Thoracic Outlet Syndrome Part II: Consensus on the Management of Neurogenic Thoracic Outlet Syndrome by the European Association of Neurosurgical Societies' Section of Peripheral Nerve Surgery

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BACKGROUND: In the first part of this report, the European Association of Neurosurgical Societies' section of peripheral nerve surgery presented a systematic literature review and consensus statements on anatomy, classification, and diagnosis of thoracic outlet syndrome (TOS) along with a subclassification system of neurogenic TOS (nTOS). Because of the lack of level 1 evidence, especially regarding the management of nTOS, we now add a consensus statement on nTOS treatment among experienced neurosurgeons.

OBJECTIVE: To document consensus and controversy on nTOS management, with emphasis on timing and types of surgical and nonsurgical nTOS treatment, and to support patient counseling and clinical decision-making within the neurosurgical community.

METHODS: The literature available on PubMed/MEDLINE was systematically searched on February 13, 2021, and yielded 2853 results. Screening and classification of abstracts was performed. In an online meeting that was held on December 16, 2021, 14 recommendations on nTOS management were developed and refined in a group process according to the Delphi consensus method.

RESULTS: Five RCTs reported on management strategies in nTOS. Three prospective observational studies present outcomes after therapeutic interventions. Fourteen statements on nonsurgical nTOS treatment, timing, and type of surgical therapy were developed. Within our expert group, the agreement rate was high with a mean of 97.8% (± 0.04) for each statement, ranging between 86.7% and 100%.

CONCLUSION: Our work may help to improve clinical decision-making among the neurosurgical community and may guide nonspecialized or inexperienced neurosurgeons with initial patient management before patient referral to a specialized center.

KEY WORDS: Neurogenic thoracic outlet syndrome, Supraclavicular approach, Subscapular approach, Transaxillary approach, Neuroplasty, First rib resection

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Diagnostic classification and management of thoracic outlet syndrome (TOS) are a matter of debate and therefore vary among brachial plexus surgeons and across different disciplines. TOS is most frequently classified according to the compromised structure into arterial TOS (aTOS), venous TOS (vTOS), and neurogenic TOS (nTOS). Recently, we introduced a new nTOS subclassification (Table 1) together with a consensus statement regarding anatomy, classification, and diagnosis among neurosurgeons experienced in TOS treatment.[1] We now aim to present a systematic review on therapeutic aspects of nTOS with special focus on nonsurgical treatment, timing, and type of surgery to guide patient counseling and to support treatment decisions. Because of a lack in level 1 evidence, we present an expert consensus among experienced TOS neurosurgeons.

ABBREVIATIONS: aTOS, arterial TOS; **DASH,** disabilities of the arm, shoulder and hand; **EANS,** European Association of Neurosurgical Societies; **EMG,** electromyography; **nTOS,** neurogenic TOS; **NCS,** nerve conduction study; **SF-36,** 36-item short form survey for health related quality of life; **TOS,** thoracic outlet syndrome; **VAS,** visual analogue scale; **vTOS,** venous TOS.

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TABLE 1. Subclassification of Neurogenic Thoracic Outlet Syndrome

Type of nTOS	Weakness, hypo- and/or atrophy	Anatomic abnormality	Pain and sensory symptoms
nTOS 1	Yes	Yes/No	Yes/No
nTOS 2	No	Yes	Yes
nTOS 3	No	No	- Radicular (nTOS3a) - Cervicoscapular (nTOS3b) - Diffuse (nTOS3c)

nTOS, neurogenic thoracic outlet syndrome.
nTOS 1-3 is subclassified by the characteristics: presence of weakness, hypo- or atrophy, presence of anatomic abnormality, and distribution of pain and sensory symptoms. For patients without motor symptoms or anatomic abnormality, the distribution of pain and/or sensory symptoms can be classified as radicular, cervicoscapular, and diffuse as presented in our previous part I consensus.[1]

