Turk J Phys Med Rehab 2025;71(1):117-121
DOI: 10.5606/tftrd.2025.15331
Available online at www.turkishjournalpmr.com

Case Report

Winged scapula after carrying weight under the armpit: Ultrasonographic examination of the distal long thoracic nerve and serratus anterior muscle

Aslinur Keles, Esra Giray, Melike Nur Balatlioglu, Feyza Unlu Ozkan, Ilknur Aktas

Department of Physical Medicine and Rehabilitation, University of Health Science, Fatih Sultan Mehmet Training and Research Hospital, İstanbul, Türkiye

ABSTRACT

The most common etiologic cause of winged scapula (WS) is paralysis of the serratus anterior muscle (SAM), typically due to an injury of the long thoracic nerve (LTN), often associated with overhead activities, including heavy weightlifting. Herein, we reported a 30-year-old male patient with WS secondary to an LTN lesion caused by carrying weight under the armpit, rather than overhead, which differs from previous reports regarding the anatomical site and cause of the LTN lesion. The ultrasonographic technique used to evaluate distal lesions of the LTN was described in detail, with the SAM thickness significantly reduced and the cross-sectional area of the LTN increased on the symptomatic side. Electroneuromyography revealed an acute/subacute, mild partial axonal lesion of the LTN, with ultrasonographic evaluation pinpointing the exact anatomical location of the lesion. Ultrasonography should be the first imaging modality used to support electrophysiological studies and evaluate the affected nerves and muscles to reveal precise anatomical localization.

Keywords: Electromyography, long thoracic nerve, serratus anterior, ultrasonography, winged scapula.

Winged scapula (WS) is defined as the medial border or inferior angle of the scapula moving away from the rib cage, characterized by shoulder dysfunction and pain.[1] The most common etiologic causes are serratus anterior muscle (SAM) paralysis secondary to long thoracic nerve (LTN) injury and trapezius muscle paralysis secondary to spinal accessory nerve injury. Rhomboid dysfunction from dorsal scapular nerve damage is less common.[2,3]

The etiologies of LTN lesions include repetitive upward arm movements, trauma, infections, and idiopathic factors.[2,4] The LTN injuries previously reported to be associated with weight-bearing activities have been described as secondary to overhead carrying rather than carrying weight under the armpit.[4,5] Additionally, previous reports of WS related to LTN lesions include ultrasonographic assessment of the proximal part of the LTN within the interscalene triangle and supraclavicular region, rather than the distal part of the nerve, which is located along the thoracic wall under the armpit.[6]

While electromyography (EMG) is widely utilized in the diagnosis of WS to assess nerve injury, comparative studies with ultrasonography (USG) have demonstrated that a considerable number of patients may exhibit normal EMG findings despite the presence of pathology.[7,8] Ultrasonography can aid in the diagnostic evaluation of WS by revealing muscle atrophy, increases in nerve diameter, and the precise anatomical location of the lesion.[9] Coraci et al.[9] visualized the LTN near the thoracic artery in a male bodybuilder after intense weightlifting. However, the USG technique used to demonstrate distal LTN lesions was not explained in detail. In this case, we reported a male patient with WS secondary to an LTN lesion caused by carrying weight under the

Corresponding author: Esra Giray, MD. SBÜ, Fatih Sultan Mehmet Eğitim ve Araştırma Hastanesi, Fiziksel Tıp ve Rehabilitasyon Kliniği, 34752 Ataşehir, İstanbul, Türkiye.
E-mail: girayesra@hotmail.com

Received: May 23, 2024 **Accepted:** September 17, 2024 **Published online:** February 14, 2025

Cite this article as: Keles A, Giray E, Balatlioglu MN, Unlu Ozkan F, Aktas I. Winged scapula after carrying weight under the armpit: Ultrasonographic examination of the distal long thoracic nerve and serratus anterior muscle. Turk J Phys Med Rehab 2025;71(1):117-121. doi: 10.5606/tftrd.2025.15331.

armpit, with both the location and cause of the injury being unique. Additionally, we aimed to provide a detailed description of the USG technique used to examine the distal part of the LTN along the lateral chest wall and the SAM.

