Offering Hope for Brachial Plexus Palsy

A traumatic birth injury such as brachial plexus palsy cannot be anticipated. Parents are often confused about their options and wonder if their baby will ever be able to perform normal, age-appropriate movements. Brachial plexus palsy is usually caused by shoulder dystocia, occurring when the baby’s shoulders are trapped in the birth canal during delivery. The result is arm weakness or paralysis.

At the Brachial Plexus Palsy Center at St. Louis Children’s Hospital, parents find hope. They discover their children can get better. And they find unparalleled pediatric expertise.

Established in 1991, our multidisciplinary Brachial Plexus Palsy Center is among only a handful of clinics of its kind in the nation. Since its establishment in 1991, our center cared for hundreds of infants with brachial plexus palsy and performed brachial plexus repair procedures on over 100 infants with brachial plexus palsy. The Center’s team consists of a pediatric neurologist, neurosurgeon, orthopedic surgeon, occupational and physical therapists, neuroradiologist, electrophysiologist, and a clinical coordinator. The Center’s team has extensive experience in medical management, therapy, direct repair of brachial plexus in infants, and orthopedic surgeries to correct later deformities.
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).

For timely treatment of birth brachial plexus injury, we recommend evaluation within a month after birth by a team of experienced physicians and therapists.

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

In general, birth brachial plexus palsy is evident immediately after birth. A baby may not move the shoulder, arm and/or hand because of external injury to the head and neck. 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 with this type of injury 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. However, weak shoulder and elbow movement may persist.

**Total Brachial Plexus Palsy**

In this injury, the upper, middle and lower 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. If the injury does not resolve spontaneously and is left untreated, it can lead to severe disabilities of the affected arm.

**Lower Brachial Plexus Palsy**

Isolated injury to the lower part of the brachial plexus is rare. 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.

**Direct Brachial Plexus Repair**

If muscle weakness remains severe after age 2 months to 6 months, direct repair of the brachial plexus is an option. Surgery is performed between the ages of 3 months and 18 months. After 18 months, direct brachial plexus repair is not recommended because the success rate of surgery decreases.

In cases of severe shoulder and upper arm weakness, surgery can help children achieve functional range of motion 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.

It is unlikely that surgery will make the affected arm as strong as an unaffected arm. However, surgery can offer a better outcome for the affected arm than can be achieved through therapy alone.

All direct brachial plexus repair procedures at our Center are performed by T. S. Park, MD. (http://neurosurgery.wustl.edu/faculty/park.htm).
Before Brachial Plexus Repair Surgery

If a patient is being considered for surgery, a preliminary evaluation is done. The evaluation consists of a chest X-ray to look for paralysis of the diaphragm, a magnetic resonance imaging (MRI) scan of the spine to determine if there is a nerve root detachment from the spinal cord, and electromyography (EMG) to determine the extent of nerve injury. For children, MRI and EMG require sedation. Sometimes MRI and EMG are obtained in the patient’s home town. A videotape is taken by our own therapists to document the child’s motor ability.

Candidates and Timing For Brachial Plexus Repair

Two groups of children can benefit from direct brachial plexus surgery. The first 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 ruptured brachial plexus or nerves detached from the spinal cord, 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 the shoulder and elbow by the age of 6 months. Many of these children show some muscle strength improvement in the shoulder and upper arm during the first six months.

The timing of direct brachial plexus repair is debatable. Some surgeons recommend surgery as early as 3 months of age; our team prefers to wait, with surgery performed at 7 months of age. The reason for our recommended timing is that the outcome of early surgery at 4 to 6 months of age may not be better than the outcome of spontaneous improvements without surgery.

We recommend that children be referred to the brachial plexus clinic as soon as the problem is suspected after birth so that a decision regarding timing of the surgery can be made without delay.

EMG

This test studies electrical potentials of the muscles and nerves leading to them. The child is sedated and lying on an examination table. Nerve function is checked by stimulating the nerve with a small electrical current and recording responses of the muscle. While the child continues under sedation, the muscles are checked by recording the muscle potentials through a small needle placed in the muscle. The muscle potentials are measured while the infant actively tightens the muscles.

MRI

This test produces a clear, detailed picture showing whether or not the nerves of the brachial plexus are detached from the spinal cord. MRI is a painless procedure but requires sedation because the patient needs to lie still on the examination table. Unlike X-rays and CT scans, MRI uses a powerful magnet that poses no health risks. However, because of the strong magnetic field, the patient should not have any metal objects within the body such as surgical clips or prostheses.
Treatment of Birth Brachial Plexus Palsy

To provide the best possible treatment for a child with birth brachial plexus palsy, parents and a group of experts including pediatric therapists, neurologists, neurosurgeons and orthopedic surgeons must work as a team.

