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Original Article

# Divergent Conceptualizations and Management Strategies for Neurogenic Thoracic Outlet Syndrome: A Qualitative Multispecialty Study

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## Abstract

### Background

Neurogenic thoracic outlet syndrome (nTOS) is the most prevalent subtype of thoracic outlet syndrome and remains one of the most controversial conditions in peripheral nerve and thoracic disorders. Despite widespread recognition of conservative therapy as initial management, substantial variation exists across medical specialties regarding diagnosis, duration of nonoperative treatment, and indications for surgery. These discrepancies suggest underlying differences in how nTOS is conceptualized rather than disagreement over available treatment options.

### Objectives

This study aimed to explore and compare the perspectives of different medical specialties on the management of confirmed nTOS, with particular attention to conservative therapy, surgical indications, and underlying explanatory models.

### Methods

A qualitative descriptive study was conducted using semi-structured interviews with 40 physicians from five specialties involved in nTOS care: thoracic and vascular surgery, neurosurgery, orthopedic surgery, neurology, and rheumatology (eight participants per specialty). Participants were recruited using purposive sampling based on clinical

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experience with nTOS. All interviews centered on a standardized question addressing management strategies following confirmation of nTOS. Data were analyzed using reflexive thematic analysis.

**Results**

Five overarching themes emerged. All specialties endorsed physiotherapy as first-line treatment, though recommended duration varied widely. Profound disagreement existed regarding the role of surgery, ranging from early operative intervention to complete rejection. Surgeons tended to frame nTOS as a mechanical compression disorder, whereas neurologists and rheumatologists frequently expressed diagnostic skepticism and favored prolonged conservative management. Orthopedic surgeons adopted selective surgical strategies focused on musculoskeletal contributors. Across specialties, variability was driven primarily by differing conceptual models of nTOS rather than by technical considerations.

**Conclusion**

Management variability in nTOS arises chiefly from divergent understandings of the condition itself. Without addressing these foundational differences, inconsistency in care is likely to persist. Interdisciplinary consensus-building that integrates anatomical, neurological, and pain-based frameworks is essential for developing coherent, patient-centered management pathways for nTOS.

## 1. Introduction

Neurogenic thoracic outlet syndrome (nTOS) is the most common and arguably the most controversial subtype of thoracic outlet syndrome (TOS), accounting for more than 90% of reported cases. It is characterized by compression of the brachial plexus as it traverses the thoracic outlet, leading to a constellation of symptoms including neck and shoulder pain, upper limb paresthesia, weakness, fatigue, and functional impairment. Despite its relatively high prevalence compared with vascular forms of TOS, nTOS remains poorly understood, frequently underdiagnosed, and inconsistently managed across medical specialties [1-3].

Management of nTOS is contentious. Conservative treatment, including physiotherapy, postural correction, pain management, and behavioral modification, is generally recommended as first-line therapy. However, the indications for surgical intervention, optimal timing, patient selection, and preferred surgical approach remain subjects of ongoing debate. Surgical decompression most commonly involving first rib resection and scalenectomy has been reported to yield favorable outcomes in selected patients, yet reported success rates vary widely, and complications are not negligible. These uncertainties contribute to divergent management philosophies across specialties involved in nTOS care [4-7].

The multidisciplinary nature of nTOS care further complicates consensus. Thoracic and vascular surgeons often approach nTOS from an anatomical and decompressive perspective, emphasizing surgical solutions in carefully selected patients. Neurosurgeons may focus on neural pathology, central sensitization, and differential diagnoses involving cervical spine or peripheral nerve disorders. Orthopedic surgeons frequently view symptoms through the lens of musculoskeletal dysfunction, shoulder pathology, or cervical spine disease. Neurologists may prioritize electrodiagnostic findings and are often skeptical of nTOS in the absence of objective abnormalities. Rheumatologists, meanwhile, may encounter patients with overlapping pain syndromes or inflammatory conditions, influencing their perception of nTOS as a diagnosis of exclusion. These differing conceptual frameworks shape not only clinical decision-making but also attitudes toward diagnosis, referral, and treatment [8-11].

