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Case Report

Thoracodorsal to long thoracic nerve transfer in a patient with traumatic injury: A case report

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ABSTRACT

Background: Traumatic injury to the long thoracic nerve causes paralysis of the serratus muscle, clinically expressed as winged scapula and functional impairment of the shoulder girdle. Treatment varies according to the severity of the injury, with a focus on early intervention for best results; however, the therapeutic approach remains a challenge at present.

Case Description: We present the case of a 32-year-old male patient, athlete, right-handed, presented with bilateral paresis predominantly in the right arm, associated with paresthesia and changes in the coloring of the upper limbs. After being diagnosed with Thoracic Outlet Syndrome and undergoing surgery, vascular symptoms persisted with a significant loss of strength in the right shoulder. Winged scapula was observed and structural lesions were excluded on magnetic resonance imaging. Electromyographic studies confirmed the presumption of traumatic nerve involvement of the long thoracic nerve. Notwithstanding 6 months of physical therapy, there was no improvement, so a nerve transfer from the thoracodorsal nerve to the right long thoracic nerve was chosen. At 12 months, complete resolution of the winged scapula and functional recovery were observed. The patient also experienced a decrease in preoperative pain from 5/10 to 2/10 on the visual analog scale.

Conclusion: Nerve transfer from the thoracodorsal nerve to the long thoracic nerve is a safe and effective technique to treat winged scapula due to long thoracic nerve injury.

Keywords: Injury, Long thoracic, Nerve transfer, Peripheral nerve, Thoracodorsal, Injury

INTRODUCTION

The long thoracic nerve – also known as the serratus major nerve or Charles Bell's nerve[10,17] – originates from the anterior branches of the cervical roots C5–C6 and in many cases in addition to C7,[17,30] continues a deep trajectory, passing through the scalene muscles, the second rib and finally ending at the serratus muscle,[17] and contributes to dynamic abduction and elevation of the shoulder by stabilizing the scapula on the thorax.[28] The injury results in paralysis of the serratus major muscle with consequent winged scapula, severe omalgia, and impaired mobility of the homolateral shoulder.[1,6,14,16,17,31,34] The etiology includes traumatic and non-traumatic causes, the latter being infectious, inflammatory, anatomical, post-radiation, familial, radiculopathy, and myelopathic.[4,14-16,21,23,24,31] Traumatic cases are the most frequent, usually related to shoulder girdle activities, from physical exercise to invasive procedures.[15,31] Iatrogenic traumatic cases, which

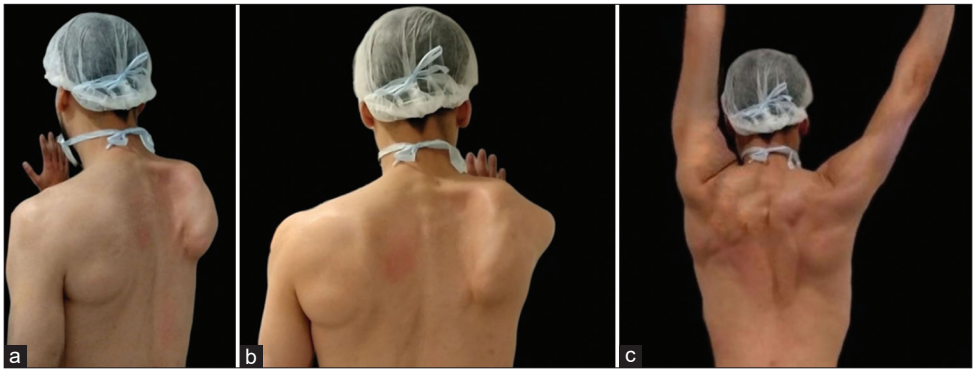


Figure 1: (a) and b) Preoperative examination showing shoulder flexion at 90° and (c) preoperative examination showing shoulder extension. The important right-winged scapula is observed.

