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What Do the Results of Conservative Therapy Tell Us About the Need for Surgery: Lack of Improvement Means Surgery Is Indicated

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Abstract

Physical therapy forms the backbone of treatment in the long term management of neurogenic thoracic outlet syndrome. Physical therapy is, however, not a sole destination therapy unless surgical decompression is contraindicated by some other patient factor, with inability to fully correct the underlying anatomic compression of the brachial plexus.

Critical Take-Home Points

1. Physical therapy should be viewed as a necessary and valuable adjunct and not a definitive therapy in patients otherwise fit for surgery.
2. For many patients, surgical decompression offers better outcomes than physical therapy alone.
3. Physical therapy can mimic, but does not match, the decompression obtained with surgery.
4. Patients who do not benefit from physical therapy are still likely to benefit from surgical decompression.
5. "Last ditch" surgery leads to "last ditch" outcomes.

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37.1 Lack of Improvement Means Surgery Is Indicated

The underlying pathophysiology of neurogenic thoracic outlet syndrome has been addressed in previous chapters, but the core of the disease process combines predisposing variations in anatomy of the thoracic outlet with localized tissue response to injury and strain. The range of symptoms that develop involving the ipsilateral upper extremity and neck are in response to this underlying inflammatory process, and include localized tenderness over the supraclavicular and/or pectoralis minor spaces, radiation of numbness, tingling, and pain down the affected extremity, and pain in the head and neck due to compensatory muscle overuse.

The clinical diagnostic criteria for neurogenic thoracic outlet syndrome have been discussed elsewhere [1–3] but, the hallmark of initial treatment remains a trial of physical therapy and symptom management [3–5]. Not only does this form the basis of long term management of the disease, but is designed to accomplish several tasks: (1) relax the scalene muscles, (2) open the thoracic outlet, and (3) reverse compensatory muscle pattern usage. The decision for surgery is often based on clinical indicators, response to anterior scalene muscle block, and response to physical therapy. Controversy remains about who should be offered surgical decompression, and this has been driven by poor functional results

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over the long term in early studies, especially in patients with a poor response to pre-operative physical therapy [6, 7].

37.2 Rationale for Physical Therapy

The role and rationale for physical therapy in the initial treatment of neurogenic thoracic outlet syndrome is to reproduce what surgery does: decompression of the thoracic outlet. It is distinct from other forms of upper extremity physical therapy, which are most often focused around strengthening the shoulder girdle. The focus is on correcting posture and maladaptive muscle group usage, while allowing for targeted relaxation of the scalene muscles to relieve compression at the level of the brachial plexus.

The abnormal posture is commonly seen as anterior flexion of the head, a drooping of the shoulders with anterior displacement, and a rounded back with scapular displacement. In patients with this anatomy it is believed that there is a decrease in the costoclavicular space with subsequent brachial plexus compression and irritation. Similar impingement patterns can be seen in the costoclavicular space in overhead (>90°) motions, and in patients with scalene muscle hypertrophy.

In targeting the costoclavicular space for therapy, the aim is to enlarge the costoclavicular space to decompress the brachial plexus. In patients with abnormal posture, this entails correcting the maladaptive muscle behaviors. In all patients, the goal is relaxation of the scalene muscles and opening the costoclavicular space.

Unfortunately, neurogenic thoracic outlet syndrome is often a delayed diagnosis, with muscle spasm, compression and irritation of the brachial plexus often ongoing for years. In patients who have an otherwise strong clinical diagnosis of neurogenic thoracic outlet syndrome, alterations in muscle mechanics and function may drive a poor response to physical therapy if the shoulder girdle is approached in isolation [8]. In patients with injury to the muscle-tendon complex, through either direct trauma or repetitive injury, there is a noted stiffening of the tendon, and a greater Young's modulus [9]. In severe cases, this stiffness may be reflected in a palpable cord overlying the supraclavicular space during direct palpation. This alternation in muscle-tendon mechanics is less responsive to physical therapy.