CASE REPORT

A 30-year-old male patient admitted to the outpatient clinic with a three-month history of right shoulder pain. The patient stated that the day after carrying a 60-kg package under his armpit, he started to feel pain and noticed winging on the same day. Physical examination revealed no significant atrophy, except for the winging of the medial margin and inferior angle of the scapula at rest. Winging was accentuated during arm abduction and flexion. The wall push-up test was positive (Figure 1). The echogenicity and thickness of the periscapular muscles were evaluated, and the tracings of the nerves were done comparatively using a General Electric LogiqP5 model USG device (GE Healthcare, Wauwatosa, WI, USA) with a 7-12 MHz multi-frequency linear probe. Ultrasonographic examinations and image acquisition were performed by the authors with over 10 years of experience in neuromuscular ultrasound and electroneuromyography. Written informed consent was obtained from the patient.

The SAM thickness on the symptomatic side was significantly reduced compared to the contralateral side over both the eight and seventh ribs (Figure 2a), and the muscle echogenicity was markedly increased. The cross-sectional area (CSA) of the nerve on the symptomatic side was significantly larger compared to the asymptomatic side (Figure 2b), and the anteroposterior diameter of the nerve was increased in the longitudinal view relative to the contralateral side. Ultrasonographic evaluation of the trapezius, supraspinatus, infraspinatus, and rhomboid muscles was normal bilaterally. Although the latissimus dorsi muscle thickness appeared slightly reduced on the symptomatic side, this reduction was likely due to the patient's three-month period of disuse, as needle EMG sampling of the latissimus dorsi revealed normal results. Additionally, needle EMG of the trapezius, rhomboid major and minor, biceps, and deltoid muscles showed normal findings. Electromyography sampling of the SAM, performed using USG guidance at the level of the seventh rib, revealed abnormal spontaneous activity (positive sharp wave and fibrillation) at rest. The motor unit action potential duration was slightly prolonged, with increased polyphasia during minimal voluntary contraction and sparse interference pattern during full contraction. The overall EMG findings were