METHODS

We performed a literature as previously described.[1] A group discussion about the findings of the literature and a possible structure of recommendations was held in an online meeting of the European Association of Neurosurgical Societies (EANS) section of peripheral nerve surgery on December 16, 2021. Statements were developed and EANS section members who fulfilled the following inclusion criteria received the questionnaire: ">5 years of specialist practice after board certification; membership in the EANS peripheral nerve surgery section; TOS experience >30 cases"[1] (**Supplementary Material 1**, http://links.lww.com/NEU/D469). In the process, 15 experts with a total of 286 years (mean 19.1 years ±10.6, range 7 to 36 years) of postcertification experience in a total of 2835 TOS cases (mean 189 cases ± 204.0 range 30-700 cases per surgeon) participated (see Table 2 for individual TOS experience of participating neurosurgeons). 100% sent their response. The results are presented in % with mean, SD, and range. For all analyses, SPSS Statistics 23.0 (SPSS Inc., IBM Chicago) software program was used. Data are available upon reasonable request.

Body of Evidence

Five RCTs reported on management strategies in TOS (please also see Table 1 in TOS part I).[1-6] Three prospective observational studies present outcomes after therapeutic interventions (please also see Table 2 in TOS part I).[1,7-9] All studies are single-center studies. There were no high-quality data on recurrent TOS.

Consensus Statements

(I) Nonsurgical management is the first treatment option in nTOS 2 to 3 patients
(II) Nonsurgical management may include pain management, physiotherapy, kinesio taping, and botox or steroid injections
(III) Timing of surgical therapy for nTOS depends on the type of nTOS
(IV) nTOS 1 has an indication for urgent surgical therapy to prevent progressive loss of hand function
(V) Indication and timing of surgical treatment for patients with nTOS 2 and nTOS 3 may be challenging
(VI) Surgery may be offered to patients with nTOS 2 and nTOS 3a if conservative management fails, or if symptoms occur in a position dependent manner and after exclusion of copathologies by MRI of the cervical spine and electrophysiological examination
(VII) NTOS 3b and nTOS3c may be addressed by conservative treatment only. Very selected patients with repetitive consultations and pain origin in the interscalenic region may be given the option of surgical management. In such a rare situation, the potential risks and benefits of a potentially unsuccessful or ex juvantibus surgery may be shared responsibly with the patient
(VIII) An anterior supraclavicular approach may provide higher safety for neural elements of the thoracic outlet and may reduce the rate of peri-interventional pneumothoraces
(IX) Circumferential decompression of neurovascular structures with special respect to the three-dimensionality of the thoracic outlet may be necessary
(X) Optical magnification may be necessary
(XI) An anterior supraclavicular approach may provide a better surgical corridor and overview from a foraminal to retroclavicular level, to microsurgically decompress the brachial plexus from different potentially compromising structures (bone, soft tissue)
(XII) An anterior supraclavicular approach enables an intraoperative dynamic function test by elevating and abducting the affected extremity under direct view and palpation of the plexus
(XIII) Intraoperative electrophysiological monitoring may be necessary
(XIV) A posterior subscapular approach may also be considered for revision surgery

Nonsurgical Management (Statements I/II)

Although there is currently no international consensus on whether or even when surgery is indicated in nTOS, most surgeons would attempt conservative treatment in patients without severe neurological deficits. In our view, primary nonsurgical management is indicated in patients without signs of muscle weakness or atrophy (statement I). Numerous reports describe a variety of nonsurgical treatment options. Intermediate- to high-quality data are available for botulinum toxin and steroid injection, kinesio taping, and the effect of physiotherapy.[2,4,5,7] Botulinum toxin injection to the anterior and middle scalene muscles showed better visual analogue scale (VAS) scores compared with placebo 6 weeks after the intervention but no effect on secondary outcome measures such as paresthesia, disabilities of the arm shoulder and hand (DASH) scores, and 36-item short form SF-36 questionnaire results.[2] Kinesio taping compared with placebo taping revealed improved outcomes in terms of pain,