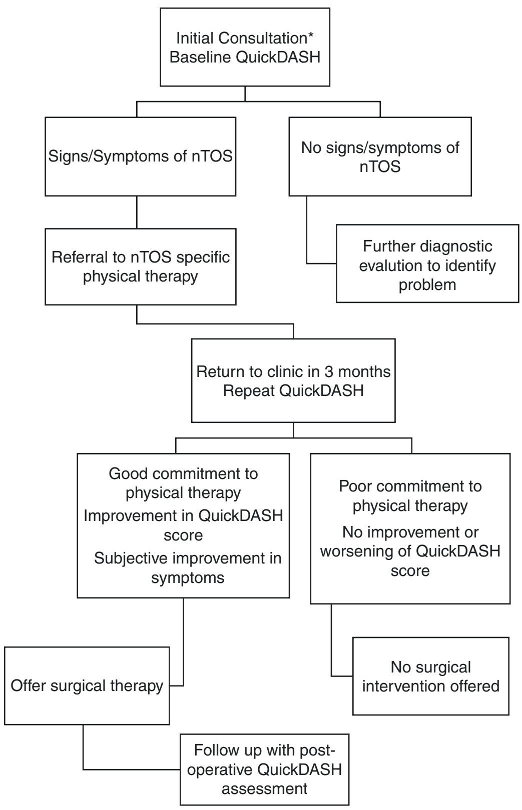
In other patients, the deposition of scar tissue along the brachial plexus may render attempts at decompression of the costoclavicular space futile, as the compression is ultimately at the epineural level, and muscle-focused decompression may fail to abate symptoms. Similar to physical therapy, these patients often fail to respond to a scalene muscle blocks.

37.3 Use of Response to Physical Therapy as a Clinical Decision

Selective protocols have been developed to standardize surgical intervention to maximize patient outcomes. One of these, the "Stanford Model", advocates surgical intervention for patients with demonstrated improvement in QuickDASH scores and duplex-demonstrated obliteration of the thoracic outlet, as shown via digital plethysmography [5]. In a recent paper this group compared a prospective group of patients treated with their highly selective algorithm to a retrospective review of all-comers prior to implementation of their protocol (Fig. 37.1). After implementation of their protocol, 41% of those evaluated for neurogenic thoracic outlet syndrome were offered surgery, with 36% electing for surgery.

Interestingly, there was no long-term follow-up provided on the 65% of patients that were diagnosed with neurogenic thoracic outlet syndrome and did not undergo surgical decompression, or the 5% of patients offered surgery who did not proceed with decompression. Most importantly, the demographics of those who underwent surgical decompression are known to have better outcomes compared to the average patient: it is well-established that the adolescent population has a better response to surgical decompression than the adult population [10], work injuries do poorly compared to recreational injuries [11], and length of symptoms is a surrogate marker for severity of disease.

In an attempt to fill this void, Balderman et al. evaluated 42 patients who demonstrated improvement in physical therapy and symptom management compared with 90 patients who underwent surgical decompression after unsuccessful physical therapy, in a prospective, observational cohort study (Fig. 37.2) [12]. The demographics in each group were more homogenous: no demographic differences were observed with regards to age, gender, duration of symptoms, previous injury, or standardized patient-reported outcome measures. Those in the surgical arm had a higher initial QuickDASH score (60.3 ± 2.1 vs. 52.9 ± 3.4), but after surgical decompression went on to have not only a larger improvement (decline) in QuickDASH score (−29.8 ± 2.4 vs. −15.6 ± 3.0, $p = 0.0008$) but also had lower overall scores at 12 month follow up (30.4 ± 2.3 vs. 37.2 ± 3.9, $p < 0.0001$) (Fig. 37.3). Thus, despite having a higher objective disability score, those who underwent surgery in a “less-selective” model benefited more from surgical decompression than physical therapy alone. By patient-rated outcomes measures, 64% reported their outcome as ‘Good’ or ‘Excellent’, 25% ‘Fair’, and only 11% ‘Poor’. This association correlated with a decreasing improvement in QuickDASH score (Fig. 37.4). The authors concluded that surgical decompression is superior to physical therapy alone.



*Initial consultation includes: history and physical exam, duplex ultrasound and occasionally other imaging studies such as MRI or CT. Duplex ultrasound is done with arterial plethysmography, which can document with provocative maneuvers the obliteration of waveforms suggestive of a narrowed thoracic outlet.

