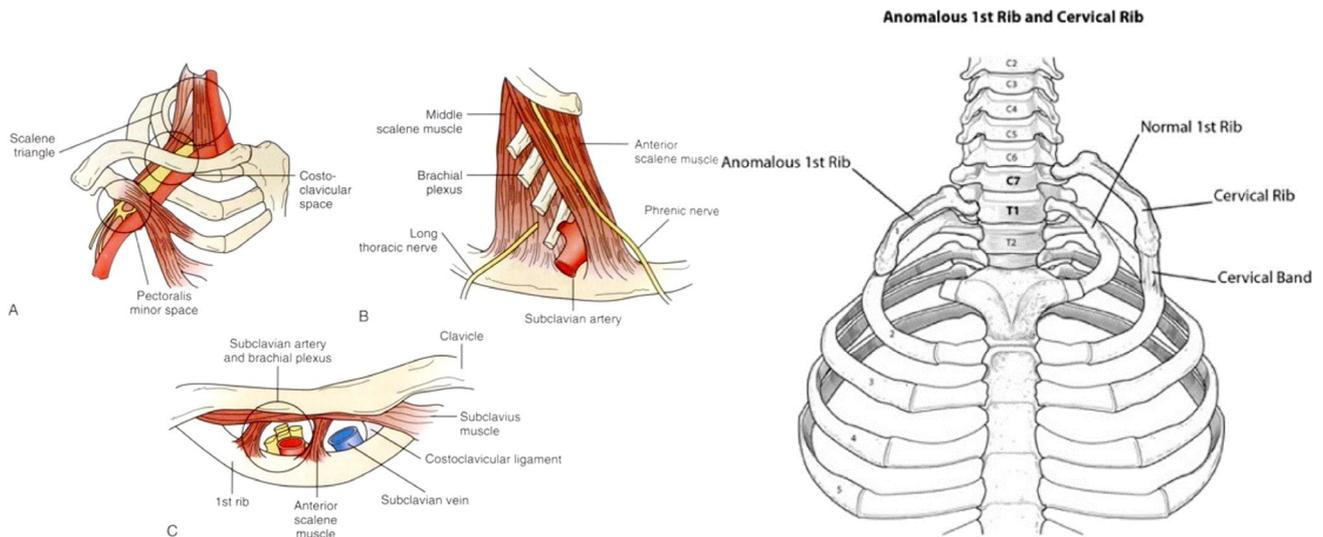


## Introduction

Thoracic Outlet Syndrome (TOS) refers to a group of different problems involving compression of the neurovascular structures (nerves and blood vessels) as they travel between the neck and the arm. The compression can involve one or more of these structures (nerves, artery and vein) and can occur either above (Scalene triangle), at (Costoclavicular space) or below the clavicle/collarbone (Pectoralis Minor Space) – see figure A in diagram below.

Typically, TOS is divided into three types depending on the main structure(s) involved: Neurogenic TOS (nTOS); Arterial TOS (aTOS); Venous TOS (vTOS). Neurogenic TOS is the most common form of TOS, accounting for more than 90% of cases. There is a group of patients who probably have a mixture of neurogenic and arterial TOS, whilst venous TOS tends to be a completely separate entity. This can be partly understood from figure C below, showing that the artery and nerves travel together through the costoclavicular space (between the clavicle and the first rib) with the vein separated by the anterior scalene muscle. Anatomical abnormalities such as cervical ribs, anomalous first ribs and abnormal fibrous bands can all contribute to TOS (see below figure). TOS can be exacerbated by repetitive activities, either at work or sporting related and has been reported to be exacerbated by some injuries (mainly nTOS) or may just occur without precipitating factors.



## Symptoms

Symptoms of TOS can be complicated and will obviously depend on which form of TOS is involved. All forms of TOS symptoms tend to be brought on or increased with movement/use of the arms/shoulder region.

- 1) nTOS: The main symptoms will be pain, paraesthesia (tingling), numbness and weakness, indicative of the nerve involvement. The symptoms can be varied in distribution depending on which areas/nerves are involved. Symptoms can however be broadly divided into “upper brachial plexus” and “lower brachial plexus” (upper nerves and lower nerves) symptoms. Upper plexus tends to involve symptoms more from the shoulder/clavicle region up to the head. Lower plexus symptoms tend to be more in the arm. There can however be a lot of crossover of these symptoms (or referred symptoms).

- 2) aTOS: Arterial symptoms will depend on whether the artery is normal at rest (most common) or has developed abnormalities such as stenosis (narrowing) or aneurysms (dilatation). Arteries are taking oxygenated blood from the heart out the the tissues (in this case the arm). Most commonly, compression of the artery occurs with elevation of the arm so that there are no symptoms at rest but symptoms develop with use of the arm. These symptoms are typically weakness, tiredness, heaviness or ache of the arm requiring it to be rested and placed back in a normal position. If a patient has developed an aneurysm (usually associated with anatomical abnormalities of the ribs), then thrombus (blood clot) can form within these and embolise (breakoff) and travel lower in the arm, blocking off the arteries particularly in the hand causing symptoms of pain and pallor (whiteness) even at rest.
- 3) vTOS: Venous symptoms relate to a reduced ability to get blood out of the arm (veins taking blood back to the heart). This can be swelling and heaviness of the arm with use of the arm (often with “blue” discolouration related to venous engorgement) or a sudden onset of swelling and discolouration of the arm with/without pain, usually associated with acute thrombosis of the vein.