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TABLE 2. Experience of Participating Neurosurgeons in TOS and Agreements, Disagreements, and Refinements to the 14 Statements of the Questionnaire Part II

Surgeon	TOS type	Transaxillary approach in TOS	Years	Cases	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	nTOS, vTOS	No	7	30	a	a	a	a	a	a	a	a	a	a	a	a	a	a
2	nTOS	No	9	30	a	a	a	a	a	a	a	a	a	a	a	a	a	a
3	nTOS	No	32	70	a	a	a	a	a	a	**d**	a	a	a	a	a	a	a
4	nTOS	Yes	21	250	a	a	a	a	a	a	a	a	a	a	a	a	a	a
5	nTOS, vTOS	No	33	290	a	a	a	a	**r**	a	a	a	a	a	a	a	a	**d**
6	nTOS, aTOS	No	7	40	a	a	a	a	a	a	a	a	a	a	a	a	a	a
7	nTOS	No	7	30	**d**	a	a	a	a	a	a	a	a	a	a	a	a	a
8	nTOS	No, revision experience	27	300	a	a	a	a	a	a	**r**	a	a	a	a	a	**r**	**r**
9	nTOS, vTOS, aTOS	No	27	500	a	a	a	a	a	a	a	a	a	a	a	a	**r**	a
10	nTOS	Yes	11	300	a	a	a	a	a	**r**	a	a	a	**r**	**r**	a	a	**r**
11	nTOS	No	7	30	a	a	a	a	a	a	a	a	a	a	a	a	a	a
12	nTOS, vTOS, aTOS	No	25	30	a	a	a	a	a	a	a	a	**r**	a	a	a	a	**r**
13	nTOS, aTOS	No	20	200	a	a	a	a	a	a	a	a	a	a	a	a	a	a
14	nTOS	No	36	700	a	a	a	a	a	a	a	a	a	a	a	a	**r**	a
15	nTOS, vTOS	No	17	35	**r**	a	a	a	a	a	a	**r**	a	**r**	a	a	a	**d**
Agreement rate in %					91.3 %	100%	100%	100%	100%	100%	91.3 %	100%	100%	100%	100%	100%	100%	86.7%

a, agree; aTOS, arterial thoracic outlet syndrome; d, disagree; nTOS, neurogenic thoracic outlet syndrome; r, refine; TOS, thoracic outlet syndrome; vTOS, venous thoracic outlet syndrome. Refinements and disagreements are depicted in bold letters. A refinement was considered as a general agreement with the statement but with suggestions for further explanations.

