

Neurogenic Thoracic Outlet Syndrome Secondary to Combined Congenital Rib Synostosis and Sternoclavicular Subluxation: First Reported Case

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Abstract

We report the first documented case combining congenital first-second rib synostosis with idiopathic sternoclavicular subluxation causing neurogenic thoracic outlet syndrome. An 18-year-old female presented with right C8-T1 paresthesia, severe writing intolerance (<10 minutes), and progressive shoulder drooping since childhood. Examination revealed positive Adson's, Wright's, and Chandler's tests with sternoclavicular instability. Computed tomography imaging confirmed right first-second rib synostosis with exostosis and bilateral anterior sternoclavicular subluxation. Electrodiagnostic studies were normal, consistent with disputed neurogenic thoracic outlet syndrome. Conservative treatment included a figure-of-eight clavicular orthosis worn for 30 days and targeted physiotherapy focusing on scalene stretching, scapular stabilization, and postural correction. Complete symptom resolution occurred within five weeks, with writing tolerance improving from less than 10 to over 30 minutes. Three-month follow-up confirmed sustained recovery without recurrence. This unique dual anatomical anomaly demonstrates that complex neurogenic thoracic outlet syndrome can be successfully managed conservatively, avoiding surgical risks while achieving durable functional recovery in young patients.

Keywords: Conservative Treatment; Physical Therapy Modalities; Sternoclavicular Joint; Synostosis; Ribs; Thoracic Outlet Syndrome; Case Reports

Introduction

Thoracic outlet syndrome (TOS) is a condition characterized by compression of the neurovascular bundle as it exits the thoracic outlet, presenting with pain, paresthesia, and weakness in the upper extremity.¹ Neurogenic TOS affects 3-80 per 1,000 individuals and typically results from compression of the brachial plexus by cervical ribs, fibrous bands, or muscular hypertrophy.^{2,3} Rib synostosis is a congenital bony fusion between adjacent ribs.¹ While congenital first-second rib synostosis occurs in only 0.07%-0.5% of the population and chronic sternoclavicular subluxation represents 3% of shoulder injuries, neither condition commonly causes TOS, and their combination has never been reported in the literature.^{1,4,5} While neurogenic TOS shows female predominance (3:1 ratio),^{1,3} congenital rib synostosis itself has no clear gender predilection in the literature.^{5,6}

We present the first documented case of neurogenic TOS resulting from the unprecedented coexistence of congenital rib synostosis and idiopathic bilateral sternoclavicular subluxation in an 18-year-old female. While each anomaly has been individually reported as a rare TOS cause, their coexistence has never been documented, making this a unique anatomical configuration with distinct therapeutic implications. This unique dual mechanism created synergistic neurovascular compression that was successfully managed conservatively, challenging traditional surgical approaches for TOS with bony anomalies and providing new insights into complex compression syndromes.

Case Report

An 18-year-old female student presented with chronic right upper limb symptoms significantly impacting her academic performance. Prior to presentation, the patient had received only symptomatic treatment with occasional analgesics provided by her general practitioner, without any structured conservative program or specialist evaluation. She reported progressive right shoulder drooping since childhood with repeated stairway falls, though no direct trauma or medical consultation occurred at that time. Family history was negative for connective tissue disorders or skeletal anomalies, and no psychological stressors were identified. The patient was a high-achieving student from a supportive middle-class family, with no history of substance use, psychiatric disorders, or significant social stressors. Her academic performance had progressively declined due to writing limitations, causing increasing anxiety about her educational future. The patient reported subjective complaints of C8-T1 dermatomal paresthesia, severe writing fatigue with tolerance less than 10 minutes, intolerance to overhead activities, and pain during arm elevation rated 7/10 on the visual analog scale.

Physical examination revealed positive provocative tests including Adson's, Wright's, Chandler's (Roos), Cyriax's, Morley's, and Tinel's tests, suggesting dynamic brachial plexus compression. A right sternoclavicular "piano sign" indicated joint instability. Inspection revealed no muscle atrophy (Gilliat-Sumner sign negative). Motor examination revealed normal strength except for mild scapular elevator weakness (4/5 on the Medical Research Council scale). Sensory examination revealed decreased C8-T1 sensation, with intact C5-C7 dermatomes. Bilateral asymmetric sternoclavicular swelling was observed, more pronounced on the right side and worsening with arm retropulsion. Vascular examination was normal with symmetric peripheral pulses. The initial Quick Disabilities of the Arm, Shoulder and Hand (Quick-DASH) score was 43, indicating significant functional impairment.

