JOURNAL LA MEDIHEALTICO

VOL. 05, ISSUE 06 (1197-1204), 2024
DOI: 10.37899/journallamedihealtico.v5i6.1677

# Scalenectomy Anterior as an Option for Thoracal Outlet Syndrome

**Yunus Abdul Bari[1], Muhammad Rafif Amir[1], Heri Suroto[2], Reyhan Pradnya Pradana[2]**

*[1]Department of Orthopedic and Traumatology, Airlangga University Hospital, Surabaya, East Java, Indonesia*

*[2]Department of Orthopedic and Traumatology, Dr. Soetomo General Academic Hospital, Surabaya, East Java, Indonesia*

**Corresponding Author: Yunus Abdul Bari*
*E-mail: yunus@fk.unair.ac.id*

Article Info

*Article history:*
Received 2 October 2024
Received in revised form 6 December 2024
Accepted 16 December 2024

*Keywords:*
Thoracal Outlet Syndrome
Scalenectomy Anterior
Case Report

**Abstract**

*The term "thoracic outlet syndrome" (TOS) refers to a collection of conditions that cause compression of the neurovasculature as it leaves the thoracic outlet. The condition was initially identified in 1956. The scalene triangle, the costoclavicular space, and the subcoracoid region are the three spaces where TOS typically occurs. The brachial plexus, the axillary artery and vein, and the subclavian artery and vein are all of the structures involved with TOS. A 38-year-old male presented to the orthopaedic department. He complained about weakness and numbness in her left arm that had been present for 15 years. The complaints had been aggravated over the last 3 years which was exacerbated by activities that required her to lift her arm. The most prevalent causes of TOS are congenital, traumatic, or functional. TOS is classified into three categories based on its clinical presentation: neurogenic (nTOS), venous (vTOS), and arterial (aTOS), with nTOS being the most frequent. Treatment for Thoracal Outlet Syndrome is conservative. However, if conservative treatment does not work well, operative treatment is needed.*

## Introduction

The term "thoracic outlet syndrome" (TOS) refers to a collection of conditions that cause compression of the neurovasculature as it leaves the thoracic outlet. The condition was initially identified in 1956 (Ghamari et al., 2016).The scalene triangle, the costoclavicular space, and the subcoracoid region are the three spaces where TOS typically occurs. The brachial plexus, the axillary artery and vein, and the subclavian artery and vein are all of the structures involved with TOS. Any or all of these structures may be compressed, producing unique clinical presentations that may include pain, paresthesia, pallor, weakness, feelings of fullness, and muscle atrophy (Mackinnon & Novak, 2002; Ohman & Thompson, 2020). Arterial TOS is caused by anatomic defects that compress the subclavian or, less commonly, axillary arteries. Patients are usually asymptomatic and unaware of the illness until they develop signs and symptoms of acute or chronic upper extremity ischemia, unless they have accompanying neurogenic symptoms that cause them to appear earlier. The prevalence of mixed arterial and neurogenic TOS is not completely known; occasionally the arterial symptoms are disregarded or missed, attributing symptoms to neurogenic TOS only (Kim & Son, 2023; Cantalamessa et al., 2017). Thoracic outlet syndrome (TOS) is characterized by a variety of symptoms, including upper extremity paresthesia, discomfort, and edema caused by compression of the brachial plexus or subclavian vasculature in the thoracic outlet (Illig et al., 2016; Masocatto et al., 2019). The epidemiology of TOS is not thoroughly established, likely because to a lack of

*ISSN 2721-1215 (Print), ISSN 2721-1231 (Online)*

agreement on universal diagnostic criteria (Illig et al., 2016).According to available statistics, the average incidence of TOS is 3 to 80 cases per 1000 people, with adolescents to middle-aged adults, especially women aged 20 to 50, being the most affected (Masocatto et al., 2019).

TOS typically occurs in three anatomical regions: the scalene triangle, the costoclavicular space, and the subcoracoid region. These regions are crucial pathways where the neurovascular structures pass through, and any compression in these spaces can lead to the onset of TOS symptoms. The primary structures involved in TOS include the brachial plexus, the axillary artery and vein, as well as the subclavian artery and vein. Compression of any or all of these structures can lead to a variety of symptoms, which may range from mild discomfort to severe neurological or vascular complications.