Column 2 refers to the type of TOS treated by the individual surgeon. Column 3 refers to the experience of the individual surgeon performing the transaxillary approach in patients with TOS. "Years" refer to the number of years after certification as neurosurgeon and 'cases' refers to the number of TOS cases treated by the individual surgeon. Refinements (r) were suggested by the following surgeons with respect to individual statements: surgeon 5: statement (I)—in nTOS 2 (with clear anatomic problems), I go directly to surgery. nTOS 3 may well be addressed to a first attempt for a conservative approach; statement (IV)—I would say "no doubt it should go to surgery", but "urgently" is not needed; it can be a matter of weeks or of a couple of months without problems. Usually, the onset is in the wake of a long and undefined story, and I do not think that this time lag will change their destiny; statement (XIV)—a posterior subscapular approach is a heavy surgery. Consequences are far more annoying than symptoms of thoracic outlet. I must add that I do not find any major problem in a revision surgery of an already operated thoracic outlet patient; surgeon 8: (VII)—I think you share the decision of surgery with the patient in every case of TOS, regardless of the type of TOS; statement (X)—I believe that optical magnification should be mandatory so I would edit "may"; statement (XIII)—we should emphasize that direct nerve stimulation should always use and intraoperative neurophysiological monitoring may be applied in selected cases; statement (XIV)—I think we should specify that the posterior approach might be considered in revision surgery only for selected case (eg, after radiotherapy); surgeon 9: statement (XIII)—agree (may be necessary) but very seldom used in TOS surgery (always used in trauma and tumor cases); surgeon 10: statement (VI)—here, I personally will definitely have an experienced dynamic high resolution ultrasound in addition to magnetic resonance neurography statement (XI)—magnification is necessary, in my opinion "may" is too weak; statement (XIV)—in some patients, an infraclavicular/transaxillary extension may be necessary, especially in patients with large cervical or first ribs. Therefore, I would include it here as well; surgeon 12: statement (XI)—I believe it should be corrected, as there should or should not be circumferential decompression within the initial surgery,; statement (XIV)—could be changed to emphasize revision surgery, rather than the posterior approach and justify its use; surgeon 15: statement (I)—for nTOS 2 and 3a we prefer surgery; statement (VII) it is very rare to offer surgery to these patients; statement (X)—optical magnification is mandatory; statement (XIII)—we only use direct stimulation, not monitoring; statement (XIV)—has not been proven necessary.

paresthesia, and DASH.[5] A comparison between steroid injection and stretching exercise on the scalene revealed a significant VAS decrease in both groups with better outcomes in the injection group, defined as more than 50% VAS reduction.[4] Physical therapy led to satisfactory symptom improvement in 27% in a hierarchic observational treatment study.[7] Therefore, these various options can be offered to patients initially presenting with nTOS (statement II).

Indications and Timing of Surgical Treatment in nTOS (Statements III-VII)

Timing and indications for surgery in our view depend on the type of nTOS (Table 1, statement III). Urgent surgical management (days to a few weeks) should be advocated for patients who present with atrophy and/or weakness of intrinsic hand muscles (statement IV). In patients with nTOS with pain and sensory symptoms, initial conservative management is the primary treatment of choice, as 27% of patients with nTOS showed satisfactory improvement of symptoms after 6 weeks of physiotherapy alone.[7] However, surgical therapy can become crucial as the majority of patients undergoing conservative management suffer pain, discomfort, uncertainty, and disability resulting in functional, emotional, and financial impairment. If conservative management fails, surgery should be considered after exclusion of copathologies and if symptoms occur in a position dependent manner in nTOS 2 (an anatomic abnormality is in explanatory concordance with the symptoms) and nTOS 3a (no obvious anatomic abnormality but radicular symptoms; statements V and VI). It has to be taken into account that the discovery of abnormality may depend on the modality of diagnostics and may not be apparent until surgical exposure.

Although one prospective single-center study reported 75% of good to excellent outcomes after transaxillary rib resection in a cohort that may be retrospectively classified as nTOS 3b, our collective experience suggests that nTOS 3b and 3c deserve special attention in terms of indication for surgery.[3] Careful evaluation of possible differential diagnoses need to be considered (Table 3).[10-15] As patients with nTOS with cervicoscapular symptoms may benefit from local injections, potentially unnecessary surgery should be avoided, especially in light of potential complications[16] (statement VII). To date, no prospective studies on treatment outcomes in patients with nTOS with diffuse symptoms and without anatomic abnormality or weakness are available in the medical literature. Therefore, nTOS 3b and 3c should mainly be treated conservatively. In the rare case of persisting incapacitating symptoms and pain origin in the interscalenic regions (Tinel's sign, supraclavicular pressure, and benefit from local injection), surgery may be considered.[17,18] Patients should be informed on benefits and risks of surgical management and the prospect of symptom improvement rather than cure.

