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THORACIC OUTLET SYNDROME (T.O.S)

WHAT IS THORACIC OUTLET SYNDROME?

The thoracic outlet is the upper aperture of the chest, between the collar bone and the first rib. This narrow passageway is crowded with blood vessels that run out of the chest to the arm (subclavian vein and artery), as well as the nerves that exit the spine in the neck to supply the arm. The nerves fuse to form 3 large trunks (Brachial Plexus) and these run through the thoracic outlet and split up again into separate nerves lower down.

Thoracic outlet syndrome refers to the symptoms that arise when these nerves or blood vessels are compressed at the thoracic outlet.

WHERE DOES THE COMPRESSION OCCUR, AND WHY?

The thoracic outlet is bordered by the collar bone at the top and front, the first rib below and two muscles, one in the front, and another behind.

These muscles are called scalene muscles, and their function is to stabilise the first rib. They run from the spine, higher up and run downwards, and are attached to the first rib, one in the front and the other at the back of the rib.

The brachial plexus nerves and subclavian artery pass through the triangle formed between the first rib and scalene muscles. The subclavian vein lies in front of the first scalene muscle and behind the collar bone.

Enlargement of the muscles, as well as scar tissue between them can compress the structures. The muscles may enlarge due to muscle imbalance following a shoulder injury or operation, and repetitive movements that exercise the muscle, such as certain sports, and certain work activities.

Sport activities include swimming, ball throwing (cricket), and rugby. Typical jobs that predispose to enlargement of these muscles are those where the arms are elevated a lot, such as mechanics, hairdressers, and schoolteachers (writing on blackboard). It is not uncommon in musicians.

Incorrect weight training may cause a muscle imbalance. A soft tissue injury (sprain) to the muscle can cause scar tissue. Congenital conditions such as abnormal bands that run over the nerves or between the muscles and an extra rib in the neck are other causes.

Another area of compression is between the collar bone and the first rib. Clavicle fractures may predispose to later scar formation, which may compress the structures later on. Fractures of the first rib may cause immediate damage to the brachial plexus, as it runs over the rib, making contact with it as it goes to the arm. If there is no immediate damage, symptoms may gradually develop later, as scar tissue grows around the rib, and encases the nerves and artery.

Some people may have a very thick first rib, causing compression between it and the collar bone. The third area of compression may be further down, below the collar bone, where compression occurs by a thick pectoralis minor muscle where it attaches to the shoulder blade (scapula).

Poor posture and obesity may aggravate the condition. It occurs classically in females, with long necks, and drooping shoulders, as well as in stocky, muscular people. A painful shoulder following trauma or surgery may cause the arm to hang, and stretch the nerves over the rib if this is longstanding.

WHAT ARE THE SYMPTOMS?

Pressure on the blood vessels can reduce the blood flow to the arm and hand (especially in the elevated position) and cause them to tire easily, feel cold, and go pale. Pressure on the vein can cause the arm or hand to swell a bit. Pressure on the nerves can cause vague, aching pains in the shoulder, neck, arm and hand. There may be a pain shooting all the way down to the fingers, and they may go numb. Headaches may occur. Overhead activities, carrying objects and driving may be affected. The arm may often go numb when lying on that side.

The hand may feel clumsy and one may struggle with certain tasks, such as opening a jar, wringing out a cloth and there may be a tendency to drop things.

HOW IS THE DIAGNOSIS CONFIRMED?

Diagnosis is confirmed by the typical symptoms, physical examination (to test clinical signs of artery and nerve compression) and some tests. Unfortunately there is no one special test that can accurately exclude the problem of T.O.S. That is, a positive test can confirm it, however all the tests may be negative, but the patient may still have T.O.S, and may suffer for a long time before the diagnosis has been made. Some patients may have had neck or shoulder surgery before TOS is diagnosed. In a lot of cases TOS may ultimately be diagnosed by the surgical decompression operation (“open up and see”).

TOS is often only diagnosed after excluding other conditions that may be present with similar symptoms, and these need to be excluded. These are shoulder problems (e.g. rotator cuff injury), neck problems (prolapsed disc), ulnar nerve entrapment at the elbow & carpal tunnel entrapment at the wrist. Rarely, a cancerous growth at the top of the lung may invade the brachial plexus. (Usually in patients over 55 years).

