



## OUR CLINICAL EXPERIENCE: THORACIC OUTLET SYNDROME

### TORASİK ÇIKIŞ SENDROMU: KLİNİK DENEYİMLERİMİZ

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#### SUMMARY:

**Introduction:** The compression of the brachial plexus and subclavian circulatory elements at the cervicoaxillar canal is called the thoracic outlet syndrome (TOS). Among the ethological reasons, congenital fibromuscular osseous anomalies lead the top. Electrophysiological study of the upper nerves is single most dependable diagnostic test.

**Material-Method:** In our clinic between the years 2008 and 2014, 10 patients were diagnosed with TOS. The average age of the patients were 46.2 (36-64), with 5 of them being women and the remaining 5 men. The average length of the symptoms was 14 months (8-36). 4 of the patients were undergone operation with transaxillary approach and the other 4 with supraclavicular approach for decompression of the brachial plexus. All of the patients were evaluated using the VAS score.

**Results:** Solitary scalenectomy was done on one patient, single cervical cot resection was done to 4 of the patients and both scalenectomy and cot resection was done to 3 patients. No major complications or recurrence were observed on the patients. The average preoperative VAS score of the patients were 6.3 (5-8) lowered to an average of 2.1 (1-5) after the surgical intervention.

**Conclusion:** The previous articles reported benefit results from both surgical and non-surgical methods. We believe that a treatment plan should be worked on for every patient starting with non-surgical treatment, going with the surgical way on recurrent cases.

**Keywords:** Thoracic outlet syndrome, brachial plexus, cervicoaxillary canal, ulnar nerve conduction speed, surgical decompression, supraclavicular approach.

**Level of evidence:** Retrospective clinical study, Level III

#### ÖZET:

**Giriş:** Brakial pleksus ve subklavian damarların servikoaksiller kanalda baskıya uğramasına Toraksın çıkım sendromu denilir. Etiyolojik nedenlerin başında konjenital fibromuskuler ve osseöz anomaliler gelir. Üst ekstremitte sinirlerinin elektrofizyolojik çalışmaları nörojenik TOS'un kanıtlanmasında tek ve en güvenilir tanı yöntemidir.

**Materyal-Metot:** Kliniğimizde 2008-2014 yılları arasında 10 hastaya TOS tanısı konuldu. Hastaların yaş ortalaması 46,2 (64-35), 5 kadın, 5 erkek kişiden oluşmaktaydı. Hastalarımızın hepsinin şikayeti ortalama 14 ay (8-36) idi. Hastaların hepsine supraklaviküler yaklaşım ile brakial pleksus dekompresyonu yapıldı. Hastaların hepsinin preoperative ve postoperative ağrısı VAS skoru ile değerlendirildi.

**Sonuçlar:** Hastalardan birine yalnızca skalenektomi, dört hastaya servikal kot rezeksiyonu ve skalenektomi, üç hastaya skalenektomi ve 1. kot rezeksiyonu yapıldı. Hastalarımızda postoperatif major komplikasyon ve rekürrens gelişmedi. Hastaların preoperatif kol ağrısı VAS skoru ortalama 6.3 (5-8), postoperatif kol ağrısı VAS skor ortalaması 2.1 (1-5) olarak değerlendirildi.

**Çıkarım:** Çalışmalar cerrahi olmayan ve cerrahi tedavilerin iyi sonuçlar verdiği yönünde. Tedaviye cerrahi olmayan yöntemler ile başlanabilir, inatçı vakalarda cerrahi tercih edilir.

**Anahtar Kelimeler:** Torasik çıkış sendromu, Brakial pleksus, servikoaksiller kanal, ulnar sinir iletim hızı, cerrahi dekompresyon, supraklaviküler yaklaşım

**Kanıt Düzeyi:** Retrospektif klinik çalışma, Düzey III.

## INTRODUCTION:

The compression of the subclavian circulatory elements and the brachial plexus while passing the cervicoaxillary canal is called the thoracic outlet syndrome (TOS). Previously these clinical features were called; scaleneus anticus, costoclavicular syndrome, cervical rib syndrome or 1. Rib syndrome<sup>21</sup>.

Seen around 0.3-8% throughout the whole population. Generally seen in older women. Mostly appears unilaterally. Neurological involvement is seen in 95 % of the patients<sup>7-8,21,28-29</sup>.

Most important anatomical element in the upper thoracic exit for TOS is the cervicoaxillary canal. Before entering the upper extremity, subclavian artery and vein crosses the brachial plexus along with the branches of the brachial plexus in the cervicoaxillary canal. The first costa divides the cervicoaxillary canal into two parts (Figure-1).