Types of Surgical Management (Statements VII-XIII)

The transaxillary approach is most frequently used among vascular surgeons to remove the first and/or cervical rib.[19-21] Some surgeons argue that transaxillary first rib resection is indicated in patients with lower root and vascular symptoms. However, perioperative risks include brachial plexus injury (1%-3%), venous injury (2%), pneumothorax (3%-26 %), Horner's syndrome, and damage to the thoracic duct.[16,22,23] Most neurosurgeons prefer the anterior supraclavicular approach as it provides a better view and the possibility to perform microsurgical dissection and mobilize plexus and vascular elements, gaining wider access to confined structures other than ribs (statement VIII); they also reckon that, in comparison with the transaxillary approach, the supraclavicular approach is more appropriate for treating multiple potential sites of compression at the brachial plexus, subclavian artery, or the subclavian vein. Such a microsurgical approach is expected to reduce tissue damage and bleeding that can potentially cause scarring and recurrence.[23] Upper- and lower-root symptoms can be treated by scalenotomy with section of fibrous bands, and resection of a cervical rib, if present, or a first rib, if deemed necessary (statement IX-XIII). Perioperative risks of first rib resection are higher and include neuropathic pain, phrenic nerve injury (3%-6%), pneumothorax (1%-2%), chylothorax (1%-2%), and vascular injury (1%-2%).[22,23] The classic posterior subscapular approach, as described

TABLE 3. Characteristics and Modalities for Differential Diagnosis of Neurogenic Thoracic Outlet Syndrome 3b and c

Differential diagnosis	Characteristics and modalities for differentiation
Cervical radiculopathy	Pain or sensory symptoms radiating in the distribution of a spinal nerve, muscular weakness or loss of reflexes in specific muscles innervated by the respective cervical radix modality: MRI of the cervical spine, EMG[15]
Dorsal scapular neuropathy	Mid-scapular, upper to mid-back, and costovertebral pain; sometimes even radiating to the C5/C6 dermatome, dysesthesia in the mid-scapular region, weakness of the rhomboids causing lateral scapular winging, sometimes also of levator scapulae muscle modality: EMG and NCS[10]
Suprascapular neuropathy	Shoulder pain, atrophy of supraspinatus and infraspinatus muscle, weakness in arm abduction and external shoulder rotation Modality: clinical examination, electromyography, MRI that shows fatty atrophy of infraspinatus and supraspinatus muscle and/or ganglion cysts, MRI neurography[11]
Scapular dyskinesis	Alteration of scapular motion because of various reasons also resulting in pain (labral injury, impingement, rotator cuff injury, acromioclavicular joint fractures, clavicle fractures, "nerval injury") Modality: MRI arthrogram, x-ray, EMG, NCS[12]
Plexus neuropathy/neuralgic amyotrophy	Classic symptoms in terms of acute onset of pain over 2-3 weeks that do not respond to usual analgesic treatment, then onset of paresis Modality: classic clinical symptoms[13]
Fibromyalgia	Chronic pain in more than one region of the body, sleep disturbance, exhaustion, pressure pain in 11 of 18 specific points of pressure, exclusion of a somatic origin that explains the symptoms Modality: questionnaire for symptoms of fibromyalgia[14]

EMG, electromyography; NCS, nerve conduction study.

by Kline and Dubuisson, is associated with increased access morbidity due to the transection and the reattachment of periscapular medial muscle layers to the costotransverse bone layer.[24,25] This approach has been viewed as a reserve approach for recurrent scarred TOS and tumor cases. A more recent modification offers a less-traumatic access with decreased morbidity.[26] The posterior subscapular approach may be indicated as a last resort only in very selected cases if a prior anterior or transaxillary access did not reach satisfactory results.[15] The classic posterior approach is more invasive, as the levator scapulae, and the rhomboid minor and major muscles are dissected at the edge of the scapula, which may cause damage to neighboring structures in that area. However, the proximal nerve roots may be better visualized than with other approaches. Complications include injury of long thoracic, dorsal scapular, or spinal accessory nerves during extensive muscle dissection, with a 5% prevalence of scapular winging.[13,16]

