

BRACHIAL PLEXUS CENTER

DEPARTMENT OF NEUROSURGERY, NEUROLOGY,
AND ORTHOPEDIC SURGERY

ESTABLISHED IN 1991



Children's
HOSPITAL • ST. LOUIS
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University in St. Louis
Physicians

ST. LOUIS CHILDREN'S HOSPITAL

- 390 beds
- 3,330 employees
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- 1,300 auxiliary members and volunteers
- More than 45 pediatric subspecialty departments and divisions
- Level I Pediatric Trauma Center, the highest level of emergency care available
- Recognized as one of the best children's hospitals in the nation by *U.S. News & World Report*
- Received the nation's highest honor for nursing excellence, the Magnet designation, from the American Nurses Credentialing Center.



Founded in 1879, St. Louis Children's Hospital is one of the premier children's hospitals in the nation. It serves not just the children of St. Louis, but children across the world. As the pediatric teaching hospital for Washington University School of Medicine, St. Louis Children's Hospital offers nationally recognized programs for physician training and research.



EXPERTISE OF THE BRACHIAL PLEXUS CENTER



Left to Right: Tae Sung Park, MD, Nicole Meyer, PA-C, Lindley Wall, MD, Michael Noetzel, MD

Established in 1991, the Brachial Plexus Center has extensive experience in the treatment of birth brachial plexus injury. **Our Center has cared for over 1,000 infants with brachial plexus injury and performed brachial plexus repair procedures on over 250 infants.**

The Center's team consists of pediatric neurosurgeons, neurologist, orthopedic surgeon, occupational and physical therapists, neuroradiologist, and clinical coordinator.

At the Brachial Plexus Center at St. Louis Children's Hospital, parents find hope and unparalleled pediatric expertise.

The Brachial Plexus

The brachial plexus is a complex arrangement of nerves that controls the muscles of the shoulder, arms and hands. It is located on the side of the neck above the collarbone (see diagram 1). The nerves of the brachial plexus branch off the spinal cord (see diagram 2).

Diagram 1: Location of Brachial Plexus



Diagram 2: Nerves of Brachial Plexus

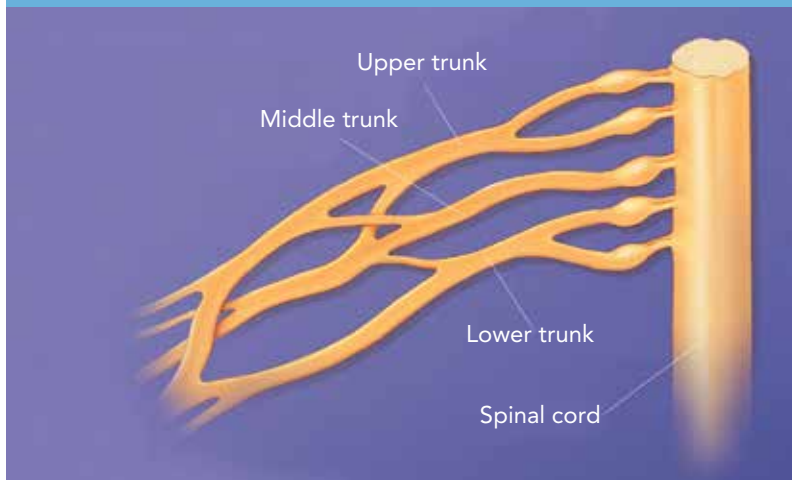
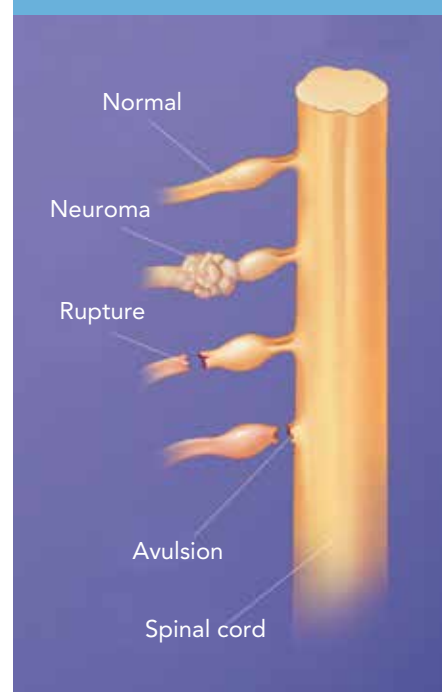


Diagram 3: Shoulder Dystocia



Diagram 4: Trauma of the Brachial Plexus



THE CAUSE OF BIRTH BRACHIAL PLEXUS PALSY

Brachial plexus injury occurs when the brachial plexus is stretched during birth (see diagram 3). The most common cause is shoulder dystocia, occurring when the shoulder is trapped in the birth canal. Known risk factors for shoulder dystocia include a large baby, maternal obesity, maternal diabetes, prolonged pregnancy, prolonged labor and delivery by forceps.