Patients with TOS often experience a combination of symptoms, including pain, paresthesia, pallor, weakness, feelings of fullness, and muscle atrophy. The clinical presentation of TOS can vary depending on which structures are compressed and to what extent. This variability makes TOS a challenging condition to diagnose and manage. The symptoms can be quite subtle in the early stages, making it possible for the condition to be overlooked or misdiagnosed as another musculoskeletal disorder (Rooks & Cowel, 2006; Manaster, 2016).

Arterial TOS, one of the subtypes, is primarily caused by anatomic defects that lead to compression of the subclavian or, less frequently, the axillary arteries. Interestingly, many patients with arterial TOS remain asymptomatic for a long period, only becoming aware of the condition when they develop signs of acute or chronic upper extremity ischemia. In some cases, arterial TOS may be accompanied by neurogenic symptoms, prompting an earlier presentation. However, the arterial symptoms might be subtle and are often missed, with a tendency to attribute the signs solely to neurogenic TOS (Raptis et al., 2016; Illig et al., 2013).

Neurogenic TOS, the most common form, results from compression of the brachial plexus. This compression can lead to a variety of neurological symptoms, such as upper extremity paresthesia, weakness, and discomfort. The involvement of the subclavian vasculature can also cause swelling and edema, further complicating the diagnosis. Given the overlap of symptoms with other conditions, it’s not uncommon for patients to undergo extensive evaluations before a definitive diagnosis of TOS is made (Thompson, 2021; Chang & Kim, 2021; Jeong et al., 2022).

The epidemiology of TOS is not thoroughly established, which may be attributed to the lack of universally accepted diagnostic criteria. The varied presentation and the overlap of symptoms with other conditions contribute to this ambiguity. Despite this, available data suggests that the incidence of TOS ranges from 3 to 80 cases per 1,000 people, indicating that it is relatively rare but not insignificant. Adolescents to middle-aged adults, particularly women aged 20 to 50, are the most affected demographic, although TOS can occur in individuals of any age.

The complexity of TOS and its varied presentations necessitate a comprehensive approach to treatment. One potential treatment option is anterior scalenectomy, a surgical procedure that involves the removal of the anterior scalene muscle to relieve the compression (Suzuki et al., 2023; Teijink et al., 2023). This approach is often considered in cases where conservative treatments have failed, and it has been shown to be effective in alleviating symptoms in many patients. The decision to proceed with a scalenectomy should be based on a thorough evaluation of the patient's symptoms, anatomy, and overall health.

In conclusion, thoracic outlet syndrome is a multifaceted condition that presents unique diagnostic and therapeutic challenges. Understanding the different forms of TOS, including arterial and neurogenic variants, is crucial for effective management. While scalenectomy anterior offers a promising surgical option for patients with severe or refractory symptoms, further research is needed to refine diagnostic criteria and optimize treatment strategies for individuals affected by this condition.

The decision to proceed with an anterior scalenectomy is often made after careful consideration of the patient's symptoms, response to conservative treatments, and imaging studies. Conservative treatments such as physical therapy, pain management, and posture correction are typically the first line of intervention. However, when these methods fail to provide relief or if there is a significant risk of vascular compromise, surgical intervention becomes a necessary option. Anterior scalenectomy has shown promising results in decompressing the neurovascular structures, thereby alleviating symptoms and improving patients' quality of life (Ammi et al., 2022).

Despite the potential benefits of scalenectomy anterior, the procedure is not without risks. Possible complications can include damage to the brachial plexus, subclavian vessels, or the development of postoperative scar tissue that could potentially lead to recurrence of symptoms. Therefore, it is crucial for patients to undergo a comprehensive evaluation by a specialist experienced in TOS management to determine the appropriateness of the surgery. Advanced imaging techniques such as magnetic resonance imaging (MRI) or computed tomography (CT) angiography can be beneficial in identifying the exact location and nature of the compression, aiding in surgical planning (Dave et al., 2024; Costa et al., 2023; Kappanayil, 2021).

Research into the long-term outcomes of anterior scalenectomy continues to evolve, with studies suggesting that many patients experience significant improvement in symptoms following surgery. However, the variability in patient responses highlights the need for a personalized approach to treatment. Factors such as the duration of symptoms, the severity of neurovascular compression, and the presence of other comorbidities should be considered when determining the best treatment plan. Ultimately, the goal is to provide effective symptom relief while minimizing the risk of complications, ensuring the best possible outcome for individuals suffering from thoracic outlet syndrome.