The assessment above is explanatory rather than evidence-based. Intermediate- to high-quality data on surgical therapy include one RCT comparing transaxillary rib resection to supraclavicular "neuroplasty" without rib resection in a subgroup of patients with nTOS without weakness or anatomic abnormality but with tenderness in the supraclavicular fossa.[3] The authors describe superior results for transaxillary rib resection. Another RCT found no effect of reduction mammoplasty on electrophysiological outcomes.[6] The results of 2 observational studies on hierarchic nTOS interventions (with an initial physiotherapeutic attempt) report 89% fair to excellent outcomes in patients undergoing supraclavicular decompression,[7] and 90 % symptomatic improvement after supraclavicular decompression with rib resection, combined with middle and anterior scalenotomy.[7,8] A nonhierarchic observational trial showed significant differences in preoperative and postoperative status after transaxillary rib resection between patients with nTOS and patients with vTOS.[9] Patients with nTOS had worse baseline SF-12 scores, less improvement after surgery, and a lower percentage of return to work than patients with vTOS.[9] This shows that surgical treatment via the supraclavicular route in patients with nTOS may be successful in hierarchic setups with exclusion of patients benefiting from physiotherapy. However, it suggests that treatment of patients with nTOS may be more challenging compared with patients with vTOS as individual baselines are worse and the benefit of surgery is less pronounced. Moreover, the study by Chang et al[9] supports the hypothesis that the transaxillary route may not be the adequate standard approach for patients with nTOS. A large retrospective analysis of outcomes of 668 primary operations on 491 patients with up to 15 years of follow-up showed similar results with lower complication rates in patients undergoing the supraclavicular approach, with or without rib resection, compared with the transaxillary route.[23] To date, the question whether routine resection of the first rib is indicated may not be answered based on currently available evidence. However, 3T MR neurography and high-resolution nerve ultrasound were shown to improve visualization of potentially compressing structures to a degree that may help therapists devise approach strategies other than transaxillary.[27-30] However, in our view, "prophylactic surgery" for patients with anatomic abnormality but without symptoms is unnecessary.

Recurrent nTOS (Statement XIV)

In our literature search that focused on intermediate- to high-quality data, no reports specifically on recurrent nTOS were identified. Recurrence of symptoms after a previously successful transaxillary rib resection or scalenectomy is reported in 15% to 20% of cases in retrospective series.[31,32] Reoperation may be challenging in terms of scarring and may justify a different approach (statement XIV).[25]

Epilogue and Limitations

We found a general lack in high-quality multicenter data on nTOS treatment, especially regarding specific surgical techniques and standardized outcome measures. Moreover, the existing studies do not exclusively focus on nTOS. To date, only lower-quality studies were published on nTOS management, which complicates clinical decision-making, especially among nonspecialized or inexperienced neurosurgeons. Within our expert group, the agreement rate was high, with a mean of 97.8% (±0.04) for each statement, ranging between 86.7% and 100%. Statement XIV had the lowest agreement rate (Table 2). Refinements mainly addressed the use of stronger wording, which was not implemented in most cases because of the limitations of our work, as discussed previously.[1] Our work is limited as it may not represent a classic guideline, and as interdisciplinarity and level-1 evidence are lacking. Treatment strategies across disciplines may vary, which may diminish the generalizability of our work. Within our expert group, most surgeons do not routinely use the transaxillary approach in nTOS surgery, which may comprise a certain bias for statement VIII. The usability of our previously suggested nTOS subclassification warrants further verification in future prospective studies. A combination of radicular (nTOS 3a) and cervicoscapular (nTOS 3b) symptoms may be present in some patients. Further work is needed to explore the optimal order and hierarchy for nonsurgical management.