account for about 11%, include procedures involving anatomical areas related to the nerve pathway in the neck, axilla, and ribs.[1,11,22,29,31] In general, patients with mild-to-moderate partial injuries would benefit from conservative treatment.[9,12,14,16,32] Patients with more severe injuries will require surgical intervention by primary nerve reconstruction, nerve transfer, or secondary muscle, bone, or tendon surgery.[1,2,8,13,20,22,34] The nerve approach is most successful when performed within 1 year of the onset of symptomatology.[2,6,7,26,32] In experimental and clinical models of peripheral nerve injury, recovery is directly related to the location, severity, and mechanism of injury,[27,30] the outcome being more favorable in inflammatory-idiopathic and worse in traumatic cases.[2,27,30]

CASE REPORT

We present a 32-year-old male patient, a right-handed athlete, who presented with a bilateral (predominantly right upper limb) abduction paresis of 12 months duration, associated with progressive paresthesias and changes in the coloring of the upper limbs. As an important history before the consultation, he had been diagnosed with vascular Thoracic Outlet Syndrome in another institution for which he had undergone surgery. The right first rib had been resected in that procedure with an axillary approach on that side. After surgery, the patient developed persistence of previous vascular symptoms and loss of flexion strength in the right shoulder. On physical examination at our clinic, we observed a right-winged scapula together with an absence of commitment of the deltoid, triceps, supraspinatus, and infraspinatus muscles [Figure 1]. Magnetic resonance imaging of the right scapular region ruled out structural joint lesions at the level of the rotator cuff and the remaining ligament and muscle structures. The suspected diagnosis was traumatic injury of the long thoracic nerve, which was confirmed by electromyographic studies. The patient underwent physical therapy for 6 months without improvement. We, therefore, decided to perform surgical treatment 8 months after the onset of symptoms by means of a nerve transfer from the thoracodorsal nerve to the right long thoracic nerve. The reason for this indication was the absence of improvement in the paralysis observed up to that moment. The patient was positioned in dorsal decubitus, with the right upper limb in 90° abduction. A 15 cm skin incision was made on the right mid-axillary line, following the free border of the latissimus dorsi muscle. Dissection of the subcutaneous cellular tissue and aponeurosis of the latissimus dorsi muscle was continued until the right thoracodorsal nerve was identified by dissection and neurostimulation. Subsequently, the aponeurosis of the serratus anterior muscle was opened, which allowed the identification of the right long thoracic nerve, which had not responded to intraoperative motor stimulation [Video 1]. A donor branch of the right thoracodorsal nerve of similar size to that of the recipient was repaired to perform a nerve transfer in which the former would function as the axon donor and the latter as the recipient [Figure 2]. End-to-end neurorrhaphy was performed under microscopic magnification using a 9–0 nylon microsuture. Fibrin glue was used to coat the repair.

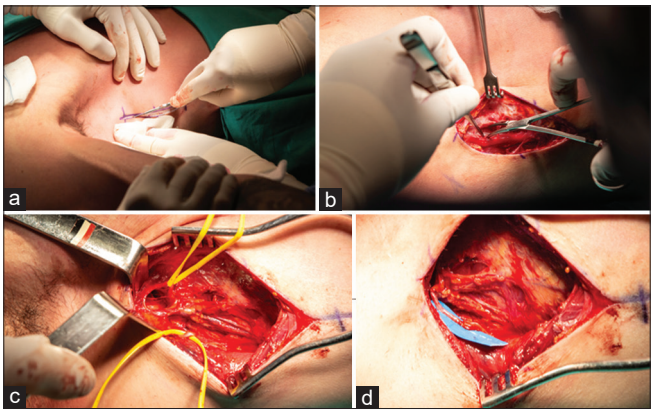
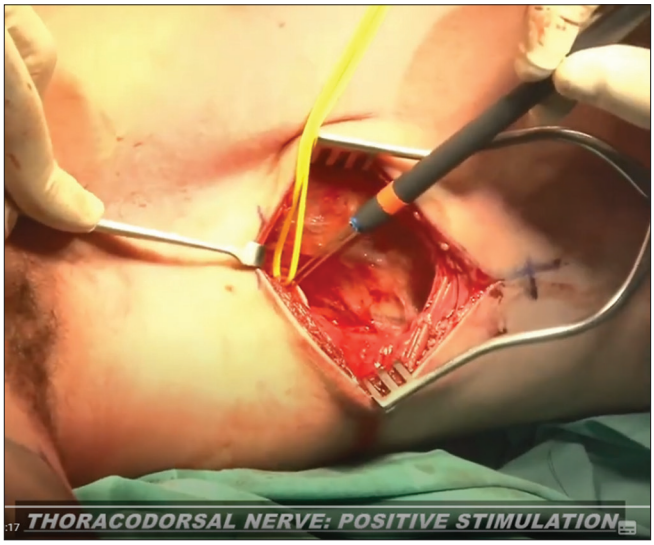


