16



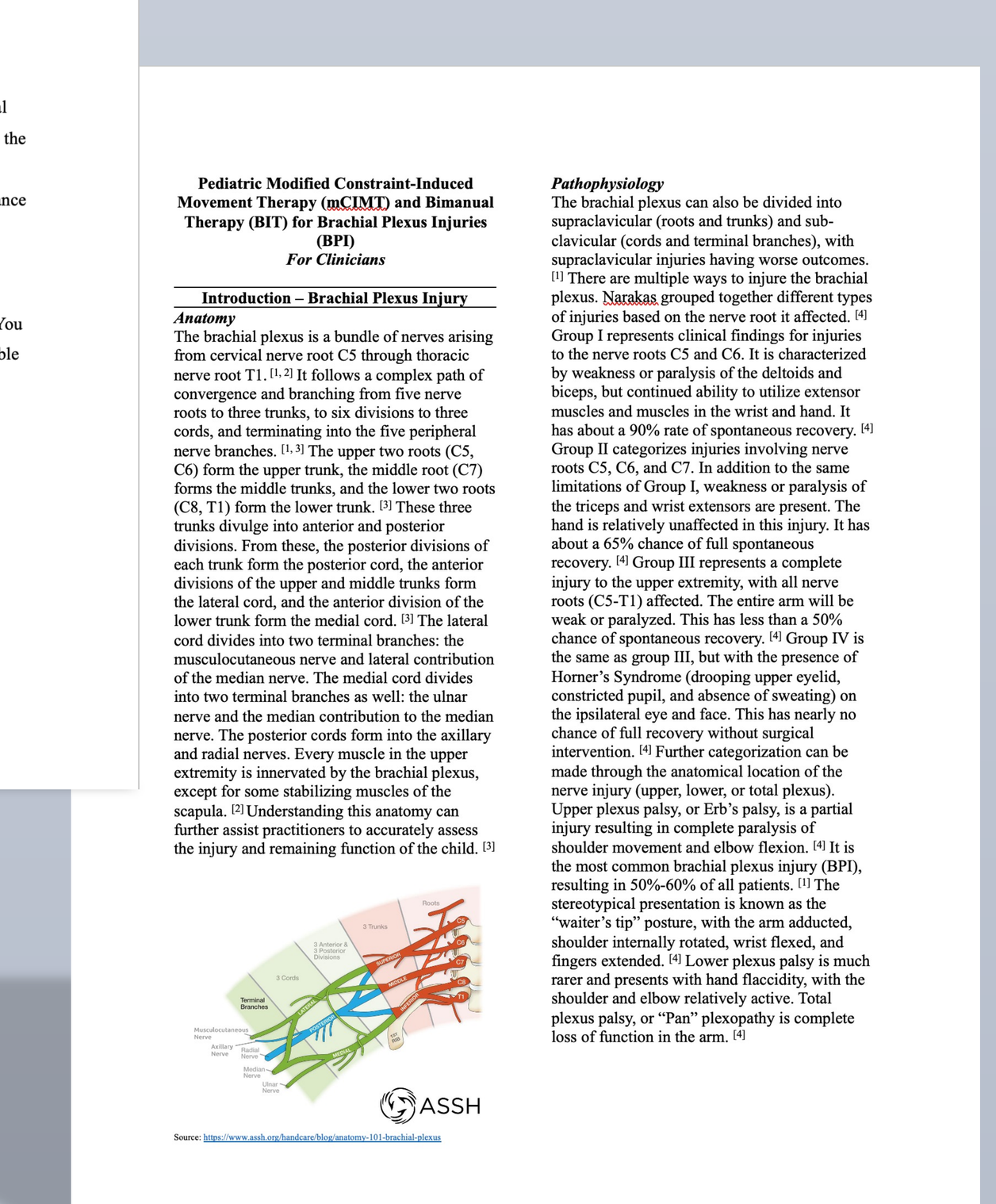
Brachial Plexus Injury
A Caregiver's Guide to Therapy at Home

What is brachial plexus injury? What will therapy do?

Brachial plexus injury, or BPI, is an injury to a bundle of nerves known as the brachial plexus. These nerves are responsible for all movement and sensation in our upper body, from the neck down. Upset caused to the brachial plexus can produce muscle weakness, diminished movement, or diminished feeling in the impacted arm. Fortunately, your child has a good chance of recovery as they get older. The recovery depends on the type/severity of BPI and what treatment they receive.

Occupational or physical therapy help facilitate proper movement in your child's impacted arm. They will guide and educate you in how to carry over treatment in the home. You play an important role in promoting movement, and we want to make sure you feel comfortable and confident doing so. This guide will provide step-by-step instructions on stretches, positioning, and play you can do at home with your child.