The following investigations are routinely performed:

- Evaluation by a shoulder surgeon to exclude shoulder pathology, with clinical examination, ultrasound and x-rays and possibly MRI scan of the shoulder.
- X-rays of the cervical spine to assess for cervical ribs and check the alignment, and if indicated, MRI scan of the neck.
- Chest X-Ray to check the lung, and look for the clavicle and first rib deformities.
- Other tests performed, include:
 - Nerve conduction tests (done by neurologists) together with neurological evaluation. These may on occasion be of value, but a negative test does not mean that TOS is not present. The test is expensive.
 - Multi-slice CT scan (CT Angiogram). This can be performed with the arms at the side and then with the arms elevated above the head, and can confirm dynamic compression of the artery. This may be helpful, but may not diagnose nerve compression.
 - A venogram (contrast injected into vein) may on occasion be useful if it is thought that the vein is obstructed.

It should be stressed however that the most important key to diagnosis remains the exclusion of other causes of shoulder and neck pain along with a good history and clinical examination.

If symptoms are severe and longstanding and surgery is being considered, then further tests may be included (but may still not prove that the patient has TOS).

HOW IS THE CONDITION TREATED?

- For most patients, conservative (non surgical) treatment is recommended. Avoiding precipitating factors such as wrong exercises, and time for the condition to settle, may be all that is needed.
- Stress avoidance, work simplification and job site modification are recommended to avoid sustained muscle contraction and repetitive or overhead work that worsens symptoms.
- Physiotherapy to help strengthen the muscles around the shoulder (deltoids and rhomboids) so that they are better able to support the collar bone. Ultrasound to the scalene muscles and, sometimes strapping of the shoulders may help.
- Postural exercises to help you stand and sit straighter, which lessens the pressure on the nerves and blood vessels.
- If you are overweight, losing some weight may help.
- Anti-inflammatory medication, such as voltaren or brufen, together with rest, may help.
- If the condition settles, remember that a return to the precipitating factors may cause a recurrence. The condition does tend to flare up again, from time to time, even if the aggravating factors are avoided.
- Avoiding a recurrence: Avoid carrying heavy bags over the shoulder, and in particular, do not ever carry a heavy backpack. (TOS is often called “backpackers shoulder”, as a heavy weight pushes the collar bone down onto the first rib, narrowing the thoracic outlet).
- Surgical treatment is considered when conservative measures have failed, and the symptoms continue to be bad.

WHAT ARE THE EXACT INDICATIONS FOR SURGICAL TREATMENT?

If the cause is due to bony obstruction such as a cervical rib, or fractured first rib or collarbone with malunion; then surgery will be best as the condition is unlikely to get better on its own.

If the cause is presumed to be due to compression by the scalene muscles, or inadequate space between the rib and collar bone, then surgery is recommended if there is no improvement after 3-4 months, and the symptoms are severe.

If the symptoms are longstanding and the patient can tolerate them, then conservative treatment can be continued. Surgical decompression may be performed earlier in sportsmen who want to get back to their activities earlier.

HOW IS SURGERY PERFORMED?

A decompression is performed. Any cervical ribs are removed. The scalene muscles are divided off the first rib, and any scar tissue between the muscles, arteries, and nerves is removed.

It is better to also remove the first rib, to open the floor of the thoracic outlet and make sure an adequate decompression has been performed.

The incision usually just above the collar bone, about 6-8cm long. Some surgeons perform the procedure through the axilla, or armpit, for a better cosmetic result, and to stay away from the brachial plexus, thereby avoiding the risk of injuring it.

We prefer the incision above the collar bone, as we find it easier to dissect any scar tissue off the brachial plexus. We find it easier to identify the whole brachial plexus this way, and make sure there is no scar around it higher up.

Once the procedure has been done, a small drainage catheter is placed into the wound. We usually place an epidural catheter around the nerves, and give local anaesthetic through it for post operative pain relief. This is usually left in for 2 days, and initially may cause the whole arm to go numb for a few hours so we warn patients not to be worried about this before the time.

The procedure takes 1 to 1½ hours to perform; patients generally spend two to three days in hospital and are booked off work for three to four weeks to recover. The procedure is

performed by cardiothoracic surgeons, vascular surgeons, general surgeons and sometimes orthopedic surgeons.