Figure 2: (a) Intraoperative picture showing a skin incisión; (b) intraoperative picture showing a dissection of the latissimus dorsi; (c) intraoperative picture showing a separate thoracodorsal nerve in the inferior side and long thoracic nerve in the superior side; and (d) intraoperative picture showing the preparation of donor branches for neurorrhaphy.

Figure 3: (a) Postoperative examination at 12 months showing total resolution of the winged scapula, functional recovery, and muscle strength; (b) Postoperative examination at 12 months showing total resolution of the winged scapula, functional recovery, and muscle strength; and (c) postoperative examination at 12 months showing total resolution of the winged scapula, functional recovery, and muscle strength.



Video 1: An intraoperative picture shows positive stimulation for the thoracodorsal nerve and negative stimulation for the long thoracic nerve.

A bandage was applied to immobilize the patient's shoulder in adduction and internal rotation for 2 weeks, after which physical therapy sessions were started with activation movements for the latissimus dorsi and pectoralis major muscles, 5 times a week for 90 min during the first 3 months, and then continued for the same duration, 3 times a week. During the sessions, the exercises described by Ray *et al*. were carried out, with evident and progressive results from the 4th month of physiotherapy.[25]

The patient was monitored 6 months after surgery, with partial improvement of the winged scapula and good recovery of flexion and function of the right shoulder. At 12 months, there was complete resolution of the winged scapula, with full functional recovery and muscle strength of both the latissimus dorsi and pectoralis muscles. The patient reported that he was able to complete all his routine activities normally and also showed a decrease in preoperative pain with Visual Analog Scale, 5/10–2/10 [Figure 3].

DISCUSSION

Injury to the long thoracic nerve results in severe loss of shoulder function, particularly flexion, due to loss of scapular stabilization and rotation.[3,35]

It remains difficult to determine a definitive therapeutic option in this pathology, especially due to its varied presentations. Physiotherapy and clinical observation are the recommended initial treatment, with many documented cases describing favorable results with this conservative strategy.[9,14,16,33,35] Specifically, in iatrogenic traumatic injuries, such as the case presented, some series report first rib resections performed through the axillary approach as the main cause, followed by surgical procedures related to breast and lymph node pathology, neck pathology treated through the supraclavicular approach and anesthetic blocks of the brachial plexus, among others.[11] This subgroup of patients – iatrogenic traumatic injuries – generally do not have favorable results with physiotherapy and require surgical intervention in the short to medium term.[2,26,32]

Surgical options are extensive, although recently, according to literature reports, both nerve transfer and modified pectoralis major muscle-tendon transfer have gained prominence.[3,5,13,18,19,22,25,28,32] Nerve transfers provide direct nerve-to-nerve coaptation closer to the target muscle, which guides motor axons directly to the muscle. There are actually few reports on surgical outcomes after primary repair with nerve grafts in the long thoracic nerve. The first case report of this type of nerve transfer was reported by Novak and Mackinnon in 2002 in a young patient with idiopathic long thoracic nerve palsy.[19] Subsequently, in 2011, Ray *et al*. presented a case of neuritis of the long thoracic nerve in which a double nerve transfer was performed, one inferior donor being the thoracodorsal nerve and the other superior originating from a branch of the pectoral nerve.[25] In 2017, Shelley Noland presented a series of 19 patients with isolated long thoracic nerve palsy, with a total of three patients undergoing nerve transfer – two patients of traumatic origin and 1 of inflammatory etiology – two patients performed