The patient's clinical timeline began in childhood with shoulder asymmetry, progressed to paresthesia onset at age 16-17 with writing difficulties, and culminated in severe symptoms prompting medical consultation at age 18. Diagnostic workup included cervical spine radiography excluding cervical ribs and vertebral anomalies, chest radiography showing incomplete right first rib morphology [Figure 1], computed tomography revealing synostosis between the right first and second ribs with associated exostosis and bilateral anterior sternoclavicular subluxation (more pronounced on the right) [Figure 2], and ultrasound confirming rib synostosis without vascular compression [Figure 1]. Brachial plexus ultrasound showed no obvious compression. Electrodiagnostic studies were normal. While magnetic resonance (MR) neurography could have provided additional soft tissue detail, the complete symptom resolution with conservative treatment validated our clinical diagnosis, demonstrating that advanced neuroimaging may not be necessary in cases with excellent treatment response. Differential diagnoses were systematically excluded: cervical radiculopathy by absence of neck pain, normal cervical spine examination, negative cervical tests (Spurling's test, cervical distraction, Bakody sign, upper limb tension test), and normal cervical imaging; cubital tunnel syndrome by negative Tinel's and Froment's signs at the elbow with normal ulnar nerve conduction studies; fibromyalgia by absence of widespread pain and tender points. The final diagnosis was right-sided disputed neurogenic TOS secondary to the dual mechanism of congenital rib synostosis and sternoclavicular subluxation.

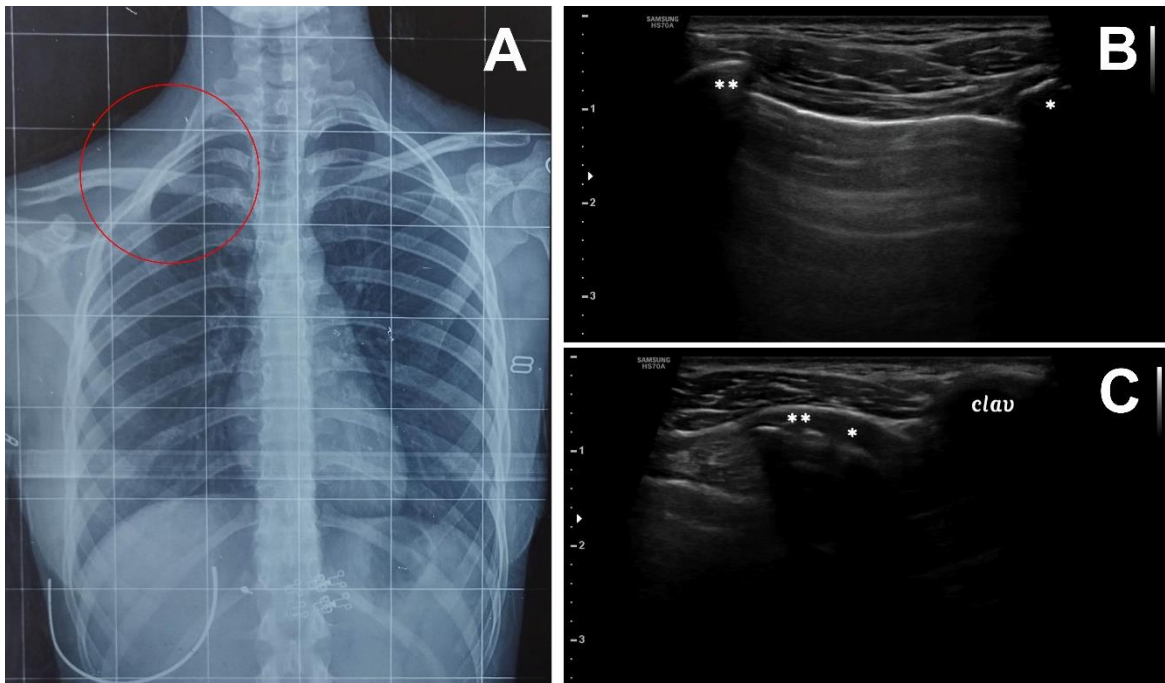


Figure 1: (A) Frontal chest radiograph showing a depressed right shoulder and incomplete or abnormal first thoracic rib (white arrow). (B, C) Anterior sagittal ultrasound sections of the asymptomatic left side (B) and symptomatic right side (C) illustrating synostosis between the first (*) and second (**) ribs. **Abbreviations:** clav: clavicle; *: first rib; **: second rib