CONCLUSION

We provide an overview on current intermediate- to high-quality evidence on indication, timing, and type of surgical intervention in patients with nTOS. Moreover, we present an interpretation of the available literature and consensus statements based on the judgment of experienced TOS neurosurgeons. Attempts to harmonize reports on classification, diagnosis, treatment, and outcomes in patients with nTOS are necessary as well as future multicenter prospective studies on nTOS. Our work aims to help to improve clinical decision-making within the neurosurgical community and may guide nonspecialized or inexperienced neurosurgeons in initial patient management before patients are referred to a specialized center.

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Supplementary Material 1. Questionnaire on nTOS treatment sent to the expert group.

COMMENTS

The authors in this review article provide a consensus guideline for management of neurogenic thoracic outlet syndrome (nTOS). They first classify nTOS into 3 major categories and provide the best treatment option for each, whether medical or surgical.

TOS is a difficult diagnosis because there is no one good study that would diagnose it for sure. Clinical judgment is crucial in analyzing symptoms, signs, and ancillary studies, including imaging and electrophysiology. The separation into neurogenic and vascular is too artificial because the artery and nerves pass together in that tight space. Most patients have a component of both, although one may dominate the clinical picture. Physical therapy may help initially but is not definitive treatment. Most patients would benefit from anterior scalenectomy alone without the need or risk or resecting the first rib.

This clinical review provides clinicians, both general and inexperienced neurosurgeons, an algorithm for managing TOS. This was done by an international expert panel of neurosurgeons who treat this entity.

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This consensus statement from the EANS section on peripheral nerve surgery provides helpful guidelines for the management of neurogenic thoracic outlet syndrome (TOS), building on their previous report describing the diagnosis and classification of TOS overall. As the authors concede, the absence of high-quality, multicenter studies on this topic invariably limits the utility of these guidelines in clinical practice, and further prospective work is required to validate the subdivisions put forth in part I. In our experience, not all patients fit within these categories. For instance, many patients present with both radicular (type 3a) and cervicoscapular (type 3b) pain and sensory symptoms, in which case these guidelines become challenging to apply. As in other areas of medicine, the management plan for TOS must be tailored to the individual patient, and the surgeon must carefully exercise his or her judgment based on the

patient's age, history, comorbidities, symptomatology, examination findings, prior interventions, psychological condition, and potential issues of secondary gain, especially for type 3 patients who repeatedly request surgery. Nevertheless, these recommendations reflect the collective wisdom of several experienced surgeons, offering a framework for new practitioners and underscoring the dire need for more rigorous, prospective evidence in this domain.

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Neurogenic thoracic outlet syndrome (nTOS) should be considered as a discrete entity from the management standpoint. The consensus statements presented in this article represent the distilled wisdom of the experts in the EANS section of peripheral nerve surgery with an aggregate experience of managing 2835 nTOS cases. This is a follow-up paper to the systematic review and consensus statements published by the EANS section in an earlier issue of *Neurosurgery.*

In the absence of level 1 evidence or good guidelines for the management of nTOS cases, the effort of the authors in bringing out this consensus are greatly appreciated. The high agreement rate of 97.8% signifies the validity of these statements.

We also recommend considering urgent surgery prima facie only for those cases with motor deficits (nTOS 1). In all other cases, it is prudent to consider a trial of physical and symptomatic measures. If the symptoms are refractory to nonsurgical measures, the potential risks of the surgical procedure should be discussed in detail with the patient and weighed against the severity of symptoms and the possibility of benefit from the surgery. In patients with no motor deficits, no demonstrable compression site, and vague sensory symptoms, especially if it is not positional, one should strongly consider the possibility of other diagnoses.

The supraclavicular approach for brachial plexus exploration is preferred by us in most cases as it provides good exposure to possible compression sites with the least risk of major complications. A first rib resection is not required for most cases.

More high-quality multicenter randomized and prospective studies focused on the management of nTOS will help us formulate evidence-based guidelines for the management of these cases in the future. Until then, the consensus statements formulated by these experts will guide the neurosurgical community well.

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