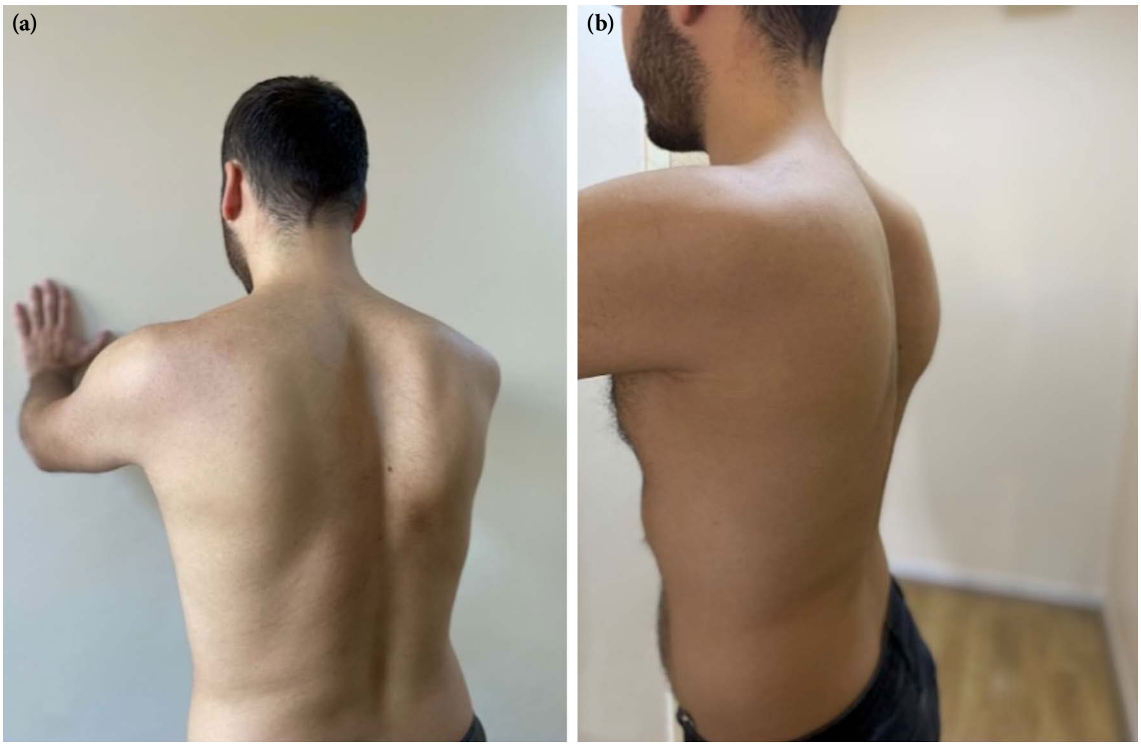

Figure 1. **(a)** Medial winging of the right scapula during wall push-up test. **(b)** Lateral view of the winging.