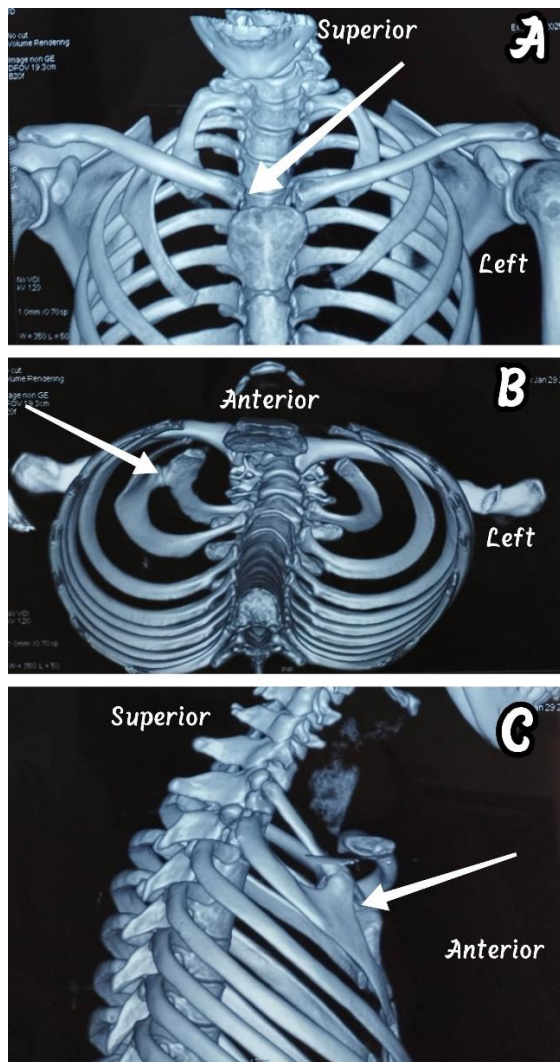


Figure 2: Three-dimensional computed tomography reconstruction revealing dual anatomical abnormalities (A) Anterior subluxation of the right sternoclavicular joint (white arrow); (B, C) Congenital synostosis between the first and second ribs with associated first rib exostosis (white arrows)

The patient was counseled that surgical options (first rib resection, sternoclavicular stabilization) would be considered if symptoms recurred despite conservative treatment. A conservative multimodal treatment approach was implemented. The patient wore a figure-of-eight clavicular orthosis continuously for 15 days followed by 15 days of gradual weaning. Concurrently, a five-week physiotherapy protocol was initiated: week one focused on analgesia using heat application for 20 minutes and transcutaneous electrical nerve stimulation for 15 minutes, along with diaphragmatic breathing exercises; week two included passive-active joint mobilizations and myofascial release; weeks three through five emphasized postural correction and progressive strengthening of scapular stabilizers. A daily 45-minute home exercise program complemented supervised sessions. Treatment modifications included orthosis weaning after initial pain reduction to prevent muscle atrophy.

At five-week follow-up, complete paresthesia resolution was achieved. Writing tolerance improved from less than 10 minutes to over 30 minutes continuously. Pain scores decreased from 7/10 to 0/10, and the Quick-DASH score improved to 15. The patient expressed satisfaction, stating: "I'm grateful to return to my studies without limitations." Treatment adherence was 100% as documented by physiotherapy attendance records. No adverse events occurred. While our three-month follow-up is relatively short, it demonstrates sustained functional recovery and symptom-free status without recurrence [Figure 3]. The patient remains under annual clinical and ultrasound surveillance. Longer-term outcomes will be reported in future studies. The persistent sternoclavicular swelling remained asymptomatic, and regular Doppler ultrasound monitoring was planned to detect potential vascular complications given the underlying structural abnormalities.