### **Investigations**

There are no investigations which will definitively diagnose TOS. This is because there are many patients with symptoms who will have entirely normal investigations, and many of the normal population who will have abnormal investigations though are completely asymptomatic. The investigations which may be performed during investigation for possible TOS include a simple chest x-ray (to assess for cervical or anomalous ribs), vascular ultrasound studies (performed both at rest and with provocative manoeuvres of the arms) and nerve conduction studies. Other investigations may include CT scans and MRI scans, particularly to exclude other pathologies that may also cause symptoms similar to TOS such as problems with the cervical spine (neck).

### **Treatment**

Treatment options are varied depending on the nature of the TOS and severity of symptoms. Treatment options include

- 1) Reassurance, Conservative Management
- 2) Alteration to lifestyle/work patterns
- 3) Physiotherapy
- 4) Surgical Decompression

Many patients will simply require reassurance once the diagnosis is made if symptoms are relatively mild or in asymptomatic patients where TOS is an incidental finding. Other patients will respond well to simply changing how they do things in order to avoid positions that will bring on symptoms. Many patients with nTOS will respond to specialised physiotherapy programs. Patients with aTOS or vTOS are more likely to require surgical intervention for decompression of their thoracic outlet region.



## **Surgery**

There are several different approaches to surgery for TOS. The different approaches will depend partly on the type of TOS being treated and where it is felt the main compression is occurring. Surgery can be performed via a supraclavicular approach (above the collarbone), particularly for nTOS and may or may not involve removal of the first rib. An infraclavicular approach (below the collarbone) can be performed particularly in some cases of vTOS or aTOS requiring formal arterial reconstruction (usually in association with a supraclavicular approach). A transaxillary approach (from the arm pit) with removal of the first rib can be performed for all types of TOS, though particularly those with some form of vascular involvement. Depending on the structures involved, Dr Neale may perform surgery from any of these approaches. However if the issue is nTOS requiring surgery from a supraclavicular approach, you will most likely be referred to a surgeon who would normally operate on the nerves in the neck (commonly a specialist hand/upper limb surgeon or neurosurgeon).

## **Outcomes and Risks of Surgery**

There are no guarantees in relation to the outcomes for surgery for TOS. This relates mainly to the complex nature of symptoms in many patients with TOS and the lack of any specific investigations that can prove any relationship between symptoms and TOS. The potential outcomes of surgery can be simply summarised therefore in the following possibilities.

- 1) Complete resolution of symptoms
- 2) Partial resolution of symptoms
- 3) No change in symptoms
- 4) Worsening of symptoms (uncommon)

Probably the most common outcome of surgery would be a partial resolution of symptoms, though again this clearly depends on the type of TOS being treated. This would particularly be the case for patients with nTOS, whilst patients with purely vascular TOS (arterial or venous) would be more likely to experience complete resolution of symptoms.

All surgery is of course associated with some risk. Surgical risks can be classified into general risks associated with all surgery and risks that are specific to each surgical procedure. Some of these risks will be summarised below. Please do not hesitate to ask Dr Neale if you have any questions or concerns regarding these risks and be aware that there may be other rare or unexpected complications from surgery that may not be mentioned here.

**General Risks:** These risks include risks normally associated with general anaesthetic (and should be discussed with your anaesthetist if undergoing surgery), wound healing problems including infection and keloid scars, DVT, stroke, myocardial infarction (heart attack), other heart problems (e.g. arrhythmia) and death.

**Specific Risks:** Possibly the main risk for TOS surgery might be considered failure to relieve the symptoms for the patient (as outlined above). The risks for complications will be slightly different depending upon the surgical approach. The risks however can be summarised fairly easily as the surgery is designed to decompress the neurovascular structures. As such, the main risks are related to injury to the neurovascular structures (nerves, arteries and veins). Injury to nerves can include areas of numbness, weakness to muscles involving the arm and shoulder region with potential loss of function,



## **THORACIC OUTLET SYNDROME – PATIENT INFORMATION, Dr M NEALE**

or pain (neuropathic or nerve pain) which could require specific medication to treat. Injuries to nerves may be temporary (short duration or lasting many months) or permanent. Injuries to the arteries and veins include risks related to bleeding (possibly requiring return to the operating theatre) or occluding (blocking off). Arterial occlusion is likely to require return to theatre for intervention with the worst case scenario being potential for loss of the affected limb (rare). Venous occlusion/thrombosis may or may not require return to theatre and may be managed with anticoagulation (blood thinning agents) with the potential for pulmonary embolism (PE) associated with venous thrombosis (DVT). There is also a risk for pneumothorax (collapsed lung) with any surgical approach for TOS and a small potential for haemothorax (bleeding into the chest) requiring either catheter or surgical drainage, formally opening the chest (thoracotomy).

Please do not hesitate to contact Dr Neale's rooms for a further appointment should any further clarification be required or should you have any further questions, particularly prior to proceeding with surgery for management of TOS.