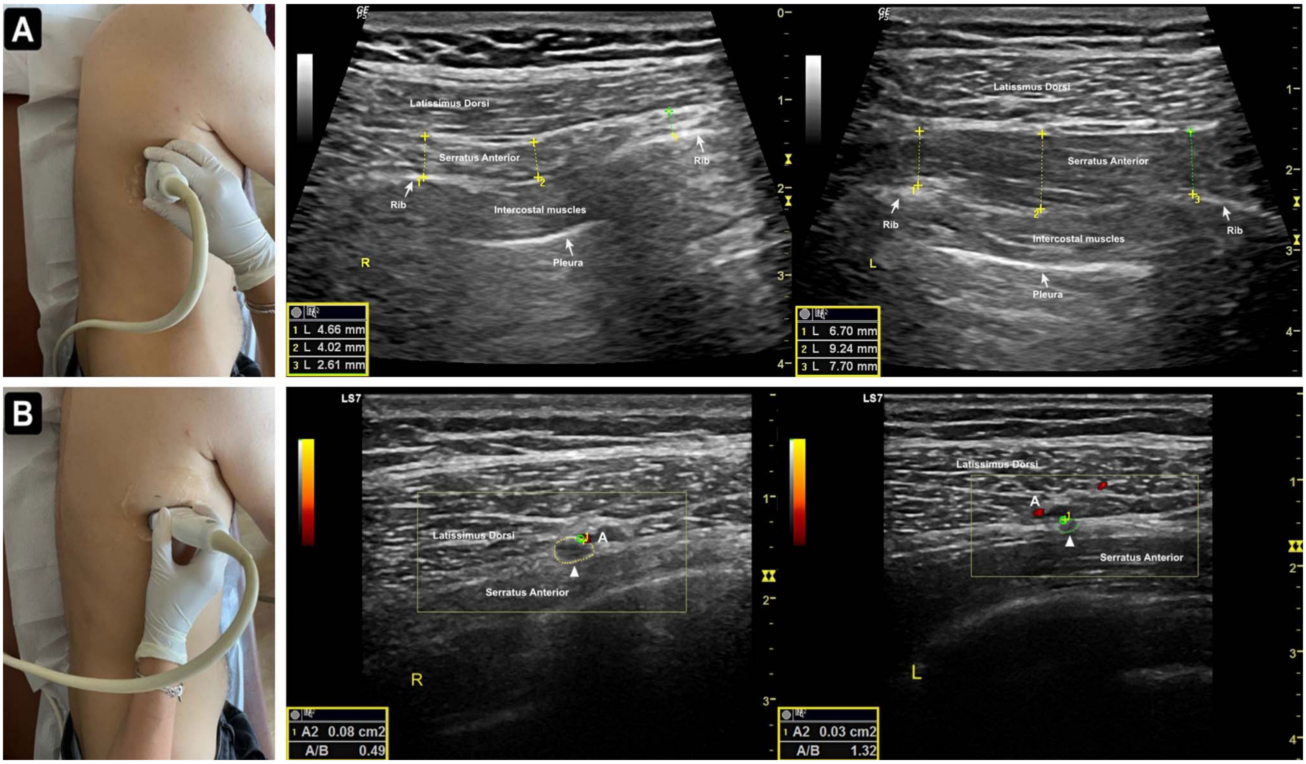

Figure 2. **(a)** The SAM evaluation in the coronal plane. The patient was in a side-lying position with the arms flexed, and the probe was placed longitudinally on the posterior axillary line with the superior border of the probe tangential to the imaginary horizontal line drawn from the inferior angle of the scapula. The SAM thickness was measured by the perpendicular linear distance between the superior and inferior fascial lines over the center of the upper and lower ribs and the intercostal line at the levels of the seventh and eighth ribs with the muscle at rest. On the symptomatic side, the SAM thickness was measured as 4.66 mm, 4.02 mm, and 2.61 mm, with a mean of 3.63 mm. On the asymptomatic side, the SAM thickness was 6.70 mm, 9.24 mm, and 7.70 mm, with a mean of 7.2 mm. There was a marked decrease in muscle thickness on the symptomatic side. The SAM on the right side appeared atrophic. **(b)** Visualization of the LTN (arrowhead) in the transverse plane. The probe, positioned in the transverse plane in the posterior axillary line at the nipple level, identified the lateral thoracic artery between the latissimus dorsi and SAM using power Doppler USG, with the LTN detected nearby. At the fourth intercostal space, the LTN CSA was 8 mm^2 on the symptomatic side and 3 mm^2 on the asymptomatic side. The CSA on the symptomatic side was significantly increased compared to the asymptomatic side.

SAM: Serratus anterior muscle; LTN: Long thoracic nerve; USG: Ultrasonography; CSA: Cross-sectional area; R: Right symptomatic side; L: Left asymptomatic side; A. Artery. Pleura and ribs are marked with green arrows.

consistent with a mild partial axonal lesion of the LTN in the acute/subacute period.

After starting a six-week physiotherapy and rehabilitation program, the patient continued with a home exercise program. One year later, a significant decrease in scapular winging was observed, with the scapular winging severity score[10] improving from 4 to 1 (Figure 3).

DISCUSSION

In this case report, we presented a patient with WS secondary to a distal LTN lesion caused by carrying a heavy weight under the armpit. The diagnosis was confirmed through a combination of physical examination, USG, and EMG. Ultrasonography revealed significant differences, including an increased CSA of the distal LTN on the symptomatic side compared to the asymptomatic side, as well as changes in muscle thickness and echogenicity, confirming the exact anatomical site of the lesion. Electromyography showed a partially reinnervating LTN lesion and revealed the extent and prognosis of the nerve injury. This case highlights the technique to evaluate the distal LTN along the chest wall, as well as the importance of detailed imaging and diagnostic techniques in accurately identifying the cause and extent of nerve injuries in patients with WS.

