

Brachial Plexus Injuries in Neonates: An Osteopathic Approach

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Neonates and infants with brachial plexus injuries are typically treated using splinting, range-of-motion exercise, and, in more severe cases, nerve reconstruction. However, myofascial release—a common osteopathic manipulative treatment technique that has been used to manage thoracic outlet syndrome in adults—may provide effective, noninvasive management of brachial plexus injuries in neonates and infants. While emphasizing the importance of good communication with parents of affected patients, the authors review brachial plexus anatomy, describe diagnostic examinations, and outline a comprehensive treatment strategy.

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Brachial plexus injury, or Erb-Duchenne paralysis, is relatively common among neonates. According to a recent epidemiologic study,¹ neonatal brachial plexus paralysis occurs in 1.51 of 1000 live births.

Although some of these injuries can result from traumatic delivery, others may be caused by intrauterine positioning.² Brachial plexus injury may also be caused by infantile myofibromatosis,³ or it may be of iatrogenic⁴ or hereditary⁵ origin.

Physicians treating neonates or infants with brachial plexus injury must be aware of parental sensitivities. As previously discussed,² the majority of parents of afflicted patients who have sued for malpractice have reported that they were dissatisfied with their physicians' communication. Better communication can not only minimize lawsuits but also improve outcomes, as discussed later in greater detail. These challenges need to be addressed throughout each medical visit, from

physical examination through treatment.

The mainstay of treatment for neonates and infants with brachial plexus injury is conservative, particularly when no evidence of substantial vascular compromise or motor loss is present.⁶ Standard treatment options include splinting and range-of-motion exercises.⁷

For neonates with severe injuries, such as nerve avulsion or rupture, invasive treatment options such as neurolysis or nerve transfer may be required. Infants with mild injuries who have not responded to standard treatment by age 3 months may also need surgical attention.^{8,9}

To our knowledge, osteopathic manipulation has not been previously explored in the management of neonatal brachial plexus paralysis. However, osteopathic manipulative treatment (OMT) techniques—specifically myofascial release—have been shown to benefit older individuals with thoracic outlet syndrome.¹⁰⁻¹²

Although the etiologic processes involved in thoracic outlet syndrome and neonatal brachial plexus injuries are clearly different, the osteopathic principle of restoring form to improve function—assisting in the body's natural ability to heal itself—suggests that this OMT technique may improve neonatal function in patients with less severe injury as well.

Although the OMT techniques recommended in the present article are derived from those used to treat older individuals with thoracic outlet syndrome, they allow the neuromusculature of the shoulder to approximate normal anatomic positions—the goal in manual treatment regardless of patient age. In our clinical experience, we have observed improved function in neonates and infants when OMT is used as an initial treatment option.

In the following section, we review the brachial plexus anatomy, addressing how it relates to our recommended manual treatment model.

Brachial Plexus Anatomy

The brachial plexus arises from the spinal nerves C5 through T1, with C4 and T2 contributing. Nerves C4 through C6 form the superior trunk; C6 and C7, the middle trunk; C8 through T2, the inferior trunk—each with an anterior and posterior aspect.

The anterior aspect of the superior and middle trunk form the lateral cord; the three posterior aspects form the posterior cord; and the anterior division of the inferior trunk comprises

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the medial cord.

The lateral cord forms the lateral pectoral nerve (C5 through C7) and then separates into the musculocutaneous nerve (C5 through C7) and part of the median nerve (C5 through T1). The posterior cord gives rise to the upper subscapular nerve (C5 and C6), the thoracodorsal nerve (C6 through C8), and the lower subscapular nerve (C6 and C7). The posterior cord continues on to give off the axillary nerve and then becomes the radial nerve. The medial cord gives off the medial pectoral nerve (C8 and T1), medial cutaneous nerve of arm (T1), and medial cutaneous nerve of forearm (C8 and T1) and then contributes to the median nerve (C5 through T1) and becomes the ulnar nerve (C7 through T1).¹³

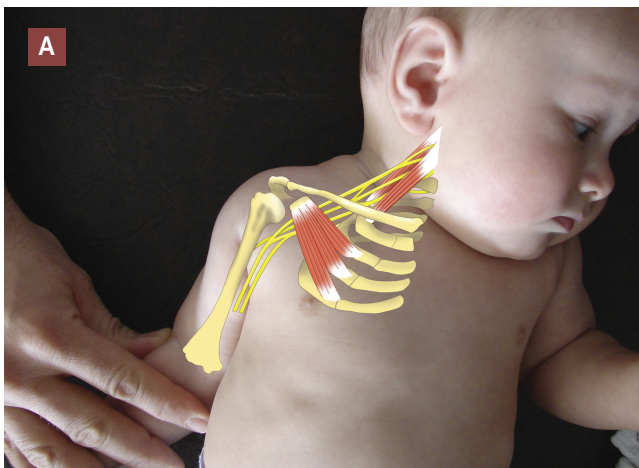
The anatomic relationships in this region are the same in infants and adults. Therefore, any disruption or impingement of the nervous supply to the upper extremity is going to manifest in similar symptoms. Likewise, returning the anatomic relationships to a healthy state should reduce those symptoms.