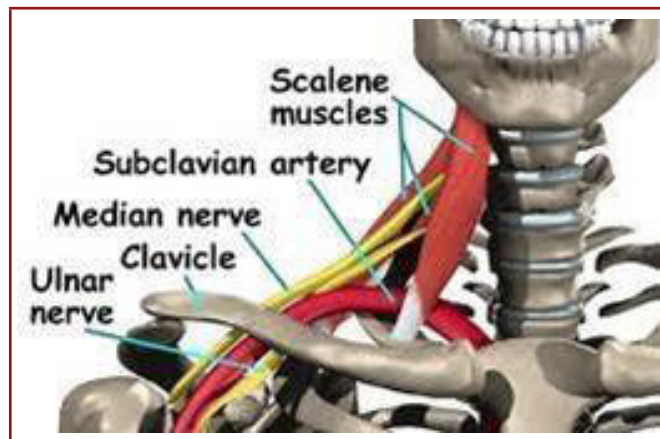


Figure-1. Cervicoaxillary canal

In the proximal section of the first costa, there is the scalene triangle and the costoclavicular space and distal to the costa lies the axillary cavity as a triangle. These three areas are the potential zones for neurological compression<sup>6,9,20,25-26</sup>.

Among the ethological causes (Table-1) comes fibromuscular and osseous anomalies the first. Vascular pathologies are rare with the venous pathologies topping as it's highest<sup>23</sup>.

Symptoms vary depending on the element being compressed. The symptoms can be grouped as neurological, musculoskeletal and vascular. The single most common symptom in TOS is pain. Pain can be seen in the compression of all three elements. Neurological symptoms are seen almost in all of the patients with vascular symptoms appearing in 13-46 %<sup>14,16,20,26</sup>.

Table-1. Etiology

Soft Tissue Origin (70 %)	Skeletal Origin (30 %)
Scaleneus muscle variations	Cervical costa
Scaleneus muscle hypertrophy	C7 transvers process
Accessory scaleneus minimus muscle	Malposition in the union of first costa fracture
Abnormal ligament and bands	Fracture of the clavicle or first costa
Neoplasms of the soft tissue	Neoplasms of the osseous tissues
	Traumatic dislocations of the acromioclavicular and the sternoclavicular joint

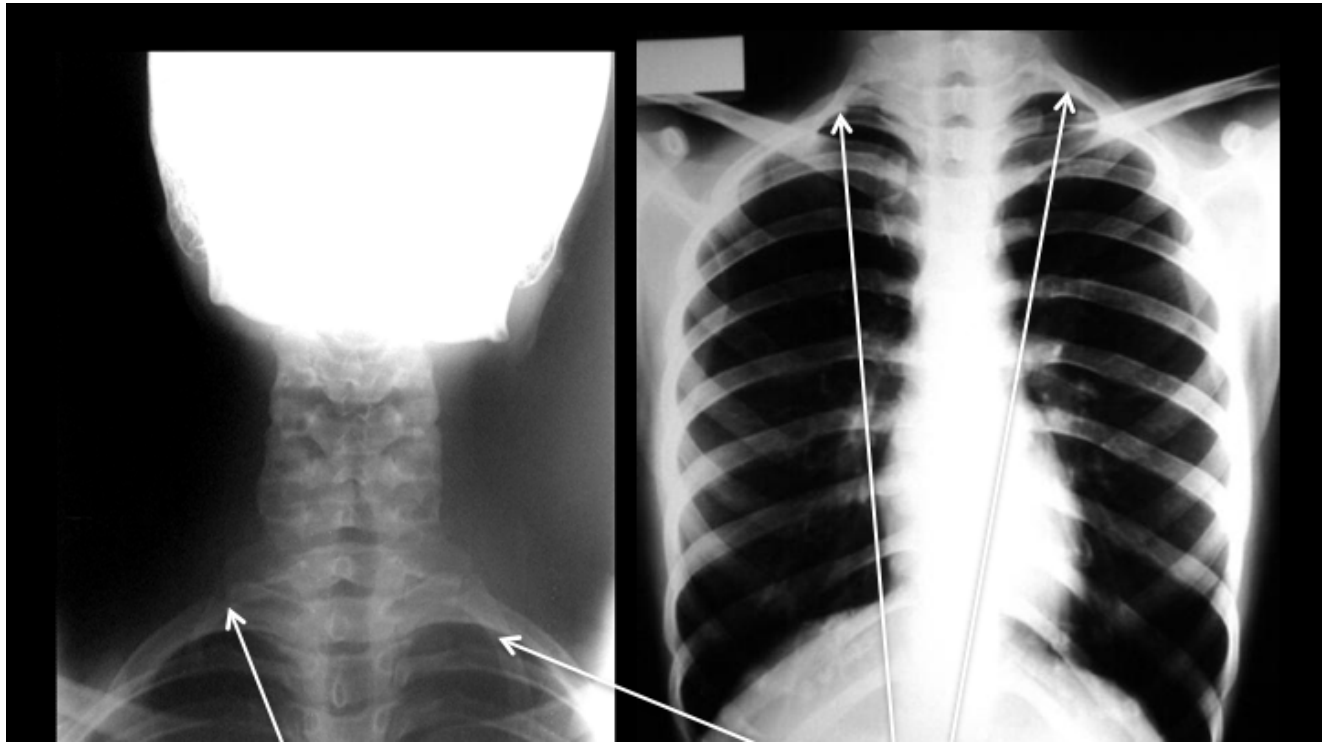
The most affected element in TOS is the brachial plexus being consisting the neurological symptoms part. 75 % of the patients have compression of a single nerve or nerve along with a vascular element. The most common neurological symptoms are pain, paresis or muscle weakness. Pain and paresthesia seen in 95 % of the patients whereas motor symptoms are seen in 10 % of the patients.