Fig. 37.1 Stanford model

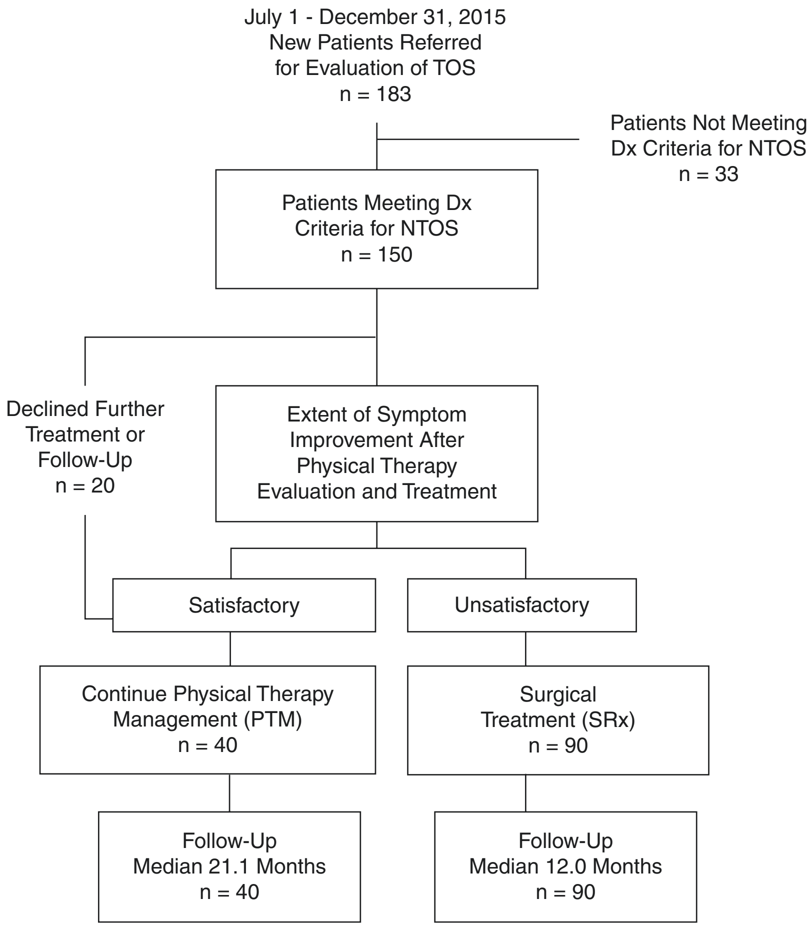


Fig. 37.2 Non-selective surgical decompression model

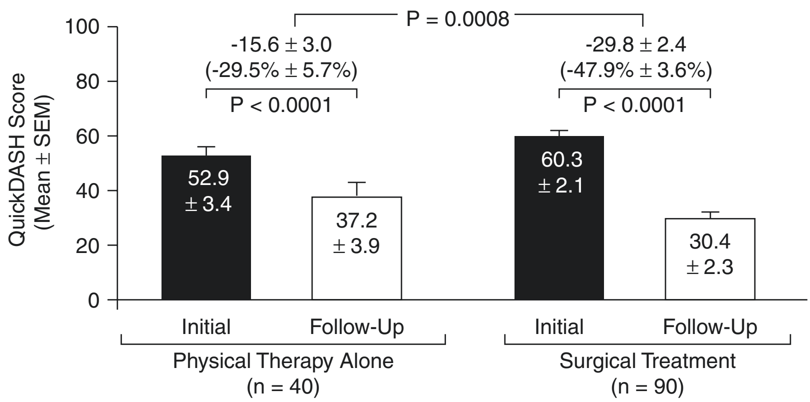


Fig. 37.3 QuickDASH scores before and after physical therapy management or surgical treatment for NTOS

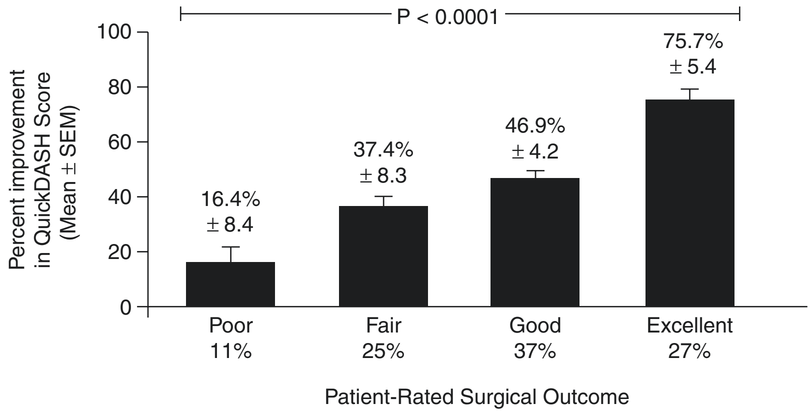


Fig. 37.4 Improvement in QuickDASH scores and patient-rated outcomes after surgical treatment for NTOS