Diagnosis

Before determining treatment options, the type and degree of injury as well as patient response must be assessed. For the osteopathic physician, several techniques can be used to locate areas of somatic dysfunction.

Regions of Nerve Impingement

Electromyography has certain diagnostic benefits in neonates, such as identifying a disorder's etiology.¹⁴ However, several reports¹⁴⁻¹⁶ on the prognostic value and reliability of these tests—especially in patients aged 3 to 6 months—present conflicting results. Therefore, to identify areas of neurologic impingement in this patient population, clinicians must rely on their understanding of functional anatomy¹⁰ and the results of a complete neurologic, orthopedic, and vascular examination of the following three areas (Figure 1):



- **Scalene muscles**—The entire brachial plexus passes between the anterior and middle scalene muscles while still forming separate nerve roots. After a traumatic birth, the reflex hypertonicity of this area should be evaluated through careful palpation for symmetry and an assessment of the patient's passive range of motion. When physical findings are consistent with impingement of all nerves of the brachial plexus, an anterior scalene muscle spasm is likely the cause of injury.
- **First rib and clavicle**—Elevation of the first rib or depression of the clavicle can impinge the brachial plexus at the level of the medial, lateral, or posterior cords. To help identify somatic dysfunction of the upper ribs or clavicle, results of static palpation and range-of-motion testing of the affected upper extremity at the ribs and clavicle should be compared for symmetry with those from the contralateral side.
- **Pectoralis minor**—The three brachial plexus cords pass posterior to the pectoralis minor muscle with the brachial artery. Clavipectoral fascial restriction may impinge the neurovascular structures here.

Comorbidities

Neonates and infants with brachial plexus injuries require careful assessment for comorbid conditions. A fractured or dislocated clavicle or humerus, which would be identified on orthopedic examination, needs appropriate treatment. Neurologic examination evaluating muscle strength, reflexes, and sensory deficits must be performed to rule out central nervous system involvement and help identify the location of peripheral nerve injury.

Radiculitis

Cervical radiculitis may be caused by irritation of one or more of the cervical spinal roots as they pass through the bony canals of the intervertebral foramina. A stretching injury with

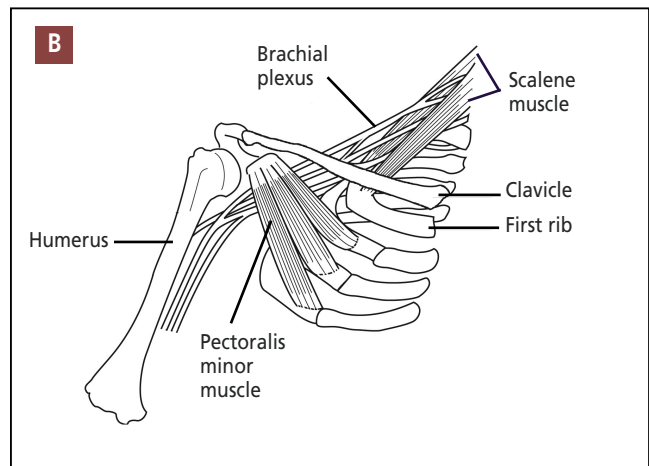


Figure 1. The brachial plexus anatomy overlaid on a photograph (A) and illustrated in detail (B). Brachial plexus nerve impingement can occur in three regions: (1) in the space of the anterior and medial scalene muscles, (2) between the clavicle and first rib, and (3) along the pectoralis minor muscle. Copyright 2007 University of Medicine and Dentistry of New Jersey-School of Osteopathic Medicine in Stratford.

resultant flaccidity of the appropriate muscles may be caused by inflamed nerve roots. When physical examination findings are restricted to a set pattern of nerve roots, radiculitis should be kept high on the list for differential diagnoses.

Additional Considerations

In addition to a complete neurologic, vascular, and orthopedic examination of the cervical spine and upper extremity, a biomechanical examination should be performed.

Evaluation of symmetry and tissue texture is essential to ensure proper osteopathic diagnosis. Passive range-of-motion testing of the cervical spine with attention to the anterior cervical musculature is also important. In normal muscle function, the scalene muscles flex, sidebend, and rotate the cervical spine to the ipsilateral side.

Patients with stretch injuries are likely to have reflexive spasm of the involved musculature—as long as the muscles are not denervated. When range-of-motion deficits are a result of intrauterine positioning, identification of the restricted myofascial structures will facilitate OMT.

Birth presentation should also be considered during patient evaluation. For example, based on common understanding of mechanism of injury, the anterior cervical myofascial structures will likely be stretched in neonates born with a face presentation. Therefore, the physician would further examine the anterior cervical musculature.

Scalene muscles are accessory muscles of respiration, elevating the first rib during inhalation. Therefore, examination of the rib cage should focus on symmetric excursion of the ribs. Inhalation rib dysfunctions can be caused by T1 somatic dysfunction, hypertonic scalene muscles, or group rib dysfunctions.

