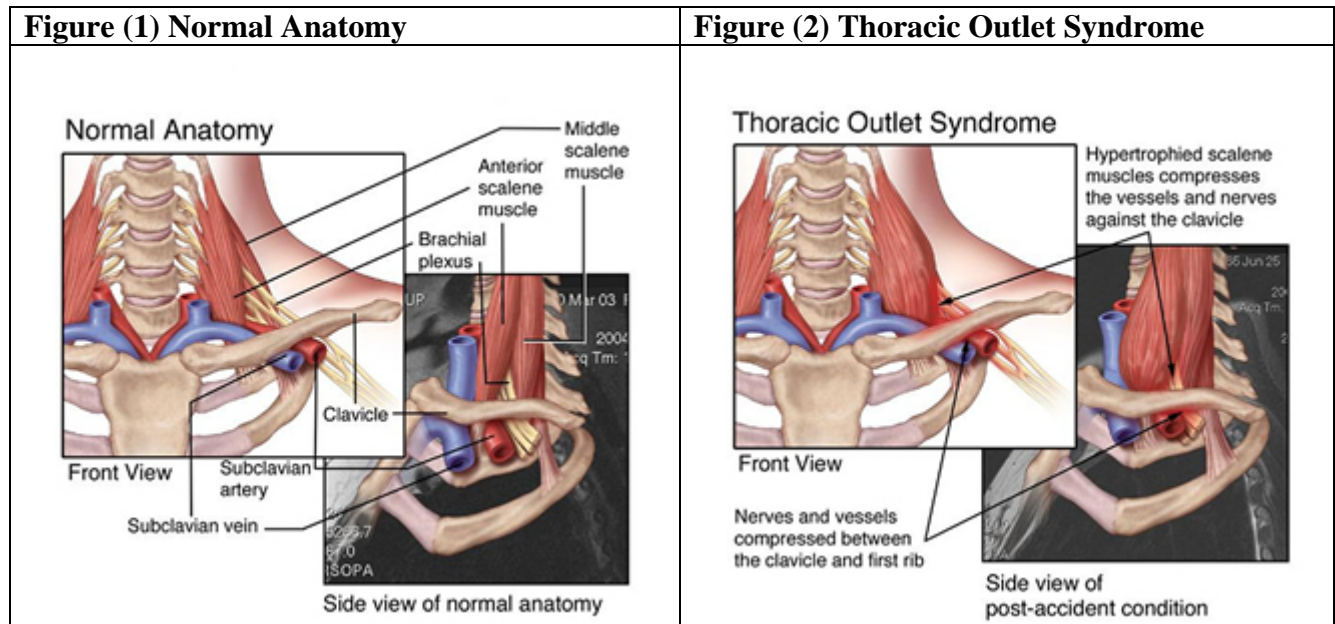


## THORACIC OUTLET SYNDROME & BRACHIAL PLEXUS INJURIES

### I. THORACIC OUTLET SYNDROME

TOS is a compression of nerves or blood vessels, or both, in the thoracic outlet region, which is the space between the collarbone (clavicle) and the armpit or first rib. See Figure (1) below for normal anatomy and Figure (2) below for when nerves/blood vessels are compressed



Thoracic Outlet Syndrome is divided into 3 types:

#### 1. Neurogenic (neurological) TOS:

Neurogenic TOS occurs when there is a compression of the brachial plexus, which is a network of nerves that come from your spinal cord and control muscle movements and sensation in the shoulder, arm and hand. See Figure (1).

#### 2. Vascular TOS:

Vascular TOS occurs when one or more of the arteries and veins under the clavicle are compressed.

#### 3. Nonspecific-type TOS:

This is also known as disputed TOS or common TOS. People with nonspecific-type TOS have chronic pain in the area of the thoracic outlet region, but the specific cause of the pain cannot be determined as readily as with the other categories of TOS.

## II. BRACHIAL PLEXUS INJURY

Symptoms from a brachial plexus injury can be similar to neurogenic TOS in that it involves injury to the brachial plexus, which sends signals from the spine to the shoulder, arm and hand, but the injury occurs when these nerves are stretched or torn rather than compressed. See Figure (3). This often happens when the shoulder is pressed down forcefully while the head is pushed up and away from the shoulder.