TYPES OF BRACHIAL PLEXUS INJURY

There are three kinds of brachial plexus injury that can cause persistent disabilities (see diagram 4):

1. Incomplete rupture of a part of the brachial plexus; the ruptured part of the brachial plexus forms scar tissue inside and outside the nerve, called a neuroma.
2. Complete rupture of a part of the brachial plexus;
3. Nerve root detachment from the spinal cord.

Diagnosis

Birth brachial plexus palsy is evident immediately after birth. A baby may not move the shoulder, arm and/or hand. A chest X-ray may reveal a fracture of the collarbone or upper arm bone, or paralysis of the diaphragm, which separates the chest and abdominal cavities.



Brachial plexus palsy is classified into the following four types:

UPPER BRACHIAL PLEXUS (ERB'S) PALSY

This is the most common type, in which the upper part of the brachial plexus is damaged. Infants cannot move the shoulder and keep their arms extended and turned inward. Often they have no movement of the arm immediately after birth but begin to move the wrist and fingers in a few weeks.

TOTAL BRACHIAL PLEXUS PALSY

In this injury, all parts of the brachial plexus are affected with varying degrees of severity. These infants have no movement of the shoulder, arm, wrist and hand for several weeks but then may begin to move a part of the shoulder, arm, wrist and hand.

LOWER BRACHIAL PLEXUS PALSY

Lower brachial plexus palsy is usually a result of total brachial plexus injury. It causes weakness of the wrist and hand while the shoulder and upper arm retain strength.

BILATERAL INJURIES

The brachial plexus can be injured on both sides. Bilateral injuries may be mistaken for other problems, like spinal cord injury.

Spontaneous Recovery

Fortunately most children with birth brachial plexus injury improve without surgery. About 80-90 percent of children make a complete or nearly complete recovery. If children are to recover strength completely, they usually do so within the first three–six months. After this time, spontaneous improvement is slow but can continue for the next few years. In general, strength does not increase after 2 years of age.

It is important to know that children who do not make a good recovery can benefit from direct repair of the brachial plexus. If deformities in the affected arm and hand develop later, orthopedic surgeries are needed to lessen disabilities.

OCCUPATIONAL AND PHYSICAL THERAPY

In all infants with brachial plexus palsy, early therapeutic intervention is important. At the initial evaluation at the Center, physical and occupational therapists evaluate the infant. Therapists instruct parents on home exercises and help set up regular local therapy, if necessary,

Exercises provided by the therapists are designed to help improve muscle strength, preserve flexibility and mobility of the joints, and protect joint integrity. The therapists concentrate on caregiver education and training because of the importance of understanding and doing the exercises several times a day at home.

For children 3 years and older, recommendations for adaptive tools or instructions for alternate techniques for Activities of Daily Living (ADLs) may be issued to help increase the child's independence in various skills, such as self feeding or dressing. The therapists may recommend community activities like swimming, dance, martial arts, musical instruments or adaptive bicycles. These activities can be motivating for children of various ages and levels of severity.

BRACHIAL PLEXUS REPAIR SURGERY

If muscle weakness remains severe, direct repair of the brachial plexus is an option. It is unlikely that surgery will make the affected arm as strong as an unaffected arm. But, the surgery can reduce disabilities of the affected arm from the brachial plexus injury.



At the Brachial Plexus Center all direct brachial plexus repair procedures are performed by T. S. Park, MD, Shi H. Huang Professor and Vice Chairman, Department of Neurosurgery, Washington University School of Medicine, St. Louis Children's Hospital

Visit StLouisChildrens.org for more information about Dr. Park.

Candidates for Brachial Plexus Repair Surgery

The first group are those who have complete paralysis of the upper arm and/or hand at birth and make no recovery during the first two months. These are cases of severe injury, in which spontaneous recovery is impossible. Surgery at 3 months of age is recommended.

The second group are those who make some recovery but have severe weakness in some muscles of the shoulder, arm and hand by the age of 4–6 months. Surgery is performed at 4–7 months of age, but sometimes up to 18 months.

PREPARING FOR BRACHIAL PLEXUS REPAIR SURGERY

If your child is being considered for surgery, an evaluation is done. The evaluation consists of a chest X-ray and MRI scan of the spine.