## Methods

A 38-year-old male presented to the orthopaedic department. He complained about weakness and numbness in her left arm that had been present for 15 years. The complaints had been aggravated over the last 3 years which was exacerbated by activities that required her to lift her arm. Physical examination showed positive adson manuver and wright test. There is also reduced light-touch sensitivity examination on the fourth and fifth fingers of the left hand, the ulnar aspect of the left hand, and the ulnar aspect of the left distal. In the supporting examination, blood sugar, liver function, kidney function were checked within normal limits. Radiologic examination of MRI Angiography found stenosis of the left subclavian vein along +- 6.8 cm (Fig,1). The patient had been doing physiotherapy for 1 year and there was no significant improvement from physiotherapy. Patient performed Anterior Scalenectomy surgery for thoracal outlet Syndrome (Fig 2.). 2 months postoperative evaluation, the patient no longer feels pain radiating to both hands in daily activities. The radiating pain is sometimes still felt but it is much better than before surgery. MRI angiography evaluation after 8 weeks from surgery no longer found stenosis in the left Subclavian vein. (Fig 3).

*ISSN 2721-1215 (Print), ISSN 2721-1231 (Online)*

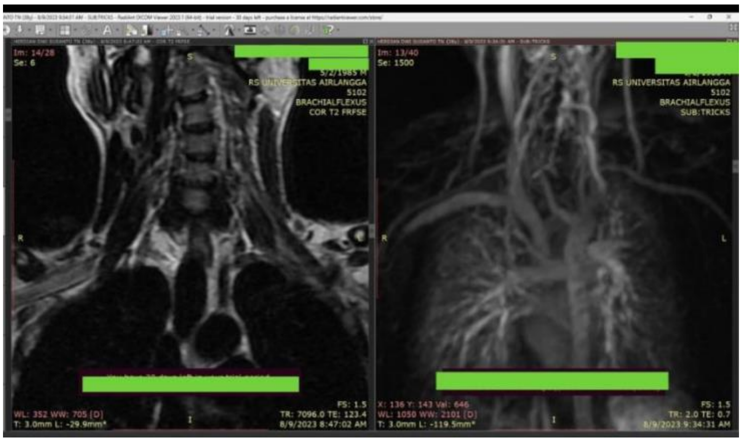


*Figure 1. MRI Angiography found stenosis of the left subclavian vein along +- 6.8 cm*

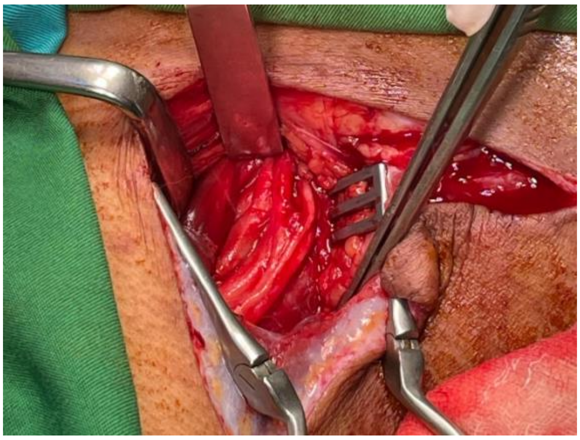

*Figure 2. Patient performed Anterior Scalenectomy surgery for thoracal outlet Syndrome*

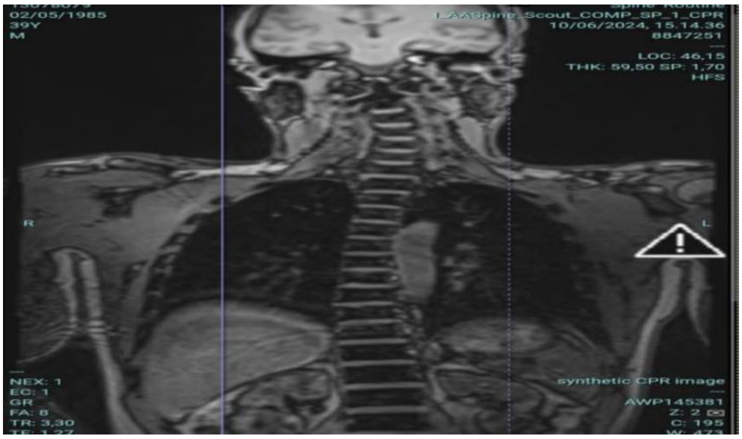


*Figure 3. MRI angiography evaluation after 8 weeks after surgery no longer found stenosis in the left Subclavian vein.*

## Result and Discussion

TOS is typically divided into three types: neurogenic TOS (nTOS), venous TOS (vTOS), and arterial TOS (aTOS), based on the etiology at presentation. TOS can be caused by inherited, acquired, or traumatic factors, however the majority of TOS cases involve some level of trauma (Dimova et al., 2022). Physical exam techniques, radiographic imaging, or vascular investigations can be used to confirm the diagnosis, which is based on both the patient's existing risk factors and clinical presentation.