In experienced hands the complications are virtually non-existent, but surgeons who occasionally perform the procedure tend to have more complications. It is a procedure that needs to be meticulously performed by a surgeon who knows the anatomy well.

WHAT ARE THE COMPLICATIONS OF THE OPERATION?

Many nerves run through the area, but luckily damage can be avoided by meticulous dissection, and identifying all the nerves before dividing the muscles.

We have not had any of these problems, but they have been seen and also described in the literature, so need to be mentioned. (The reported incidence is < 1%):

- Phrenic nerve injury – paralysis of the diaphragm on that side.
- Long thoracic nerve injury – Paralysis of the serratus anterior muscle that pulls the scapula (shoulder blade) forwards.
- Brachial plexus injury – this is usually mild and reversible. It is worthwhile to mention that mild traction on the brachial plexus may sometimes cause a bit of numbness of the fingertips for a few days.
- Removal of the first rib may result in the pleura (membrane covering the chest cavity) being opened. This happens very rarely in our practice, and then it is recognized during the operation, and the wound drain is advanced into the chest cavity to prevent a blood collection there and to make sure the lung does not collapse.
- It is common to have an area of numbness below the wound, and this may last for months.

HOW SUCCESSFUL IS THE OPERATION?

In the literature, the success rate quoted is around 70 to 80 %. In our experience, 80% have a good result, 15% show only slight improvement and another 5% have no improvement.

About 5% may have recurrence of their symptoms, usually after a year. This is usually due to the in growth of scar tissue around the nerves, and another (minor) exploration to release the scar is usually successful.

AVOIDING TOS

If you have symptoms of TOS avoid carrying heavy bags over your shoulder as this decompresses the collarbone and increases pressure on the thoracic outlet. You could also do some simple exercises to keep your shoulder muscles strong. Here are four that you can try; do repetitions of each exercise twice daily.

1. Corner stretch: Stand in a corner (about one foot away from the corner) with your hands at shoulder height, one on each wall. Lean into the corner until you feel a gentle stretch across your chest. Hold for 5 seconds.
2. Neck stretch: Put your left hand on your head, and your right hand behind your back. Pull your head towards your left shoulder until you feel a gentle stretch on the right side of your neck. Hold for 5 seconds. Switch hand positions and repeat the exercise in the opposite direction.
3. Shoulder rolls: Shrug your shoulders up, back and then down in a circular motion.
4. Neck retraction: Pull your head straight back, keeping your jaw level. Hold for 5 seconds.
5. Weight Training: Avoid bench press, snatches and any exercises that strengthen the pectoralis muscles. Rather strengthen back of shoulder girdle (deltoids, rhomboids) as well as triceps/biceps.

As with any exercise program, if you start to hurt – STOP!