TOS caused by trauma appears with the symptoms as pain over the trapezius muscle, pain in paravertebral and parascapular region and pain in the neck and occipital region. Pain in the head and neck are often related with sudden reflex contraction of the scalene muscles reacting to trauma. These types of pain are not common in musculoskeletal anomalies, however can be seen in anomalies caused by trauma.

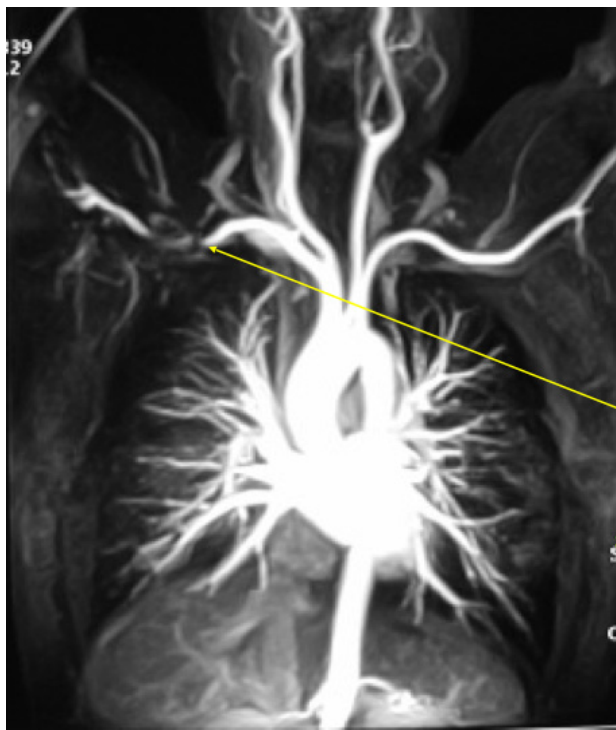
Vascular symptoms arise by the compression of the subclavian artery or vein. Solitary vascular symptoms are seen less than solitary neurological symptoms. Solitary subclavian artery compression is seen in 10 % of the patients, and compression of the subclavian vein seen in 2 % of the patients<sup>16</sup>. The compression in the upper thorax exit can remain asymptomatic during rest.

Provocative tests are used to aggravate the symptoms during physical examination. Adson or scaleneus test, costoclavicular test (arm stand test), arm stress test, hyperabduction test, pressure provocation test are among the methods used. The aim of the provocative tests is further increasing the compression of the cervicoaxillary canal resulting in the aggravation of the symptoms.

Different radiological imaging methods from cervical radiography (Figure-2) to magnetic resonance imaging (MRI) (Figure-3) can be used for the diagnosis. MRI is better for showing the fibrous bands or other soft tissue compressive elements<sup>28</sup>.



**Figure-2.** Cervical rib



**Figure-3.** Subclavian artery compression at hyperabduction.

The electrophysiological study of the upper extremity nerves is the single and most dependable diagnostic test for the patients

that have neurological symptoms. Electromyography (EMG) is better for the differential diagnosis for TOS, cervical discopathy or carpal tunnel syndrome<sup>16,20</sup>.

The most affected test is the ulnar nerve conduction speed (UNCV) test. Used by Caldwell first in 1971 for TOS diagnose<sup>20</sup>. Patients with TOS have a lower speed conduction of the ulnar nerve. Normally the average conduction speed of the ulnar nerve in the upper thoracic exit is 72m/s. Any resulting value of 70 or lower is diagnostic for TOS<sup>20</sup> The conduction speed of the nerve lowers depending on the compression. The average speed affected by neurogenic TOS is 32-65m/2<sup>9,16,20</sup>.

#### **MATERIAL-METHOD:**

In our clinic between the years 2008 and 2014, 10 patients were diagnosed with TOS. The average age of the patients were 46.2 (36-64), with 5 of them being women and the remaining 5 men. All patients had pain and paresis symptoms. The pain described throughout the patients is as a pain starting from the cervical region scattering to the arm and chest. Paresthesia was associated with C5-T1 radicles and varied throughout the patients. None of the patients had any motor deficits. None of the patients showed any vascular symptoms. The average symptom length of the patients was 14 (8-36) months. All of the patients received different lengths of medical and physical therapies.