TOS patients' symptomatology is mostly determined by the pathophysiological mechanism implicated in the illness4. patients with the arterial form of TOS may have chronic, non-

ISSN 2721-1215 (Print), ISSN 2721-1231 (Online)

radicular pain, numbness, and discomfort in the afflicted extremity, which increases with physical activity and improves with rest (Illig et al., 2016).However, there are no pathognomonic signs and symptoms of the arterial form. Physical examinations commonly reveal coldness and paleness of the limbs (Molina & D'Cunha, 2008). Paleness is more common in the upper limb, while skin changes occur in the distal limb. Ulcerations and evidence of microembolic episodes are rarely found. (Likes et al., 2014)

Patients with symptoms of TOS are frequently submitted to various additional procedures, such as magnetic resonance imaging (MRI), computed tomography (CT), electromyoneurography (EMNG), sensory and motor nerve conduction studies (NCS), and ultrasound (Chavhan et al., 2017). Imaging procedures are important for detecting vascular types of TOS, although they may yield normal results in patients with the neurogenic variety (Daniels et al., 2014). Imaging studies in diagnosing and managing TOS are very important[9].USG is the first imaging exam recommended for the evaluation of vascular types of TOS because it is easily accessible and noninvasive (Grunebach et al., 2015). Professionals can detect venous stenoses or occlusions with good sensitivity and specificity using a duplex scan (Likes et al., 2014). MRI Examination is preferred method for detecting bone, soft tissue, vascular, and nerve anomalies due to superior contrast and resolution (Daniels et al., 2014). Limb angio-MRI allows for good vessel imaging and can be an important diagnostic tool. Furthermore, MRI neurography can identify brachial plexus compression, which helps to diagnose the neurogenic variant of TOS (Daniels et al., 2014). According to (Chavhan et al., 2017) , CT can effectively show vascular structures near bones and muscles. Angio-CT and venography create high-quality, three-dimensional reconstruction pictures of the central vasculature and vessel extremities, making it easier to determine the vascular compression site and severity of the disorder.

Surgery is the the last treatment if conservative therapies fail to improve nTOS or if the patient presents with a vascular form of TOS that requires rapid decompression (Caputo et al., 2013; Hangge et al., 2017; Hempel et al., 1996; Hooper et al., 2010).There are various surgical options for TOS decompression. The two primary routes are through the axillary and supraclavicular areas. If the etiology of compression is hypertrophied scalene muscles or a cervical rib, then the supraclavicular decompression is used, which includes exploration of the supraclavicular brachial plexus, neurolysis, removal of fibrotic bands, scalenectomy, primary first rib resection, and overlooked cervical ribs (Terzis & Kokkalis, 2010). The reported complication rates for this surgery are relatively low, although the data are limited by the sample size and a lack of randomized control studies (Terzis & Kokkalis, 2010). If the location of compression is closer to the axilla, such as when the pectoralis minor connection to the coracoid process presses down on the branches of the brachial plexus, the transaxillary incision is recommended (Hangge et al., 2017). The transaxillary technique is also used to treat TOS patients who have compression of the first or cervical ribs [18]. in our case because the patient had already done physiotherapy treatment and did not get the expected results. The patient finally performed Anterior Scalenectomy surgery to overcome the problem. In this case, the evaluation of the patient's condition after surgery, the complaints felt such as radiating pain in both hands have improved.

## Conclusion

The most prevalent causes of TOS are congenital, traumatic, or functional. TOS is classified into three categories based on its clinical presentation: neurogenic (nTOS), venous (vTOS), and arterial (aTOS), with nTOS being the most frequent. Early detection of TOS in a patient with shoulder girdle and upper-extremity discomfort, with or without numbness, can aid in the treatment of the illness and/or prevent development and deteriorating severity. If additional diagnostic testing is required, such as an X-ray, ultrasound, MRI/MRA, or EMG, it may be used to further identify the area of compression and rule out other possible causes of symptoms.

In principle, the treatment for Thoracal Outlet Syndrome is conservative. However, if conservative treatment does not work well, operative treatment is needed.