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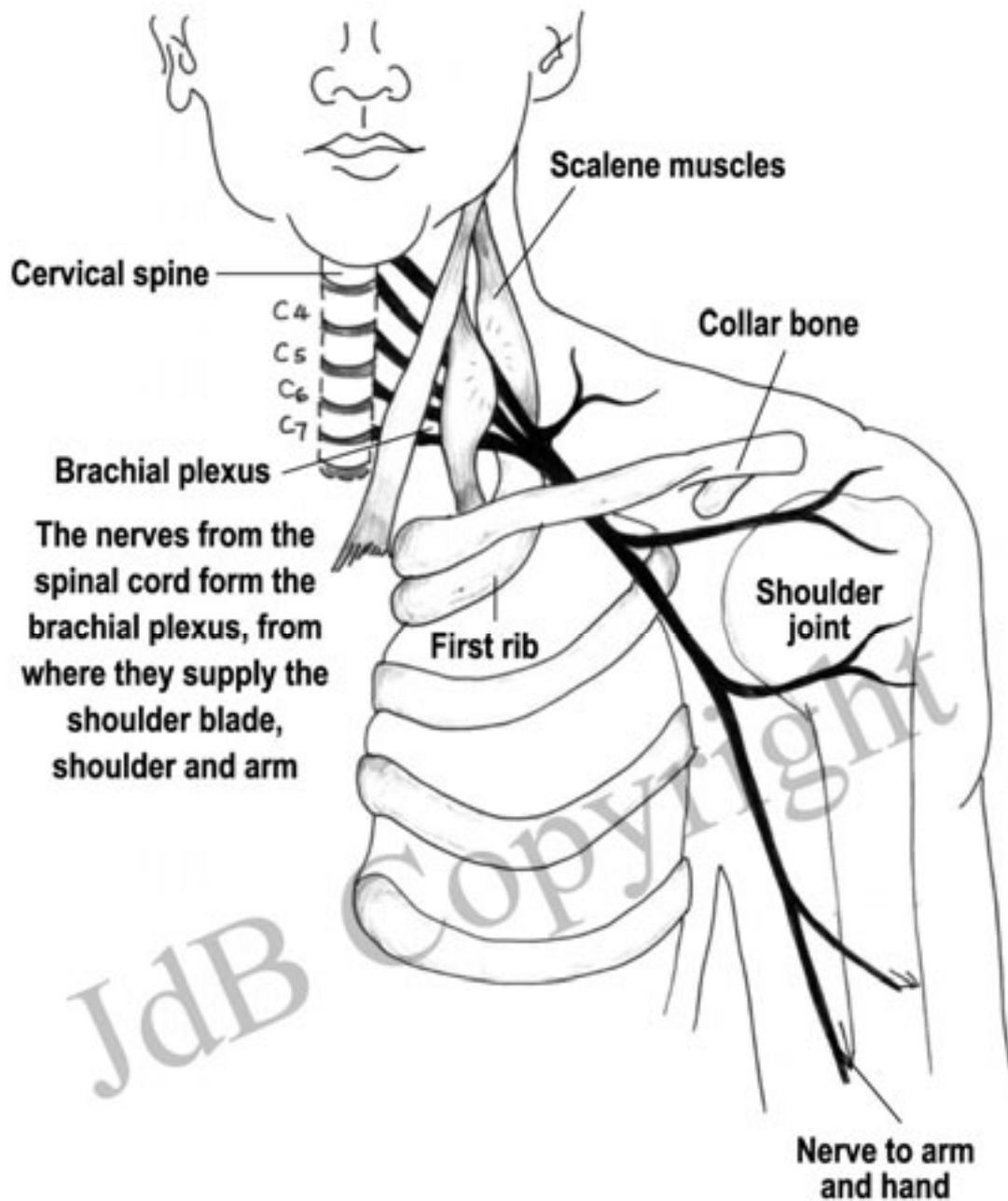
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THORACIC OUTLET SYNDROME – A SHOULDER SPECIALIST'S PERSPECTIVE