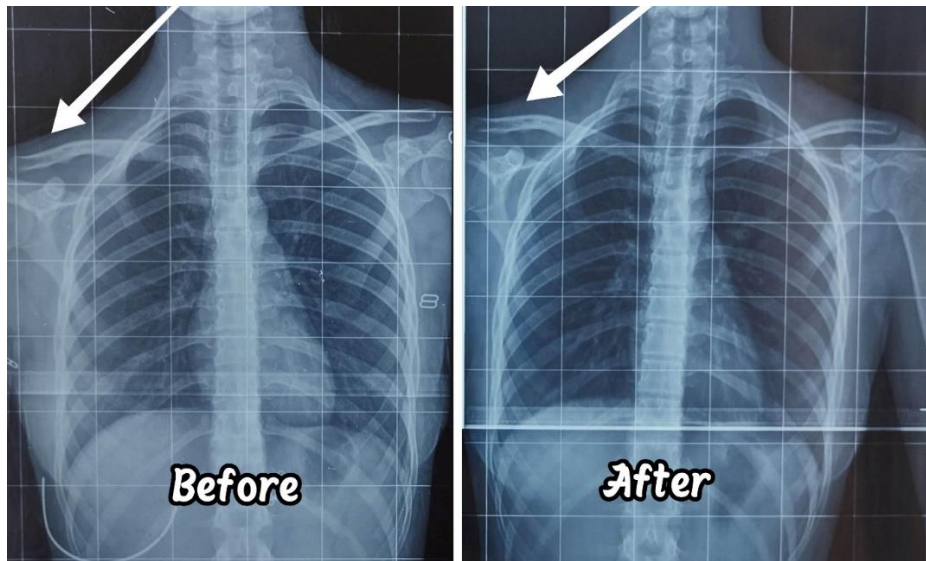


Figure 3: Comparative chest radiographs demonstrating treatment response (A) Pre-treatment radiograph showing right shoulder depression and first rib abnormality; (B) Post-treatment radiograph at 3-month follow-up showing improved shoulder alignment

Discussion

This case represents the first documented association of congenital first-second rib synostosis with idiopathic bilateral sternoclavicular subluxation causing neurogenic TOS. The coexistence of these anomalies created a unique dual compression mechanism: static narrowing from the rib fusion and dynamic compression from joint instability. This synergistic effect explains the purely neurogenic presentation without vascular involvement, as neural tissue demonstrates greater sensitivity to intermittent compression.⁷ Brachial plexus ultrasonography with bilateral comparison is an emerging diagnostic tool for TOS.⁸ Our equipment's limited resolution may have underestimated subtle compression. The excellent clinical response validated our diagnosis.

Conservative management for neurogenic TOS typically includes physical therapy focusing on postural correction, scalene stretching, and scapular stabilizer strengthening. Nichols and Seiger reported success with a similar approach for sternoclavicular subluxation-induced TOS.⁹ However, Reidler et al. described surgical management after failed conservative treatment of rib synostosis, suggesting anatomical complexity may predict treatment response.⁶ Our protocol incorporated these elements with additional sternoclavicular stabilization, representing an innovative adaptation for combined anatomical anomalies. The successful conservative management contradicts traditional surgical indications for bony anomalies in TOS. Sanders et al. reported first rib anomalies in only 3% of TOS cases, typically requiring trauma for symptom manifestation and surgical intervention.³ Our patient's idiopathic presentation and excellent response to non-operative treatment challenge this paradigm. The structured rehabilitation protocol, combining orthotic stabilization with targeted physiotherapy, achieved complete symptom resolution within five weeks, with sustained improvement at three-month follow-up.

Conservative management is preferred as first-line treatment for neurogenic TOS due to lower morbidity, absence of surgical risks (infection, bleeding, pneumothorax), preservation of anatomical structures, and cost-effectiveness.^{1,4} Additionally, young patients benefit from avoiding permanent surgical alterations, particularly given the good prognosis with non-operative approaches in properly selected cases.^{7,9} Surgical intervention (first rib resection, scalenectomy, sternoclavicular stabilization) is typically reserved for: failure of adequate conservative treatment (>3-6 months), progressive neurological deficits, severe functional impairment, vascular complications (thrombosis, aneurysm), or patient preference after informed discussion of risks and benefits.^{1,4,6} Conservative management was particularly appropriate for this patient for several reasons: young age (18 years) with excellent healing potential, absence of vascular complications or severe neurological deficits, recent symptom onset without long-standing nerve damage, identifiable mechanical component (sternoclavicular instability) amenable to orthotic stabilization, high motivation for treatment adherence due to academic goals, and normal electrodiagnostic studies suggesting reversible nerve compression rather than structural damage.^{4,7,9} These favorable prognostic factors predicted excellent response to non-operative treatment.