## References


Ammi, M., Hersant, J., Henni, S., Daligault, M., Papon, X., Abraham, P., & Picquet, J. (2022). Evaluation of quality of life after surgical treatment of thoracic outlet syndrome. *Annals of Vascular Surgery*, *85*, 276-283. https://doi.org/10.1016/j.avsg.2022.03.012

Cantalamessa, A., Martin, S., Marchegiani, A., Fruganti, A., Dini, F., & Tambella, A. M. (2017). Bilateral cervical ribs in a mixed breed dog. *Journal of Veterinary Medical Science*, *79*(6), 1120-1124. https://doi.org/10.1292/jvms.16-0281

Caputo, F. J., Wittenberg, A. M., Vemuri, C., Driskill, M. R., Earley, J. A., Rastogi, R., Emery, V. B., & Thompson, R. W. (2013). Supraclavicular decompression for neurogenic thoracic outlet syndrome in adolescent and adult populations. *Journal of Vascular Surgery*, *57*(1), 149–157. https://doi.org/10.1016/j.jvs.2012.07.025

Chang, M. C., & Kim, D. H. (2021). Essentials of thoracic outlet syndrome: a narrative review. *World journal of clinical cases*, *9*(21), 5804.

Chavhan, G. B., Batmanabane, V., Muthusami, P., Towbin, A. J., & Borschel, G. H. (2017). MRI of thoracic outlet syndrome in children. *Pediatric Radiology*, *47*, 1222–1234.

Costa, G., Lanza, E., Donadon, M., & Torzilli, G. (2023). Ultrasound, computed tomography, magnetic resonance imaging, nuclear medicine, and angiography. *Liver, Gall Bladder, and Bile Ducts*, 49. https://doi.org/10.1093/med/9780192862457.003.0006

Daniels, B., Michaud, L., Sease Jr, F., Cassas, K. J., & Gray, B. H. (2014). Arterial thoracic outlet syndrome. *Current Sports Medicine Reports*, *13*(2), 75–80. https://doi.org/10.1249/JSR.0000000000000034

Dave, B., Maniar, P., Kaur, N., Delapena, S. A., & Behnam, A. B. (2024). The Role of Advanced Imaging in Facial Reconstructive Surgery. *J Surg Care*, *3*(3), 01-09.

Dimova, Z. R., Boyadzhieva, V., Emin, S., & Stoilov, N. (2022). Клиничен случай на пациент с Thoracic outlet syndrome. *Rheumatology (Bulgaria)*, *30*(4), 65–73. https://doi.org/10.35465/30.4.2022.pp65-73

Ghamari, N., Hosseini, S. A., Layeghi, F., Khankeh, H. R., & Lajvardi, L. (2016). A Review Study: Clinical Assessment of Patients With Thoracic Outlet Syndrome. *فیزیک درمانی- نشریه تخصصی فیزیوتراپی*, *5*(4), 189–196. https://doi.org/10.15412/J.PTJ.07050401

Grunebach, H., Arnold, M. W., & Lum, Y. W. (2015). Thoracic outlet syndrome. *Vascular Medicine*, *20*(5), 493–495.

Hangge, P., Rotellini-Coltvet, L., Deipolyi, A. R., Albadawi, H., & Oklu, R. (2017). Paget-Schroetter syndrome: treatment of venous thrombosis and outcomes. *Cardiovascular Diagnosis and Therapy*, *7*(Suppl 3), S285. https://doi.org/10.21037/cdt.2017.08.15

Hempel, G. K., Shutze, W. P., Anderson, J. F., & Bukhari, H. I. (1996). 770 consecutive supraclavicular first rib resections for thoracic outlet syndrome. *Annals of Vascular Surgery*, *10*, 456–463. https://doi.org/10.1007/BF02000592

Hooper, T. L., Denton, J., McGalliard, M. K., Brismée, J.-M., & Sizer Jr, P. S. (2010). Thoracic outlet syndrome: a controversial clinical condition. Part 2: non-surgical and surgical management. *Journal of Manual & Manipulative Therapy*, *18*(3), 132–138. https://doi.org/10.1179/106698110X12640740712338

Illig, K. A., Donahue, D., Duncan, A., Freischlag, J., Gelabert, H., Johansen, K., Jordan, S., Sanders, R., & Thompson, R. (2016). Reporting standards of the Society for Vascular Surgery for thoracic outlet syndrome. *Journal of Vascular Surgery*, *64*(3), e23–e35. https://doi.org/10.1016/j.jvs.2016.04.039

