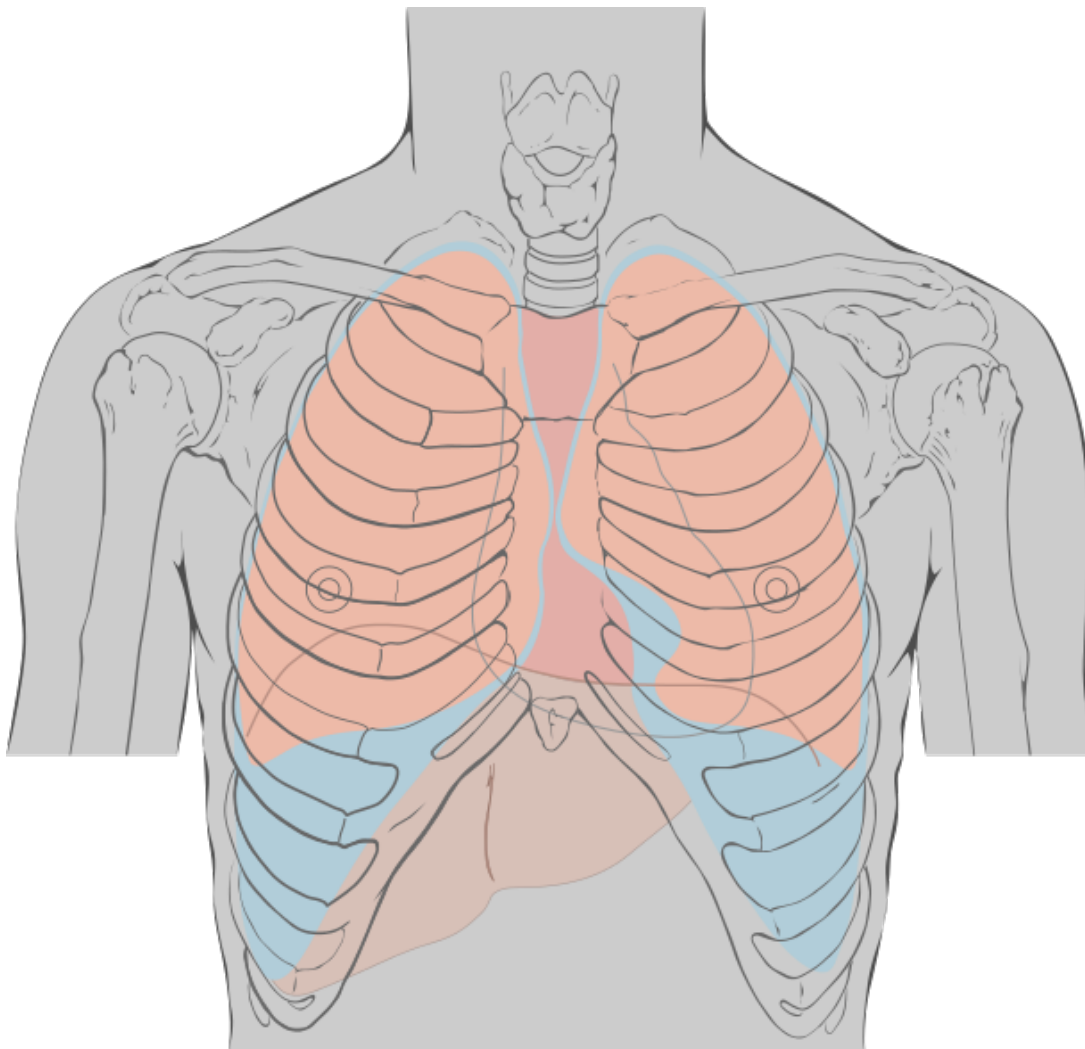


# Anatomy of the Thoracic Outlet and the Thoracic Outlet Syndrome

[See online here](#)

**The superior thoracic aperture, or thoracic outlet, is an upper chest area located below the clavicles and between the neck and the shoulders. Many important anatomical structures pass from the neck into the thorax and chest cavity from the thoracic outlet. Thoracic outlet syndrome is caused by the compression of the structures at the thoracic outlet, especially those passing through the inter-scalene triangle.**

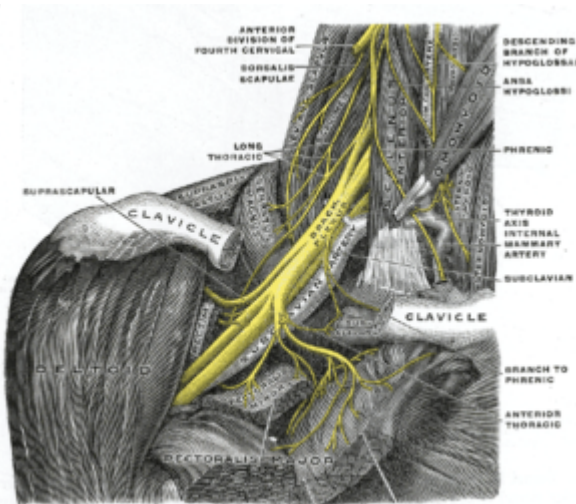


## Boundaries of the Thoracic Outlet

The thoracic outlet is the passageway from the lower neck to the axilla. It is composed of the following:

- First [thoracic vertebra](#) T1 posteriorly
- First pair of ribs laterally
- Clavicle, sternoclavicular joint, and manubrium of the sternum anteriorly

## Structures that Pass Through the Thoracic Outlet



[Image](#): 'Thoracic outlet' by Henry Vandyke Carter, Henry Gray (1918) in *Anatomy of the Human Body (Gray's Anatomy)*, Plate 808. License: [Public Domain](#).