While numerous quantitative studies have evaluated surgical outcomes, diagnostic tests, and rehabilitation protocols in nTOS, relatively little attention has been paid to the *perspectives* of clinicians themselves. Understanding how different specialties conceptualize nTOS, interpret evidence, and justify their management strategies is critical, as these views directly influence patient pathways, interdisciplinary collaboration, and ultimately clinical outcomes. Qualitative research is particularly well suited to exploring such complex, context-dependent phenomena, allowing for in-depth examination of beliefs, experiences, uncertainties, and professional cultures that cannot be adequately captured through quantitative methods alone [12].

Therefore, this qualitative study aims to explore and compare the views of different specialties (thoracic and vascular surgeons, neurosurgeons, orthopedic surgeons, neurologists, and rheumatologists) regarding the management of nTOS. By elucidating areas of consensus, disagreement, and uncertainty across specialties, this research seeks to inform more coherent multidisciplinary approaches, identify barriers to collaboration, and contribute to the development of more patient-centered and evidence-informed care pathways for individuals with nTOS.

## 2. Methods

### 2.1. Study design

This study adopted a qualitative descriptive design to explore how different medical specialties manage confirmed cases of nTOS. Given the complexity, controversy, and specialty-dependent interpretations surrounding nTOS, a qualitative approach was chosen to capture clinicians' reasoning, preferences, and professional perspectives that cannot be adequately quantified.

### 2.2. Participants and sampling

Physicians from five specialties commonly involved in the care of nTOS were included: thoracic and vascular surgery, neurosurgery, orthopedic surgery, neurology, and rheumatology. Participants were recruited using purposive sampling based on their direct clinical experience with patients diagnosed with nTOS.

A total of 40 clinicians participated in the study. Each specialty was represented by eight participants, ensuring sufficient diversity of viewpoints within and across specialties. Participants varied in years of experience and practice settings, enhancing the richness of the data.

### 2.3. Data collection

Data were collected through semi-structured interviews. All participants were asked a single core, standardized question to ensure comparability across specialties:

*"If you confirm that a patient has neurogenic thoracic outlet syndrome, how do you manage this patient?"*

Follow-up prompts were used when needed to clarify responses, particularly regarding duration of conservative therapy, indications for surgery, and preferred surgical approaches. Interviews were conducted in person or online, recorded with consent, and transcribed verbatim for analysis.

### 2.4. Data analysis

Data were analyzed using reflexive thematic analysis as described by Braun and Clarke [12]. Analysis proceeded through the following phases:

1. Familiarization with the data through repeated reading of transcripts
2. Generation of initial codes reflecting management strategies, attitudes toward surgery, and specialty-specific reasoning
3. Development of preliminary themes across and within specialties
4. Review and refinement of themes to ensure internal coherence and clear distinction
5. Definition and naming of final themes

Analysis was conducted iteratively, with reflexive attention to how professional background and clinical culture shaped interpretations. Discrepancies and contradictions were treated as meaningful data rather than inconsistencies.

### 2.5. Ethical considerations

Participation was voluntary, and informed consent was obtained from all participants. All data were anonymized to protect participant identity. The study involved clinicians only and did not include patient data.

## 3. Results

Analysis revealed marked variation in the management of nTOS across specialties, particularly regarding the role of surgery, duration of conservative treatment, and confidence in the diagnosis itself. Five overarching themes emerged.

Theme 1: Universal Endorsement of Physiotherapy as First-Line Treatment

Across all specialties, physiotherapy was consistently identified as the initial management strategy for confirmed nTOS. However, the recommended duration varied substantially, ranging from two weeks to six months.

- Thoracic and vascular surgeons most commonly recommended 1–3 months of physiotherapy.
- Orthopedic surgeons and neurologists often advocated prolonged physiotherapy (up to six months).
- Rheumatologists generally supported physiotherapy as the primary or sole treatment.