Figure 3. *Caregiver Handout*



Pediatric Modified Constraint-Induced Movement Therapy (mCIMT) and Bimanual Therapy (BIT) for Brachial Plexus Injuries (BPI)
For Clinicians

Introduction – Brachial Plexus Injury

Anatomy

The brachial plexus is a bundle of nerves arising from cervical nerve root C5 through thoracic nerve root T1. [1, 2] It follows a complex path of convergence and branching from five nerve roots to three trunks, to six divisions to three cords, and terminating into the five peripheral nerve branches. [1, 3] The upper two roots (C5, C6) form the upper trunk, the middle root (C7) forms the middle trunks, and the lower two roots (C8, T1) form the lower trunk. [3] These three trunks divulge into anterior and posterior divisions. From these, the posterior divisions of each trunk form the posterior cord, the anterior divisions of the upper and middle trunks form the lateral cord, and the anterior division of the lower trunk form the medial cord. [3] The lateral cord divides into two terminal branches: the musculocutaneous nerve and lateral contribution of the median nerve. The medial cord divides into two terminal branches as well: the ulnar nerve and the median contribution to the median nerve. The posterior cords form into the axillary and radial nerves. Every muscle in the upper extremity is innervated by the brachial plexus, except for some stabilizing muscles of the scapula. [2] Understanding this anatomy can further assist practitioners to accurately assess the injury and remaining function of the child. [3]

Source: https://www.assh.org/handcare/blog/anatomy-101-brachial-plexus

Pathophysiology

The brachial plexus can also be divided into supraclavicular (roots and trunks) and sub-clavicular (cords and terminal branches), with supraclavicular injuries having worse outcomes. [1] There are multiple ways to injure the brachial plexus. Narakas grouped together different types of injuries based on the nerve root it affected. [4] Group I represents clinical findings for injuries to the nerve roots C5 and C6. It is characterized by weakness or paralysis of the deltoids and biceps, but continued ability to utilize extensor muscles and muscles in the wrist and hand. It has about a 90% rate of spontaneous recovery. [4] Group II categorizes injuries involving nerve roots C5, C6, and C7. In addition to the same limitations of Group I, weakness or paralysis of the triceps and wrist extensors are present. The hand is relatively unaffected in this injury. It has about a 65% chance of full spontaneous recovery. [4] Group III represents a complete injury to the upper extremity, with all nerve roots (C5-T1) affected. The entire arm will be weak or paralyzed. This has less than a 50% chance of spontaneous recovery. [4] Group IV is the same as group III, but with the presence of Horner's Syndrome (drooping upper eyelid, constricted pupil, and absence of sweating) on the ipsilateral eye and face. This has nearly no chance of full recovery without surgical intervention. [4] Further categorization can be made through the anatomical location of the nerve injury (upper, lower, or total plexus). Upper plexus palsy, or Erb's palsy, is a partial injury resulting in complete paralysis of shoulder movement and elbow flexion. [4] It is the most common brachial plexus injury (BPI), resulting in 50%-60% of all patients. [1] The stereotypical presentation is known as the "waiter's tip" posture, with the arm adducted, shoulder internally rotated, wrist flexed, and fingers extended. [4] Lower plexus palsy is much rarer and presents with hand flaccidity, with the shoulder and elbow relatively active. Total plexus palsy, or "Pan" plexopathy is complete loss of function in the arm. [4]

Figure 4. *Protocol for Therapists*

Learning Objectives Achieved

- Gained experience creating and documenting relevant interventions for a wide range of orthopedic conditions
- Improved ability to fabricate orthoses and educate parents on wear and care
- Researched and observed pediatric BPI presentation in connection with CIMT and BIT
- Composed a CIMT and BIT protocol relating to BPI for therapists working at Nemours Children's Health
- Composed an educational handout for parents of children with BPI

Implications for OT Practice

- Educational resources will expand evidenced-based practices within the OT profession and increase ability to help with continuing education for OT practitioners
- The protocol will facilitate the opportunity for more OT practitioners to gain competency resulting in improved outcomes for children with BPI
- The educational handout will enhance patient knowledge on BPI and increase carryover of therapeutic stretches and exercises in the home. It will also help raise awareness of OT within the community

Figure 5. *Pediatric Hand Therapy Treatment*. From Nemours Children's Health. (2023). *Hand Therapy Program, Delaware Valley*. [Photograph]. https://www.nemours.org/services/hand-therapy.html

References & Acknowledgements

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References Available Upon Request