- Trachea
- Esophagus
- Thoracic duct
- Apexes of the [lungs](#)
- Nerves
  - Phrenic nerve
  - Vagus nerve
  - Recurrent laryngeal nerves
  - Sympathetic trunks
- Vessels

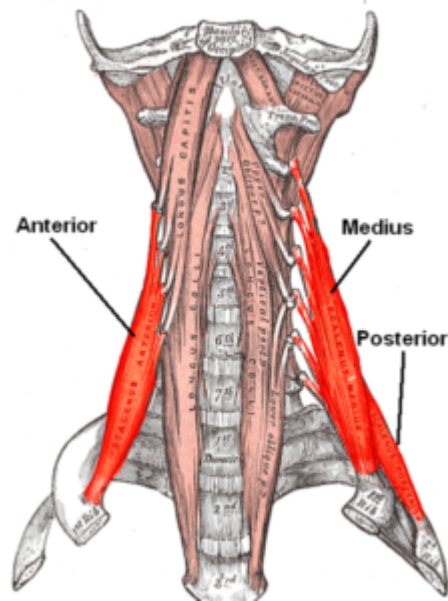


Image: 'Application of Gray 387: Scalene muscles' by User: Mikael Häggström. License: [Public Domain](#).

- Arteries
  - Left and right common [carotid arteries](#)
  - [Left and right subclavian arteries](#)
- Veins
  - Internal jugular veins
  - Brachiocephalic veins
  - Subclavian veins
- [Lymph nodes and lymphatic vessels](#)

## Inter-scalene Triangle

This is an important triangle in the neck anatomy in association with the thoracic outlet. The base of the triangle is formed by the first rib and the other two equal sides are made by the [anterior and middle scalene muscles](#). Many important structures pass through the triangle, as follows:

1. Part of the [brachial plexus](#)—inferior trunk of the plexus
2. Subclavian artery

## Thoracic Outlet Syndrome (TOS)

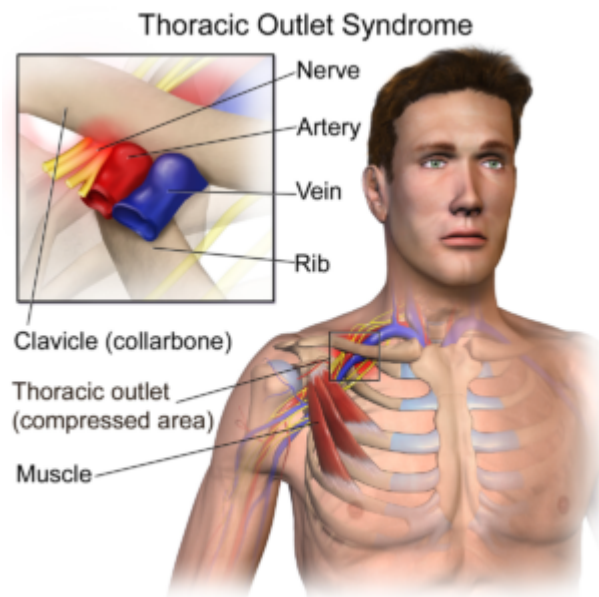


Image: 'Thoracic outlet syndrome' by BruceBlaus. Own work.  
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TOS is caused by the **compression of the neurovascular structures at the thoracic outlet**, especially those passing through the inter-scalene triangle. Signs and symptoms differ depending on the structures involved, i.e. **neurogenic, arterial, and venous symptoms**. TOS is classified on the basis of the structures involved.

## Epidemiology of TOS

Neurologic involvement most commonly occurs with a neurogenic clinical picture. Roughly 95% of the patients of thoracic outlet syndrome present with neurologic signs and symptoms. Two to three percent of patients with TOS have venous symptoms at presentation. Arterial symptoms are the least common.

The neurogenic TOS is common in females of 20-50 years of age, whereas venous TOS is more common in males, with a male-to-female ratio of 2:1.

## Etiology of TOS

As mentioned above, the symptoms of TOS are produced by the compression of the neurovascular structures in the scalene triangle at the costoclavicular space.