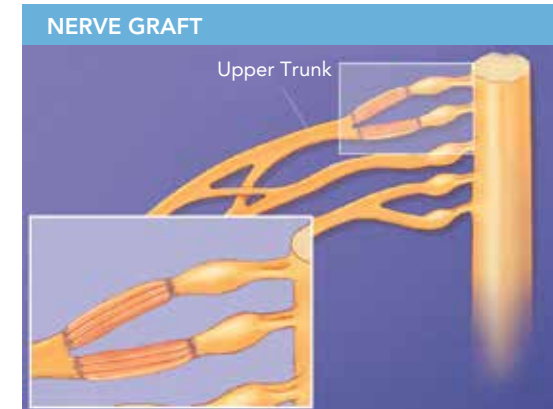
MRI: This test produces a clear, detailed picture showing whether or not the nerves of the brachial plexus are detached from the spinal cord. An MRI is a painless procedure but may require sedation because your child needs to lie still on the examination table.

What Does Brachial Plexus Surgery Involve?

Two basic operative procedures are performed:

1. BRACHIAL PLEXUS REPAIR WITH GRAFTS

An incision is made along the neck to expose the brachial plexus. Once exposed, the severity of nerve injury is evaluated. The nerves of the brachial plexus are stimulated with an electrical current and muscle responses are tested. Severely damaged parts of the brachial plexus are cut and donor nerve grafts are placed between cut ends of the nerves. The nerve grafts act as channels through which the new nerve fibers grow to reach the muscles. The surgery takes two to four hours.



2. NERVE TRANSFER PROCEDURE

This procedure is sometimes performed if the deltoid and/or biceps are weak alone. It is also performed if the brachial plexus repair with grafts fails to provide optimal improvements. Nerve transfer can be performed up to the age of 24 months. An incision is made in the underarm region and extended possibly along the inside of the upper arm to expose the appropriate nerves. The nerves are stimulated with an electrical current and muscle responses are tested. A small portion of a donor nerve is then transferred to the recipient nerve to promote nerve input to the desired muscle group. The surgery takes about two hours.

3. NEUROLYSIS PROCEDURE

Some infants, who make a good spontaneous recovery, persist with limited shoulder elevation and bending the elbow around 12 months of age. The lingering weakness can be due to compression of the nerve by the scar tissue. Surgeons can remove the scar tissue outside the nerve and free the nerve from pressure. The neurolysis surgery is performed between 12 and 18 months of age.

RISKS

The overall risks of this surgery are minimal and may include:

- damaging phrenic nerve that controls the diaphragm (located between the chest and abdominal cavities)
- infection
- failure to benefit from the surgery

Brachial Plexus Repair Surgery Outcomes

In cases of severe shoulder and arm weakness, surgery can help children achieve useful joint movements in about 70 percent of cases. In children with severe arm and hand weakness, the chance of useful recovery is about 50 percent in the shoulder and about 30 percent in the hand.

SEEING THE IMPROVEMENTS AFTER SURGERY

First improvements are noticed in the shoulder about four to six months after surgery. During that time, elbow bending also may be noticed. Hand movements begin to improve 6 to 12 months after surgery. The improvement may continue to improve up to the age of 5 years.

AFTER SURGERY

Immediately following brachial plexus repair surgery, the child's arm is strapped to the chest and a soft collar may also be applied, immobilizing the arm and neck for 2-3 weeks. No therapy is done during this time. Sponge bathing is recommended.

After the neurolysis procedure only a soft collar is applied for two weeks.

The patient is hospitalized for one day after surgery. He or she receives pain medication during hospitalization and may be given a prescription for home.

FOLLOW-UP CLINIC VISIT

The first clinic appointment after surgery is three to six weeks after the child goes home. Further clinic visits will occur every three to six months and continue for at least three years.



Michael Noetzel, MD, Vice Chair, Division of Pediatric and Developmental Neurology, Washington University School of Medicine; Medical Director, Clinical and Diagnostic Neuroscience Services, St. Louis Children's Hospital

At each clinic visit, he or she is evaluated by our Center's team. Progress is documented on videotape at the 1-year follow-up visit and subsequent visits.

POSTOPERATIVE THERAPY

At the first clinic visit after surgery, a therapy appointment will be scheduled. At this appointment, gentle arm and neck range of motion is restarted. Therapists will review any remaining precautions relating to the surgery, evaluate the child's need for splints and teach new home exercises. Our therapists will provide techniques to keep long-term scarring to a minimum. Following the first post-surgical clinic visit, a regular home therapy regimen should resume.

ORTHOPEDIC SURGERY

Children with birth brachial plexus injuries can also develop muscle and joint deformities, specifically of the shoulder, elbow and wrist. In some children, muscle releases and tendon transfer procedures can reduce disabilities and improve function.



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For referral and more information

Please e-mail park@nsurg.wustl.edu or call 800.416.9956 or 314.454.2810.

Additional information is also available at StLouisChildrens.org/bp

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