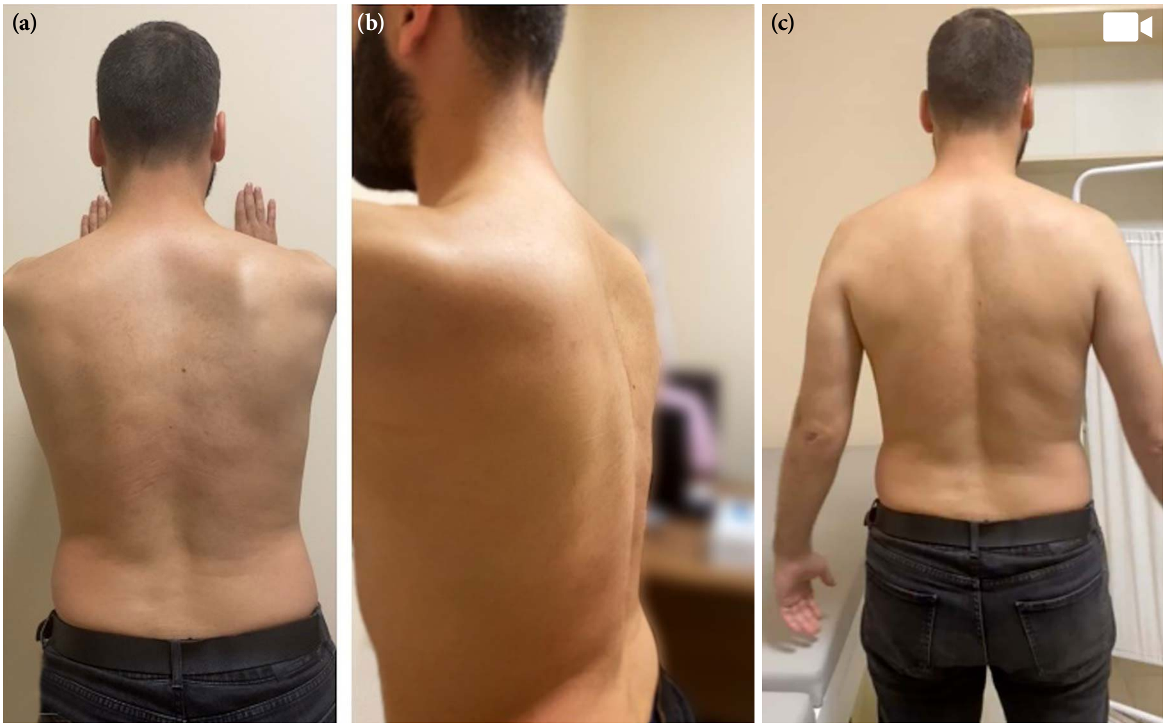

Figure 3. **(a)** Decreased medial winging of the right scapula during the wall push-up test. **(b)** Lateral view of the wing. **(c)** Significant decrease in winging during active shoulder joint movement.

Silkjær Bak et al.,[8] in their study comparing ultrasound with electrodiagnosis for scapular winging, found that EMG results were normal in 37% of the patients. While EMG is highly valuable in diagnosing WS by offering insights into its pathophysiology, false-negative results can still occur due to various factors.[11] For example, the shoulder girdle muscles overlap each other, and the examiner may insert the needle into a different muscle than intended.[12,13] Furthermore, the SAM is a large muscle spanning multiple intercostal levels, and its intermediate part, which is usually sampled, is sometimes composed only of connective tissue.[14] Additionally, the innervations of the parts of the SAM are different, particularly the inferior part, innervated by both the LTN and the intercostal nerves originating from the T6 to T9 levels, increasing the likelihood of negative results.[15] Neuromuscular USG complements the EMG by providing anatomical information and reducing false negative results. Ultrasonography-guided needle EMG of SAM also increases the sensitivity and specificity.[8] Therefore, we aimed to describe the USG examination techniques for SAM and LTN along the lateral chest wall, which we believe will serve as a valuable guide for physicians in diagnosing WS.

Ultrasonographic examination of the SAM was defined as the measurement of the interfacial space over the most distal rib in the image obtained by examining the muscle in the longitudinal plane on the mid-axillary line at the level of the inferior scapular angle. However, it was not specified which rib was the landmark, and intra-examiner reliability was found to be poor.[16] Only one study in the literature reported that muscle thickness was measured over three different ribs (2^{nd}, 3^{rd}, and 4^{th}) along the posterior axillary line from the axilla.[8] In our case, SAM thickness was measured on the posterior axillary line at the level of the inferior scapular angle, over the seventh and eighth ribs, and through the intercostal space. The mean muscle thickness was calculated by averaging the measurements.

The diagnosis of WS due to the distal LTN lesions by USG is made by measuring increased nerve CSA and visualizing increased echogenicity in the SAM, with other muscles appearing normal. In studies examining the LTN by USG, it was usually visualized in the supraclavicular area.[6,17] For the first time in the literature, the LTN was examined in the infraclavicular area, between the SAM and latissimus dorsi, in a case involving a bodybuilder who developed WS after intense weightlifting.[9] The authors emphasized that comparing LTN CSA with the intact side provides valuable imaging evidence for the diagnosis of WS. However, this report lacks a detailed technical description of the visualization of the distal LTN, including the costal levels. In this case, the cause was overhead heavy lifting, as noted in previous literature. What makes our case unique is that the causative factor was weight-bearing under the armpit and the a detailed description of USG visualization of the distal LTN, including an increased CSA of the distal LTN along the lateral chest wall corresponding to the armpit area. To our knowledge, this is the first case reported in the literature of an LTN injury developing after carrying a package under the armpit, demonstrated by USG.

In conclusion, although the diagnosis of WS is primarily clinical, it should be confirmed through electrophysiological and USG evaluations to achieve a more accurate diagnosis. The extent of the lesion and reinnervation status can be further assessed and monitored through EMG, making it a valuable addition to the anatomical insights provided by USG. Carrying a heavy package under the armpit may cause a distal LTN lesion, which can be effectively visualized by USG using the technique described in this report. Ultrasonography not only helps in the precise localization of the lesion but also reveals neurogenic causes by identifying muscle atrophy and nerve enlargement in the affected areas.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Author Contributions: All authors contributed equally to this article.