It is important to know that most children with birth brachial plexus injury are rehabilitated without surgery. About 80-90 percent of children make a complete or nearly complete recovery within the first year. If children are to recover strength completely, they usually do so within the first three months. After three months, 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 also important to know that children who do not make a satisfactory recovery can benefit from direct repair of the brachial plexus. If deformities in the affected arm and hand develop despite nerve repair, orthopedic surgeries will be needed to lessen disabilities from the brachial plexus injury.

Occupational and Physical Therapy

Early therapeutic intervention is important. At the initial evaluation at our Center, physical and occupational therapists evaluate the infant. The therapists instruct parents on home exercises, help set up regular local therapy, if necessary, and consult with those therapists as needed.

The exercises provided by the therapists are designed to help improve muscle strength, preserve flexibility and mobility of the joints, increase sensory awareness, protect joint integrity, improve coordination and enhance the child’s overall performance in typical developmental activities. The therapists concentrate on caregiver education and training because of the importance of understanding and doing the exercises several times a day at home.

At our Center, children receive reassessment by therapists at each follow-up clinic visit. These visits provide the necessary opportunity to:

• advance home exercise plans as the child grows and develops;
• provide caregiver feedback on performance of the home program;
• consult with local therapists who may be less familiar with this diagnosis in order to optimize intervention.

If the child requires surgical repair of the brachial plexus nerve, then follow-up therapeutic evaluations and training sessions are conducted as described under Postoperative Therapy (see page 11).

A detailed therapy protocol can be provided by our therapy services department.
What’s Involved

What Does Brachial Plexus Repair Involve?

Skin Incision
An incision is made along the neck and sometimes extended to the shoulder. An incision may also be made on the chest if nerves between the ribs are used for grafting. Additional incisions are made on the back of one or both legs to remove nerves for grafting. Removal of the nerve from the leg has no side effects.

Collarbone
Most of the time, it is necessary to cut the collarbone to expose the brachial plexus during surgery. The collarbone is reconnected and repaired at the end of surgery.

Nerve Repair
After the brachial plexus is exposed, the severity of the nerve injury is evaluated. The nerves of the brachial plexus are stimulated with an electrical current and muscle responses are tested.

Collarbone

Severely damaged parts of the brachial plexus are cut and 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 nerves of the brachial plexus are sometimes connected to other nerves such as nerves between the ribs.

Risks
The overall risks of this surgery are minimal. The risks include:

- damaging nerves that control the diaphragm (located between the chest and abdominal cavities), lungs, or blood vessels;
- damaging nerves that control foot movement;
- infection;
- non-union of the collarbone;
- failure to benefit from the surgery.

Some risk is also associated with general anesthesia.
After Surgery

Immediately following surgery, the child's arm is strapped to the chest and a soft neck collar is applied, immobilizing the arm and neck for three weeks. No therapy is done during this time. Sponge bathing is recommended but requires a dressing change. Parents are taught how to rewrap the arm and are given extra dressing material.

The patient is hospitalized for two to three days after surgery, spending the first night in the pediatric intensive-care unit. The child receives pain medication during hospitalization and may be given a prescription for home.

Follow-up Clinic Visit

The first evaluation after surgery is three to six weeks after the patient goes home. Further clinic visits will occur every three to six months and continue for at least three years. At each clinic visit, the child is evaluated by our Center's team. Progress is documented on videotape at the one-year follow-up visit and subsequent visits. In addition, EMG testing is periodically performed.

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 postsurgical clinic visit, a regular home therapy regimen should resume.

Seeing the Improvements

First improvements are noticed in the shoulder about three to six months after surgery. During that time, elbow bending may also be noticed. Shoulder and elbow movements will continue to improve for the next 18 months to two years. Hand movements begin to improve 6 to 12 months after surgery and may continue to improve for the next two years.

Orthopedic Surgery

Surgical repair of the brachial plexus improves arm function in most cases but does not completely restore muscle strength. Children with more severe injuries can develop muscle and joint deformities even after direct brachial plexus repair procedures. In some children, muscle and tendon transfer procedures and other orthopedic surgeries can reduce disabilities. The orthopedic procedures are typically performed after the age of 1 year.

For More Information

For more information, please call the Brachial Plexus Palsy Center at 800.416.9956. Additional information is also available at www.stlouischildrens.org/bp

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