Literature review reveals isolated reports of each anomaly causing TOS. Reidler et al. described surgical management of rib synostosis after failed conservative treatment,⁶ while Nichols and Seiger reported successful conservative treatment of sternoclavicular subluxation-induced TOS.⁹ However, no previous cases document their combination. Recent advances in MR neurography have improved detection of complex anatomical variants with 100% positive predictive value,¹⁰ suggesting many cases may be underdiagnosed. This gap underscores the importance of comprehensive imaging in complex presentations and individualized treatment approaches.

The case strengths include multimodal imaging confirmation, systematic conservative protocol, and documented functional improvement. Limitations include single-case design, short follow-up period, and absence of Magnetic resonance imaging neurography which could have provided additional soft tissue detail. The persistent sternoclavicular swelling, though asymptomatic, necessitates long-term surveillance for potential vascular complications.¹¹

The patient expressed significant relief following treatment: "Before treatment, I couldn't write for more than 10 minutes, which severely affected my studies. After completing the brace and physiotherapy, I can now write for over 30 minutes continuously. While I still have mild writing fatigue after prolonged periods, the improvement is significant and I'm grateful to return to my studies with much better function."

Conclusion

This first reported case of neurogenic TOS caused by combined rib synostosis and sternoclavicular subluxation demonstrates that complex anatomical variants can create unique compression syndromes requiring individualized treatment approaches. The excellent outcome with conservative management challenges the assumption that structural abnormalities mandate surgical intervention. Clinicians should maintain high suspicion for multiple contributing factors in complex TOS presentations and consider comprehensive conservative protocols before surgical options. Long-term surveillance remains essential given the persistent anatomical abnormalities. Further research is needed to establish optimal management guidelines for such complex cases.

Disclosure

The authors declared no conflicts of interest. Written consent was obtained from the patient.

References

1. Ferrante MA, Ferrante ND. The thoracic outlet syndromes: Part 1. Overview of the thoracic outlet syndromes and review of true neurogenic thoracic outlet syndrome. *Muscle Nerve*. 2017 Jun;55(6):782-93.
2. Illig KA, Donahue D, Duncan A, Freischlag J, Gelabert H, Johansen K, et al. Reporting standards of the Society for Vascular Surgery for thoracic outlet syndrome. *J Vasc Surg*. 2016 Sep;64(3):e23-35.
3. Sanders RJ, Hammond SL, Rao NM. Diagnosis of thoracic outlet syndrome. *J Vasc Surg*. 2007 Sep;46(3):601-4.
4. Ahmed SH, Shekouhi R, Chim H. Challenges and Advances in the Diagnosis and Management of Neurogenic Thoracic Outlet Syndrome: A Comprehensive Review. *J Hand Surg Asian Pac Vol*. 2024 Aug;29(4):269-80.
5. Weber AE, Criado E. Relevance of Bone Anomalies in Patients with Thoracic Outlet Syndrome. *Ann Vasc Surg*. 2014 May;28(4):924-32.
6. Reidler JS, Das De S, Schreiber JJ, Schneider DB, Wolfe SW. Thoracic Outlet Syndrome Caused by Synostosis of the First and Second Thoracic Ribs: 2 Case Reports and Review of the Literature. *J Hand Surg Am*. 2014 Dec;39(12):2444-7.
7. Ferrante MA. The thoracic outlet syndromes. *Muscle Nerve*. 2012 Jun;45(6):780-95.
8. Gruber H, Glodny B, Bendix N, Tzankov A, Peer S. Ultrasonographic appearance of the brachial plexus. *J Ultrasound Med*. 2001;20:509-14.
9. Nichols D, Seiger C. Diagnosis and treatment of a patient with bilateral thoracic outlet syndrome secondary to anterior subluxation of bilateral sternoclavicular joints: A case report. *Physiother Theory Pract*. 2013 Oct;29(7):562-71.
10. Davidson EJ, Tan ET, Sneag DB. Magnetic resonance neurography in the diagnosis of neurological subtypes of thoracic outlet syndrome. *Muscle Nerve*. 2024 Dec;70(6):1128-39.

11. Onode E, Takamatsu K, Kazuki K, Nakamura H. Thoracic Outlet Syndrome with Subclavian Artery Thrombosis Caused by Synostosis of the First and Second Ribs. *JBJS Case Connect*. 2022 Apr;12(2).