Conflict of Interest: The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

Funding: The authors received no financial support for the research and/or authorship of this article.

REFERENCES

1. Martin RM, Fish DE. Scapular winging: Anatomical review, diagnosis, and treatments. Curr Rev Musculoskelet Med 2008;1:1-11. doi: 10.1007/s12178-007-9000-5.
2. Aktaş İ, Akgün K. Kanat Skapula. Türk Fiz Tıp Rehab Derg 2007;53:113-7.
3. Akgun K, Aktas I, Terzi Y. Winged scapula caused by a dorsal scapular nerve lesion: A case report. Arch Phys Med Rehabil 2008;89:2017-20. doi: 10.1016/j.apmr.2008.03.015.
4. Berthold JB, Burg TM, Nussbaum RP. Long thoracic nerve injury caused by overhead weight lifting leading to scapular dyskinesis and medial scapular winging. J Am Osteopath Assoc 2017;117:133-7. doi: 10.7556/jaoa.2017.025.
5. Didesch JT, Tang P. Anatomy, etiology, and management of scapular winging. J Hand Surg Am 2019;44:321-30. doi: 10.1016/j.jhsa.2018.08.008.
6. Lieba-Samal D, Morgenbesser J, Moritz T, Gruber GM, Bernathova M, Michaud J, et al. Visualization of the long thoracic nerve using high-resolution sonography. Ultraschall Med 2015;36:264-9. doi: 10.1055/s-0034-1366084.
7. Kassardjian CD, O'gorman CM, Sorenson EJ. The risk of iatrogenic pneumothorax after electromyography. Muscle Nerve 2016;53:518-21. doi: 10.1002/mus.24883.
8. Silkjær Bak S, Johnsen B, Fuglsang-Frederiksen A, Døssing K, Qerama E. Comparison of ultrasound with electrodiagnosis of scapular winging: A prospective case control study. Clin Neurophysiol 2022;133:48-57. doi: 10.1016/j.clinph.2021.09.021.
9. Coraci D, Romano M, Paolasso I, Santilli V, Padua L. A case of traumatic long thoracic nerve suffering: High-frequency ultrasound finding. Joint Bone Spine 2017;84:505-6. doi: 10.1016/j.jbspin.2016.07.008.
10. Ng CY, Wu F. Scapular winging secondary to serratus anterior dysfunction: Analysis of clinical presentations and etiology in a consecutive series of 96 patients. J Shoulder Elbow Surg 2021;30:2336-43. doi: 10.1016/j.jse.2021.02.012.
11. Vasudeva G I. Role of Ultrasound in the EMG Lab. Open Access J Neurol Neurosurg 2021;15:555910.
12. Sella GEJB. Agonism and Antagonism of the Muscles of the Elbow Joint: An SEMG Approach 2021;49:89-94.
13. Lim HY, Kim SH, Choi JW, Chang SY, Kim GH, Kim IB, et al. Optimal needle electromyography approach to the serratus anterior muscle. Muscle Nerve 2023;68:303-7. doi: 10.1002/mus.27933.
14. Hamada J, Igarashi E, Akita K, Mochizuki T. A cadaveric study of the serratus anterior muscle and the long thoracic nerve. J Shoulder Elbow Surg 2008;17:790-4. doi: 10.1016/j.jse.2008.02.009.
15. Nasu H, Yamaguchi K, Nimura A, Akita K. An anatomic study of structure and innervation of the serratus anterior muscle. Surg Radiol Anat 2012;34:921-8. doi: 10.1007/s00276-012-0984-1.
16. Talbott NR, Witt DW. Ultrasound imaging of the serratus anterior muscle at rest and during contraction. Clin Physiol Funct Imaging 2013;33:192-200. doi: 10.1111/cpf.12012.
17. Hanson NA, Auyong DB. Systematic ultrasound identification of the dorsal scapular and long thoracic nerves during interscalene block. Reg Anesth Pain Med 2013;38:54-7. doi: 10.1097/AAP.0b013e31826f0a63.