To examine the whole thoracic inlet—including the first rib, clavicle, muscles, and supraclavicular and clavipectoral fascia—the osteopathic physician should place his or her hands over the thoracic inlet and observe several respiratory cycles. Passive motion testing should also be used to identify any abnormalities in thoracic function. Palpating both ends of the clavicles while testing shoulder range of motion will help physicians identify clavicular somatic dysfunctions (Figure 2).

Range of motion in shoulder planes should likewise be assessed for symmetry (Figure 3). External rotation coupled with flexion of the shoulder will stretch the pectoralis minor muscle and clavipectoral fascia.

Communicating With Parents

The medical interview for any patient has a dual purpose: (1) to gather information, and, more importantly, (2) to establish rapport and teach. In brachial plexus injury, a window of opportunity is available to teach the family a skill that may aid in a quicker and less invasive recovery for the neonate or infant.

The combined treatment strategy outlined in the present



Figure 2. Passive motion testing and palpation of both end of the clavicles can aid osteopathic diagnosis.



Figure 3. Assessing for symmetry of motion by stretching the shoulder flexors, internal rotators, and associated fascia.

article for those with brachial plexus injury underscores the importance of the patient-physician—or parent-physician—relationship. Although it is often a challenge to establish rapport with adult patients (or parents of pediatric patients) in a short time, the situation described in the current article presents a unique opportunity to integrate patient care and therapeutic modality education.

Patient-centered care is recognized as an important aspect of establishing an effective patient-physician relationship, which can affect treatment outcomes. Research¹⁷⁻¹⁹ suggests that the communication of healthcare practitioners influence patient satisfaction, treatment adherence, psychological adjustment, and outcomes as well as professional satisfaction for physicians. Indeed, dissatisfaction with patient-physician and parent-physician communication has been associated with increased malpractice litigation.^{2,20-22}

Physicians should be aware that younger, better educated, and more knowledgeable persons may have already done their own research on this topic.²⁴ Therefore, an open dia-

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logue is critical with parents of neonates and infants.

Treatment Options

Muscle strains cause a reflexive relative shortening of the affected muscles, which acts as a protective mechanism. Therefore, adults and infants alike may have hypertonic muscles, reduced range of motion, and tissue edema.

Stretch injury in neonates as in adults initiates inflammatory response as well as myospasm and scar tissue formation. In addition, when used, involuntary splinting also results in limited range of motion that will require adjunctive exercise.

Treatment of any patient with a muscle strain should be directed toward restoring symmetry and removing areas of potential nerve impingement by addressing diagnosed somatic dysfunctions. The complete osteopathic approach to treating neonates with brachial plexus injuries involves not only OMT but also home exercise and the simple concept of therapeutic touch.

Osteopathic Manipulative Treatment

Dr Sucher's articles²⁵⁻²⁷ on treating adult patients with thoracic outlet syndrome focus on myofascial restrictions and aggressive myofascial stretching techniques. We believe that if the osteopathic physician determines that there is decreased range of motion or hypertonicity in the myofascial structures around the thoracic inlet unilaterally in neonates, then gentle myofascial stretching may be used, along with careful patient monitoring, to remove the somatic dysfunctions and restore normal anatomic relationships around the thoracic inlet area.

Stretching of any myofascial structure on the restricted side can be achieved by restricting motion of one attachment and applying a gentle force longitudinally through hypertonic structures (Figure 4). To reduce the possibility of injury, physicians should constantly monitor the tissues. In addition, osteopathic physicians should palpate for tissue texture changes or muscle spasms and watch for patient response to treatment such as grimacing or analgesic posturing.

Clear documentation of somatic dysfunctions will aid follow-up examinations and will help the physician develop a home exercise program for the parents or guardians to provide.

Home Exercise

The simplicity of these OMT techniques are conducive to teaching for implementation at home. The physician should provide parents with treatment goals (ie, improve and restore muscle and nerve function) and a clear explanation of how to apply the technique of range-of-motion stretching for restricted myofascial structures.

Parents should be asked to demonstrate their understanding of the stretching technique and their ability to apply the home exercise techniques while supervised by the physician.



Figure 4. Gentle direct stretching of hypertonic or restricted myofascial structures on the patient's right side.

Therapeutic Touch

Therapeutic touch is a simple treatment approach that takes advantage of the bonding between parent and infant through the application of touch in the healing process. Infants' natural response to stimuli may have a therapeutic benefit. For example, restoring the normal function of the upper extremity, thoracic inlet, and the cervical spine will facilitate the body's innate ability to heal and thus improve the chance of earlier and more complete resolution of the brachial plexus injury. Of course, follow up with a physician and adherence to standard medical treatment are imperative to achieve good outcomes.

Conclusion

Educational and therapeutic opportunities exist for the treatment of infants with brachial plexus injury. Physicians must clearly communicate the goals of treatment, and parents should demonstrate their ability to apply stretch exercises to ensure appropriate technique. It is natural for a parent to want to touch their newborn child, and the increased role of therapeutic touch can embrace the bonding experience as well as assist in therapeutic outcome.

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