Illig, K. A., Thompson, R. W., Freischlag, J. A., Donahue, D. M., Jordan, S. E., & Edgelow, P. I. (Eds.). (2013). *Thoracic outlet syndrome* (Vol. 10, pp. 978-1). Springer London. https://doi.org/10.1007/978-3-030-55073-8

Jeong, Y. G., Jung, J. H., Kim, J. S., & Lee, H. J. (2022). True Neurogenic Thoracic Outlet Syndrome with Elongated C7 Transverse Processes in a Hemiplegic Patient: A Case Report. *Journal of the Korean Association EMG-Electrodiagnostic Medicine*, *24*(3), 104-108. https://doi.org/10.18214/jend.2022.00094

Kappanayil, M. (2021). Advanced Cardiac Imaging: Computed Tomography and Magnetic Resonance Imaging. *IAP Specialty Series on Pediatric Cardiology*, 117.

Kim, J.-Y., & Son, B. (2023). Paresthesia and Pain in Both Arms when Shampooing One's Hair: Symptoms of Neurogenic Thoracic Outlet Syndrome. *The Nerve*, *9*(1), 40–47. https://doi.org/10.21129/nerve.2022.00220

Likes, K., Rochlin, D. H., Call, D., & Freischlag, J. A. (2014). Coexistence of arterial compression in patients with neurogenic thoracic outlet syndrome. *JAMA Surgery*, *149*(12), 1240–1243. https://doi.org/10.1001/jamasurg.2014.280

Mackinnon, S. E., & Novak, C. B. (2002). Thoracic outlet syndrome. *Current Problems in Surgery*, *39*(11), 1070–1145. https://doi.org/10.1067/msg.2002.127926

Manaster, B. J. (2016). *Diagnostic Imaging: Musculoskeletal Non-Traumatic Disease E-Book: Diagnostic Imaging: Musculoskeletal Non-Traumatic Disease E-Book*. Elsevier Health Sciences.

Masocatto, N. O., Da-Matta, T., Prozzo, T. G., Couto, W. J., & Porfirio, G. (2019). Thoracic outlet syndrome: a narrative review. *Revista Do Colégio Brasileiro de Cirurgiões*, *46*, e20192243. https://doi.org/10.1590/0100-6991e-20192243

Molina, J. E., & D'Cunha, J. (2008). The vascular component in neurogenic-arterial thoracic outlet syndrome. *International Journal of Angiology*, *17*(02), 83–87. https://doi.org/10.1055/s-0031-1278286

Ohman, J. W., & Thompson, R. W. (2020). Thoracic outlet syndrome in the overhead athlete: diagnosis and treatment recommendations. *Current Reviews in Musculoskeletal Medicine*, *13*, 457–471. https://doi.org/10.1007/s12178-020-09643-x

Raptis, C. A., Sridhar, S., Thompson, R. W., Fowler, K. J., & Bhalla, S. (2016). Imaging of the patient with thoracic outlet syndrome. *Radiographics*, *36*(4), 984-1000. https://doi.org/10.1148/rg.2016150221

Rooks, Y. L., & Corwell, B. (2006). Common urgent musculoskeletal injuries in primary care. *Primary care: clinics in office practice*, *33*(3), 751-777. https://doi.org/10.1016/j.pop.2006.06.009

Suzuki, T., Kimura, H., Matsumura, N., & Iwamoto, T. (2023). Surgical approaches for thoracic outlet syndrome: a review of the literature. *Journal of Hand Surgery Global Online*, *5*(4), 577-584. https://doi.org/10.1016/j.jhsg.2022.04.007

Teijink, S. B., Goeteyn, J., Pesser, N., van Nuenen, B. F., Thompson, R. W., & Teijink, J. A. (2023). Surgical approaches for thoracic outlet decompression in the treatment of thoracic outlet syndrome. *Journal of Thoracic Disease*, *15*(12), 7088. https://doi.org/10.21037/jtd-23-546

Terzis, J. K., & Kokkalis, Z. T. (2010). Supraclavicular approach for thoracic outlet syndrome. *Hand*, *5*(3), 326–337. https://doi.org/10.1007/s11552-009-9253-0

Thompson, R. W. (2021). Diagnosis of neurogenic thoracic outlet syndrome: 2016 consensus guidelines and other strategies. *Thoracic outlet syndrome*, 67-97. https://doi.org/10.1007/978-3-030-55073-8_9

*ISSN 2721-1215 (Print), ISSN 2721-1231 (Online)*