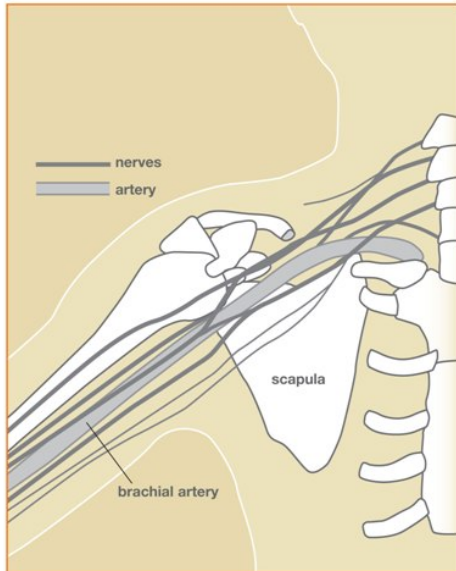


Fig. (3) The brachial plexus is a network of nerves that originate near the neck and shoulder, whose branches form the nerves that go into the arm, forearm, and hand

Brachial Plexus Injury is divided into 3 types:

1. Avulsion injuries: The nerve is torn from attachment to the spinal cord. This is the most serious type of injury.
2. Rupture injuries: The nerve is torn, but not at the spinal cord. Rupture injuries also include stretch injuries; the nerve is damaged, but not torn.
3. Neuroma injuries: The nerve injury causes scar tissue formation, which compresses nerves.

### **III. CAUSES**

#### **Thoracic Outlet Syndrome**

The compression of the nerves or blood vessels in the thoracic outlet area can be caused by:

- **Trauma**: Events such as car accidents or falls causing trauma to the shoulders or neck.
- **Repetitive Activity**: Activities such as heavy lifting, lifting repeatedly over your head, typing for extended periods of time. Swimmers, baseball players and instrumental musicians are also at high risk due to repetitive arm activity.
- **Pressure on joints**: Obesity and carrying an oversized bag or backpack.
- **Pregnancy**: Joints loosen during pregnancy, and signs of TOS may appear when pregnant.
- Individuals who have predisposing characteristics -- those who lift heavy loads or engage in repetitive activities at work, athletes, pregnant women -- are more susceptible to thoracic outlet injuries from trauma.

#### **Brachial Plexus Injury**

Stretching or tearing of the brachial plexus nerves can be caused by:

- **Trauma**: Events such as car accidents or falls. Animal bites, blunt trauma, bullet or knife wounds can also cause damage to the nerves.
- **Contact Sports**: Sports such as football or wrestling causing the nerves to get stretched.

### **IV. SYMPTOMS**

#### **Thoracic Outlet Syndrome**

Symptoms of Neurogenic TOS:

- tingling and/or numbness along the arm, hand and fingers
- pain in shoulder and neck
- pain in arm or hand
- weakening grip or clumsiness

Symptoms of Vascular TOS:

- hand may be sensitive to cold
- hand may turn pale or bluish
- arm pain and swelling, possibly due to blood clots
- throbbing lump near your collarbone
- lack of color in one or more of your fingers or entire hand
- tiny black spots on your fingers

## **Brachial Plexus Injury**

Symptoms of Stretched Brachial Plexus (also known as “stingers” or “burners”):

- an electric shock or burning sensation shooting down the arm
- numbness and weakness in arm

Symptoms of Torn or Ruptured Brachial Plexus:

- ability to use fingers, but little to no control of shoulder and elbow muscles
- ability to use arm but not fingers
- complete lack of movement and feeling in arm
- severe pain in the arm

## **V. DIAGNOSIS AND TREATMENT**

### **Thoracic Outlet Syndrome**

The doctor will often look for physical signs of TOS including discoloration in arms or hands, limited range of motion in upper body. The doctor will also ask the patient to perform tests designed to reproduce the symptoms discussed above such as holding the elbows at shoulder height and repeatedly opening and closing the hands, while holding back the shoulders. To confirm the diagnosis of TOS, tests such as x-ray, MRI, EMG, or nerve conduction study may be ordered by the doctor.

### **Brachial Plexus Injury**

Symptoms of brachial plexus injury are typically noticed soon after injury. The doctor will often order tests to diagnose the extent and severity of brachial plexus injury such as MRI, nerve conduction studies, CT myelography, electromyography.

Stretched nerves have a fair chance of recovery on their own with physical therapy, which improves strength and range of motion. Surgical repair is often required for nerves that have been cut or torn. Occupational therapy is also prescribed to deal with issues of everyday living. Medication is often prescribed to control the pain from the damaged nerve.

Symptoms in the upper extremity following a traumatic event are often “assumed” to originate in the spinal region -- that they are caused by a bulging or herniated disc. However, when treatment directed at the spinal region is not effective, TOS or a brachial plexus injury should be considered.

## **VI. TOS AND BRACHIAL PLEXUS INJURIES IN THE COURTROOM**

In the courtroom, imaging studies and anatomical models can be utilized by the plaintiff's attorney and the testifying treating doctor or surgeon to demonstrate the anatomy and "mechanics" of these serious, difficult-to-treat injuries, and to bring these injuries to life so that jurors can understand both how the injuries occurred and what the actual anatomical causes of the symptoms are.