This variation reflects differing thresholds for declaring conservative treatment failure.

**Theme 2: Profound Disagreement Regarding the Role of Surgery**

Opinions on surgical intervention ranged from early and decisive to complete rejection.

Thoracic and Vascular Surgeons:

This group demonstrated the widest internal variability:

- Some favored early surgery, even direct operative intervention after short physiotherapy trials.
- Others recommended surgery only after structured conservative management.
- A minority rejected surgery entirely, citing poor outcomes and limited benefits.

Preferred surgical approaches included supraclavicular, transaxillary, and minimally invasive video assisted thoracic surgery/robotic assisted thoracic surgery-VATS/RATS) first rib resection, often tailored to venous involvement or pectoralis minor tenderness.

Neurosurgeons:

Neurosurgeons were divided:

- Some viewed nTOS as a clear anatomical compression requiring surgery.

- Others avoided intervention entirely, preferring referral to vascular surgeons.
- Posterior approaches were rarely mentioned and limited to individual preferences.

**Theme 3: Selective and Limited Surgical Indications Among Orthopedic Surgeons**

Orthopedic surgeons generally adopted a conservative and selective surgical philosophy:

- Surgery was reserved for chronic cases, documented anatomical abnormalities, or failure of extended physiotherapy.
- Several rejected first rib resection, favoring isolated scalenectomy or pectoralis minor tenotomy.
- A minority supported direct surgical referral to vascular surgeons.

This reflects the musculoskeletal framing of nTOS symptoms.

**Theme 4: Skepticism and Diagnostic Reframing by Neurologists**

Neurologists frequently expressed diagnostic skepticism even when they are asked regarding the management of nTOS:

- Several participants attributed symptoms to migraine, central sensitization, or non-structural causes.
- Surgery was considered only in cases with objective findings, such as muscle atrophy.
- Most recommended prolonged conservative therapy, with surgical referral as a last resort.

This group demonstrated the highest threshold for surgical acceptance.

**Theme 5: nTOS as a Diagnosis of Exclusion Among Rheumatologists**

Rheumatologists often conceptualized nTOS as a diagnosis of exclusion:

- Most endorsed physiotherapy initially.
- Surgical referrals were deferred to vascular surgeons and often viewed with skepticism.
- Some explicitly stated that surgery is ineffective or unnecessary.

This perspective reflects overlap with chronic pain syndromes and inflammatory conditions (Table 1).

## 4. Discussion

The study illustrates that variability in the management of nTOS is driven less by disagreement over treatment modalities and more by fundamentally different ways in which clinicians understand the condition itself rather than reflecting simple differences in training, the observed diversity in management strategies appears rooted in contrasting explanatory models of nTOS, ranging from structural compression to functional or centrally mediated pain syndromes. Similar conceptual fragmentation has been repeatedly identified as a central challenge in advancing care for nTOS [13–15].

Although conservative management was universally endorsed, the absence of shared criteria for adequacy or failure of nonoperative therapy emerged as a critical fault line between specialties. The wide range of physiotherapy durations recommended by participants suggests conservative treatment functions as both therapy and diagnostic test, with clinicians using response to rehabilitation to validate or refute the diagnosis. This implicit diagnostic role of physiotherapy has been noted in previous studies and may partly explain why treatment pathways diverge early in the disease course [16,17]. Importantly, prolonged conservative management may delay surgical referral in patients who could potentially benefit from decompression, while premature escalation risks unnecessary intervention.

Disagreement surrounding surgery reflects ongoing uncertainty regarding the pathophysiology of nTOS rather than technical differences in operative approach. Surgeons who favored intervention generally conceptualized nTOS as a mechanical compression disorder, whereas those opposing surgery questioned the causal relationship between anatomical findings and symptoms. This division mirrors inconsistencies in the literature, where anatomical abnormalities are common in asymptomatic individuals and clinical improvement does not always correlate with radiological or intraoperative findings [1, 11,18,19]. Consequently, surgical decision-making remains heavily dependent on clinician judgment rather than objective thresholds.