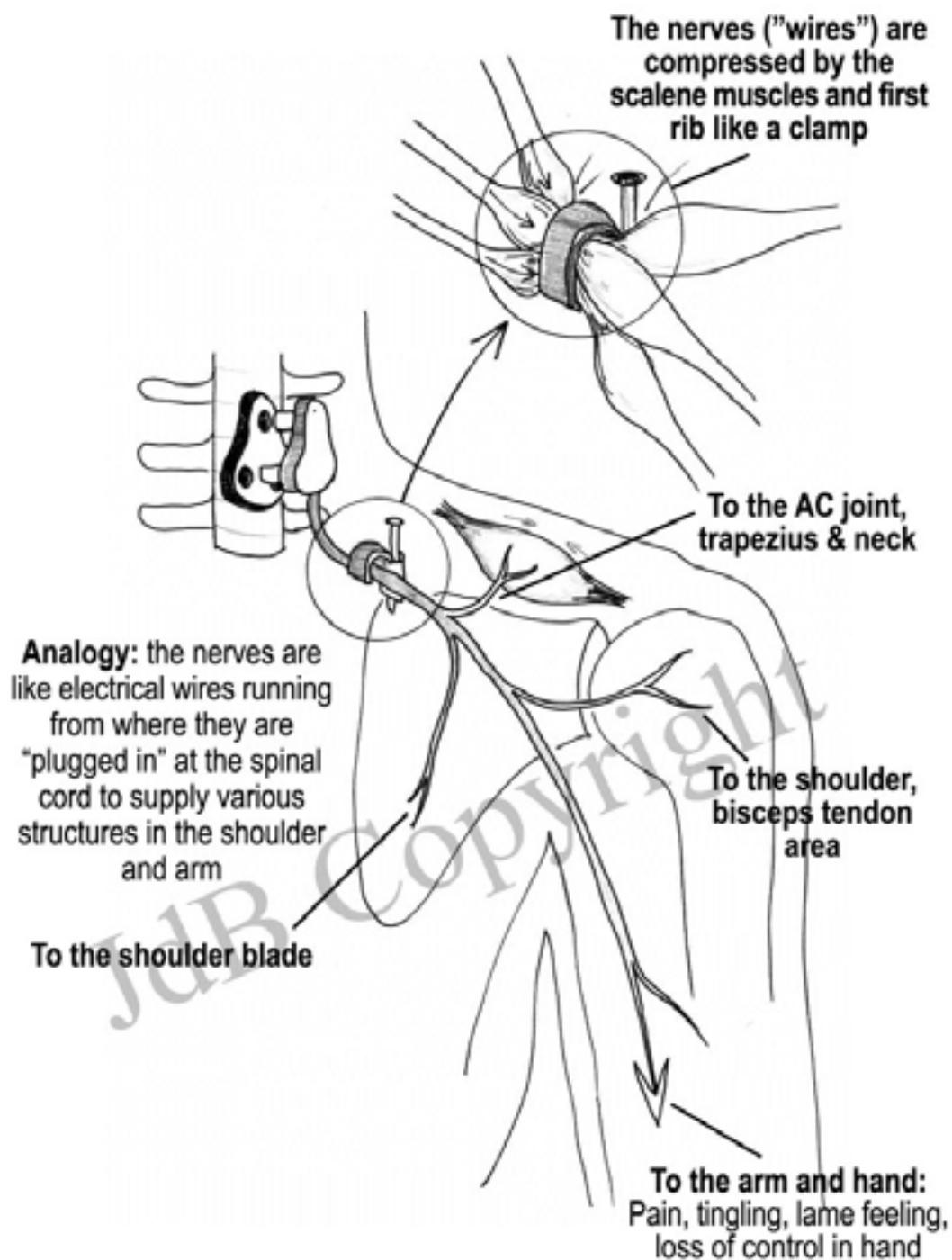
Dr Joe de Beer

In the rest of this document there are well explained details of the thoracic outlet syndrome by Dr Dave Harris, a renowned thoracic surgeon.

As mentioned by Dr Harris (see above) the nerves and vascular structures (arteries and veins) are compressed between the first rib and scalene muscles.



Thoracic Outlet Syndrome



Thoracic Outlet Syndrome

Typical patients presenting to the shoulder specialist are:

1. Those with enlarged scalene muscles due to repetitive work or sporting activities: swimmers, weight-lifters and others. Also people doing lifting of objects regularly at work.
2. Young people with droopy shoulders and doing repetitive arm motions: e.g. musicians.
3. Scar tissue formation after collar bone or first rib fractures.
4. Postural problems: dropping shoulders causing traction on the brachial plexus or short stocky necks with soft tissue compressing the thoracic outlet.

A few of the symptoms which would make the doctor suspect this condition in any patient would be:

1. Shoulder pain: often over the AC joint or biceps area. Not uncommonly over the back of the upper arm.
2. A continuous burning, lame feeling in the shoulder and down the arm.
3. Tingling (pins and needles) may be felt down the arm and into the hand and often particularly into the little and ring fingers. There may be loss of control of the hand with dropping objects.
4. The pain is often present at rest eg. when driving or simply sitting watching TV etc.
5. The pain may radiate into the neck, the trapezius muscles, the shoulder blade (with a burning character), jaw, the head and even chest area.
6. Traction downwards on the arm eg. when carrying shopping bags may aggravate the sensation down the shoulder and arm.
7. Pain and discomfort is often present following activities and not only during the activities – eg. after swimming, throwing, etc.
8. Overhead activities as doing one's hair, hanging up washing, etc., may cause a feeling of fatigue and burning in the arm, having to bring the arm down because the overhead position cannot be sustained.

Many of these patients present to a shoulder surgeon after having had various shoulder operations for erroneous indications like "impingement", "subtle instability", etc. The message is that the surgeon and therapist must be wary not to miss this diagnosis before deciding on treatment.