37.4 Conclusion

Physical therapy alone has the potential to improve symptoms by correcting posture and other maladaptive compensatory muscle use, but does not have the ability to completely resolve symptoms in most patients. Patients with underlying muscle architectural changes that prevent adequate decompression of the costoclavicular space and/or chronic compression of the brachial plexus with scar formation are likely to respond poorly to physical therapy. These patients are likely to benefit from surgical decompression for correction of the underlying muscle dysfunction and any bony abnormalities underlying the anatomic distortion of the thoracic outlet.

Physical therapy forms the hallmark of treatment of neurogenic thoracic outlet syndrome in both the pre- and post-operative periods, and plays a critical role in maintaining improvements in symptom improvement after surgical decompression. However, evidence continues to argue against withholding surgical decompression from patients who do not demonstrate an improvement in physical therapy, which would consign them to continued disabling symptoms from compression at the thoracic outlet. In patients who have a strong clinical diagnosis of neurogenic thoracic outlet syndrome, a lack of response to physical therapy should not be used to justify avoiding surgical decompression.

References

1. V.B. Emery, R. Rastogi, M.R. Driskill, R.W. Thompson. Diagnosis of neurogenic thoracic outlet syndrome. M.K. Eskandari, M.D. Morasch, W.H. Pearce, J.S.T. Yao (Eds.), Vascular surgery: therapeutic strategies, People's Medical Publishing House-USA, Shelton, CT (2010), pp. 129–148.
2. Thompson RW. Development of consensus-based diagnostic criteria for NTOS. In: Illig KA, Thompson RW, Freischlag JA, Donahue DM, Jordan SE, Edgelow PI, editors. Thoracic outlet syndrome. London: Springer; 2013. p. 143–55.
3. Balderman JA, Holzem K, Field BJ, Bottros MM, Abuirqeba AA, Vemuri C, et al. Associations between clinical diagnostic criteria and pretreatment patient-reported outcomes measures in a prospective observational cohort of patients with neurogenic thoracic outlet syndrome. J Vasc Surg. 2017;66:533–44.
4. Mackinnon E, Novak CB. Thoracic outlet syndrome. Curr Probl Surg. 2002;39:1070–145.
5. Chandra V, Olcott C 4th, Lee JT. Early results of a highly selective algorithm for surgery on patients with neurogenic thoracic outlet syndrome. J Vasc Surg. 2011;54:1698–705.
6. Altobelli GG, Kudo T, Haas BT, Chandra FA, Moy JL, Ahn SS. Thoracic outlet syndrome: pattern of clinical success after operative decompression. J Vasc Surg. 2005;42:122–8.
7. Landry GJ, Moneta GL, Taylor LM, Edwards JM, Porter JM. Long-term functional outcome of neurogenic thoracic outlet syndrome in surgically and conservatively treated patients. J Vasc Surg. 2001;33:312–9.
8. Herbert R. The passive mechanical properties of muscle and their adaptations to altered patterns of use. Aust J Physiother. 1988;34:141–9.

9. Hrysomallis C, Goodman C. A review of resistance exercise and posture realignment. J Strength Cond Res. 2001;15:385–90.
10. Caputo FJ, Wittenberg AM, Vemuri C, Driskill MR, Earley JA, Rastogi R, et al. Supraclavicular decompression for neurogenic thoracic outlet syndrome in adolescent and adult populations. J Vasc Surg. 2013;57:149–57.
11. Goff CD, Parent FN, Sato DT, et al. A comparison of surgery for neurogenic thoracic outlet syndrome between laborers and nonlaborers. Am J Surg. 1998;176:215–8.
12. Balderman J, Abuirqeba AA, Eichaker L, Pate C, Earley JA, Bottros MM, et al. Physical therapy management, surgical treatment, and patient-reported outcomes measures in a prospective observational cohort of patients with neurogenic thoracic outlet syndrome. J Vasc Surg. 2019;70:832–41.