Diagnosis was done with EMG, direct radiography of the cervical region, MRI and MR angiography. 5 of the patients were undergone operation with transaxillary approach and the other 5 with supraclavicular approach for decompression of the brachial plexus. All of the patients were evaluated using the VAS score.

## RESULTS:

The average follow-up of the patients was 38 months. Patients were hospitalized for an average of 3 (2-5) days after the surgery. Solitary scalenectomy was done on one patient, only cervical rib resection was done to 5 of the patients and both scalenectomy and rib resection was done to 4 patients. No major complications or recurrences were observed on the patients. The average preoperative VAS score of the patients were 6.3 (5-8) lowered to an average of 2.1 (1-5) after the surgical intervention. It was worked out that all patients operated for TOS diagnose showed successful results.

## DISCUSSION:

Patients diagnosed with TOS are first taken to undergo conservative treatment. Mild and moderate cases respond well to medical treatment. Serious cases don't respond well to the conservative approach.

Conservative treatment protocols are losing weight, painkillers, and muscle relaxers, warm compresses, correcting posture and exercise programs. Furthermore, enlightening patients about the harms of carrying weight on the shoulder, sleeping with a high pillow or sleeping with the affected side down are among the conservative treatment protocols<sup>13</sup>.

Novak et al. reported successful results with their 42 patient series with 25 cures with conservative methods. The follow up with these patients were done for 6 months along with

physiotherapy. Painkillers and muscle relaxers were prescribed and activity education was given. Also transcutaneous electrical nerve stimulation and injection methods were used<sup>10</sup>.

Torriani et al. reported 69 % short-term clinical regression of the symptoms using conservative methods<sup>19</sup>. Vanti et al. reported that a conservative approach is a viable treatment following their literature sweep.

The patients that cannot be treated with conservative methods, having bone pathologies, and have UNCV of a value lower than 60 m/s, are good candidates for surgical treatment. Surgical decompression methods include resection of the first rib and other bone pathologies, division of the fibrous and other soft tissue bands, division or resection of the scaleneus muscle<sup>13,21,23</sup>. Transaxillary, supraclavicular or posterior subscapular approach can be taken in surgical intervention<sup>27</sup>.

With the supraclavicular approach, the brachial plexus, first costa and the neurological elements can be seen better thus can be conserved better. Surgeons take this approach in neurogenic TOS for resection of the first costa and the scaleneus muscle<sup>5</sup>. Terzis et al. reported successful results and low complication rates for the surgical treatment with this approach<sup>18</sup>. In our series, all our patients had neurogenic TOS and 5 patients whom we used this approach had successful results and no complications.

Transaxillar approach is first described by Ross (12) in 1966. It is said that this approach is better for resection of the first costa along with the fibrous band. It is reported that this approach gives a better field of view for first costa resection (4-5). Urchel et al. in their series of experiences with patients for 50 years reported successful results with their resection of first costa and costoclavicular ligament, and neurolysis of C7, C8 and T1 branches using the transaxillary approach<sup>24</sup>. In our series, we operated 5 of our patients using this approach with no major complications and had successful results (Figure-4).



**Figure-4.** First rib resection with tranaxillary approach

Clagett first described posterior subclavian approach in the year of 1962<sup>3</sup>. It is used for the neurolysis of the proximal

portion of the brachial plexus. This method is very invasive has the most complications. Urschel et al. used this method

for the resection of the residual costa and neurolysis of the brachial plexus in recurrent TOS patients<sup>24</sup>.

Depending on the reported results, the clinical success rates of supraclavicular approach is 80-85 %<sup>6</sup> and the transaxillary approach 80-93 %<sup>21,23</sup>. In cases with the primary cause being the soft tissue, partial scalenectomy path can be taken. It is reported that this method is more successful and has less complications compared to the resection of the first costa method<sup>2,11,15</sup>.

In our day, with the video guided thoracoscopic approach (VATS) thoracic semiparavertebral approach is used for some TOS patients<sup>1,17,22</sup>. With this approach deeper anatomical structures can be observed better.

Pneumothorax, and damage on the subclavian artery, vein, brachial plexus and thoracic duct are among the complications that can be listed. Karamustafaoglu et al. have reported an incidence of pneumothorax 25%<sup>4</sup>. Other complications are reported much less.

TOS is a rare condition of the upper extremity which has symptoms of a wide variety and not very specific. It has been reported that both surgical and non-surgical treatments have good clinical results. Treatment can be started with a non-invasive approach and continued on with a surgical intervention on stubborn cases.

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