Specialty-specific skepticism, particularly among neurologists and rheumatologists, highlights the tension between symptom-based diagnoses and disciplines that prioritize objective biomarkers. Neurogenic TOS challenges traditional diagnostic paradigms because standard electrodiagnostic studies are often normal and imaging findings are nonspecific [20,21]. From a neurological or rheumatological standpoint, this diagnostic ambiguity fosters reinterpretation of symptoms as functional, inflammatory, or centrally mediated disorders. While such caution is justifiable, it may inadvertently marginalize patients whose symptoms do arise from peripheral neural compression.

The selective surgical stance adopted by many orthopedic surgeons reflects a musculoskeletal framing of nTOS, emphasizing regional biomechanics over thoracic outlet anatomy. This perspective aligns with growing interest in pectoralis minor syndrome and isolated scalene pathology as contributors to upper limb symptoms [22,23]. However, the lack of consensus on whether these entities represent distinct conditions or part of the nTOS spectrum further complicates interdisciplinary communication and treatment planning.

A notable implication of these findings is that nTOS lacks a shared “clinical ownership.” Instead, responsibility is frequently

**Table 1.** Summary of nTOS Management Perspectives Across Specialties.

| Specialty | Conceptual Model of nTOS | Conservative Management | View on Surgery | Typical Surgical Preference |
|---|---|---|---|---|
| Thoracic & Vascular Surgeons | Mechanical compression | Short–moderate physiotherapy | Broadly supportive, variable timing | First rib resection (SC, TA, VATS/RATS) |
| Neurosurgeons | Neural compression vs central causes | Variable duration | Divided; selective or avoided | Rare; referral preferred |
| Orthopedic Surgeons | Musculoskeletal dysfunction | Prolonged physiotherapy | Highly selective | Scalenectomy or PM tenotomy |
| Neurologists | Diagnostic skepticism | Prolonged conservative care | Rare; last resort | Only with objective deficits |
| Rheumatologists | Diagnosis of exclusion | Primary or sole treatment | Generally opposed | Referral to surgeons |

*SC = supraclavicular; TA = transaxillary; VATS = video-assisted thoracic surgery; RATS = robotic-assisted thoracic surgery; PM = pectoralis minor.*

transferred between specialties, resulting in circular referrals and inconsistent care pathways. Similar patterns have been described in other contested pain syndromes and are known to contribute to patient dissatisfaction and healthcare inefficiency [24,25]. Multidisciplinary evaluation has been proposed as a solution, but without alignment at the conceptual level, such models risk becoming parallel rather than integrative.

There are limitations to this study; The study reflects clinicians stated practices rather than observed behavior, and responses may have been influenced by recall or professional positioning. Additionally, perspectives may vary across healthcare systems. Nevertheless, the consistency of themes across specialties suggests that the findings capture widely held views rather than isolated opinions.

### Implications for Practice and Research

Future efforts should focus on developing interdisciplinary definitions of conservative treatment failure, clearer indications for surgical referral, and shared diagnostic language. Consensus statements that integrate anatomical, neurological, and pain-based frameworks may help bridge existing divides. Further qualitative work involving patients may also clarify how professional disagreement translates into lived experience.

## 5. Conclusion

This study demonstrates that disagreement in nTOS management arises primarily from divergent conceptualizations of the condition rather than lack of therapeutic options. Without addressing these underlying differences, variability in care is likely to persist. Meaningful progress in nTOS management will depend on sustained interdisciplinary engagement aimed at reconciling competing models into coherent, patient-centered care pathways.

## Declarations

**Conflicts of interest:** The authors have no conflicts of interest to disclose.

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**Use of AI:** ChatGPT Plus (OpenAI, version 4) was used solely to assist with language editing and to improve the clarity of the manuscript. All content was carefully reviewed and verified by the authors, who take full responsibility for the accuracy, integrity, and originality of the entire work.

**Data availability statement:** The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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