### Common causes of TOS include the following:

1. Trauma after a car accident
2. Repetitive injuries from sports-related activities
3. Anatomic defects: These include a cervical rib, a prolonged transverse process and muscular abnormalities (e.g., in the scalenus anterior muscle, a sickle-shaped scalenus medius), or fibrous connective tissue anomalies.
4. Pregnancy
5. A condition called forward head posture (FHP) seen in people who read on the computer for long periods of time, such as students, teachers, and typists.
6. Abnormal pressure on the shoulders due to a heavy backpack or bag

# Pathophysiology of TOS

Neurogenic TOS usually occurs after trauma to the head and neck. Swelling or disturbance of the anatomy at the scalene triangle leads to the irritation of the cords of the brachial plexus, which produces neurologic symptoms. The brachial plexus supplies the muscles of the upper limbs and chest.

Arterial TOS may occur as a result of a cervical rib or an excessively long transverse process of C7, resulting in arterial compression with the movement of the arm. The involvement of the artery due to outlet obstruction can progress to arterial stenosis with post-stenotic dilatation or aneurysm formation as well as thromboembolism. The second part of the subclavian artery is commonly involved.

Venous obstruction or involvement can occur with compression along the rib or clavicle. The subclavius and costoclavicular ligaments are commonly involved.

## Signs and symptoms of TOS

**In neurogenic TOS, the following signs and symptoms are seen:**

1. Wasting of the base of the thumb (Gilliat-Sumner hand)
2. Painless atrophy of the muscles of the hands with [carpal tunnel syndrome](#)
3. Numbness or tingling in the arm or fingers
4. Pain in the neck, shoulder, or hand
5. Weakening grip and difficulty in daily activities
6. Associated signs of arterial insufficiency (anterior scalene syndrome)

**In venous and arterial TOS, symptoms and signs include the following:**

1. Discoloration of the hands during activities or even at rest (bluish color)
2. Arm pain due to claudication and [edema](#) due to disturbance of venous flow
3. Blood clot in veins or arteries in the upper area of the arm due to [atherosclerosis](#)
4. Pallor in one or more fingers or the entire hand
5. Cold fingers, hands, or arms
6. Fatigue or tiredness after minor activity or with activity
7. Numbness or tingling in fingers or hands
8. Weakness of arm or neck
9. Throbbing lump near the collarbone

Due to disturbance of vascular flow in the vessels after compression, a change in the color of the hands and fingers with early fatigue after minor activities is common.

## Complications of TOS

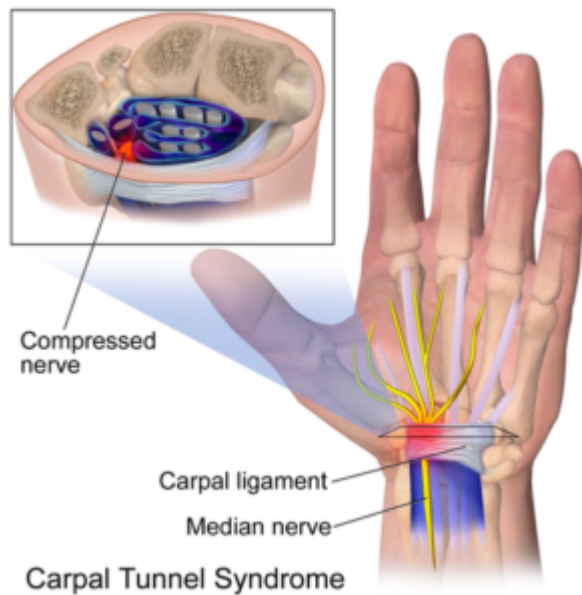


Image: 'Carpal tunnel syndrome' by Blausen.com staff. 'Blausen gallery 2014.' *Wikiversity Journal of Medicine*. DOI:10.15347/wjm/2014.010. ISSN 20018762. Own work. License: [CC BY 3.0](https://creativecommons.org/licenses/by/3.0/).

1. Frozen shoulder
2. [Carpal tunnel syndrome](#)
3. **Paget-Schroetter syndrome**
4. Cerebrovascular arterial insufficiency
5. Loss of vision as a circumstance of vertebral artery compression

## Diagnosis of TOS

**An anterior scalene syndrome** produced due to the compression of the plexus and the subclavian artery is diagnosed by **Adson's sign**, whereas the **costoclavicular syndrome** is caused by the narrowing and compression of structures between the clavicle and the first rib. It is diagnosed with the **costoclavicular maneuver**.

Adson's sign is the loss of the radial pulse when the head is rotated toward the ipsilateral side with neck extension and deep inspiration. If it is negative, TOS still cannot be ruled out because many people with outlet obstruction may still present with a positive Adson's sign.

## Treatment of TOS

**Management of TOS includes the following:**

- Stretching
- Acupuncture
- Chiropractic adjustments
- Osteopathy
- Occupational therapy
- Physical therapy

**Intramuscular steroid injection** settles the inflammation and pain in the muscle.

**Surgical management** has a greater chance of success in TOS. First rib resection or cervical rib removal can be done if structures are compressed against the rib. The

scalene muscle is removed in patients in whom neurovascular structures are compressed along the scalene muscle.

## References

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