single nerve transfer through the axillary approach, and 1 patient received a double transfer.[18] Another therapeutic option used is that published by Elhassan and Wagner in 2014, comprising a series of 51 patients undergoing a modified tendon transfer whose results, as reported, are satisfactory.[5] Surgical intervention by nerve transfer will restore neural continuity and reinnervation of the serratus muscle, with a positive impact on muscle strength and shoulder function.[19] Our case supports the results reported so to date, demonstrating the usefulness of this technique for the primary treatment of serratus major muscle palsy.

CONCLUSION

Nerve transfer from the thoracodorsal nerve to the long thoracic nerve is very useful, proving to be a safe and successful technique for the treatment of winged scapula due to long thoracic nerve injury. We recommend this procedure for patients with <1 year of postinjury evolution. It is important to implement a good physical therapy program before and after surgery to optimize the functional results of the shoulder.

Ethical approval

The Institutional Review Board approval is not required.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Nil.

Conflicts of interest

There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

REFERENCES

1. Atasoy E, Majd M. Scapulothoracic stabilisation for winging of the scapula using strips of autogenous fascia lata. J Bone Joint Surg Br 2000;82:813-7.
2. Berry H, MacDonald EA, Mrazek AC. Accessory nerve palsy: A review of 23 cases. Can J Neurol Sci 1991;18:337-41.
3. Connor PM, Yamaguchi K, Manifold SG, Pollock RG, FlatowEL, Bigliani LU. Split pectoralis major transfer for serratus anterior palsy. Clin Orthop Relat Res 1997;341:134-42.
4. Del Sasso L, Mondini A, Brambilla S. A case of isolated paralysis of serratus anterior. Ital J Orthop Traumatol 1988;14:533-7.
5. Elhassan BT, Wagner ER. Outcome of transfer of the sternal head of the pectoralis major with its bone insertion to the scapula to manage scapular winging. J Shoulder Elbow Surg 2015;24:733-40.
6. Friedenberg SM, Zimprich T, Harper CM. The natural history of long thoracic and spinal accessory neuropathies. Muscle Nerve 2002;25:535-9.
7. Fu SY, Gordon T. Contributing factors to poor functional recovery after delayed nerve repair: Prolonged denervation. J Neurosci 1995;15(5 Pt 2):3886-95.
8. Gordon SL, Graham WP 3rd, Black JT, Miller SH. Acessory nerve function after surgical procedures in the posterior triangle. Arch Surg 1977;112:264-8.
9. Gregg JR, Labosky D, Harty M, Lotke P, Ecker M, DiStefano V, *et al*. Serratus anterior paralysis in the young athlete. J Bone Joint Surg Am 1979;61:825-32.
10. Grzybowski A, Kaufman MH. Sir Charles Bell (1774-1842): Contributions to neuro-ophthalmology. Acta Ophthalmol Scand 2007;85:897-901.
11. Kauppila LI, Vastamäki M. Iatrogenic serratus anterior paralysis. Long-term outcome in 26 patients. Chest 1996;109:31-4.
12. Klebe TM, Døssing KV, Blenstrup T, Nielsen-Ferreira J, Rejsenhus L, Aalkjaer G, *et al*. Scapulae alatae--englevinger. En opgørelse of 64 patienter behandlet med brace-bandage og fysioterapi på Viborg Sygehus [Scapulae alatae-angels' wings. A study of 64 patients treated with braces and physical therapy at the Viberg's hospital]. Ugeskr Laeger 2003;165:1779-82.
13. Mackinnon SE, Novak CB. Nerve transfers. New options for reconstruction following nerve injury. Hand Clin 1999;15:643-66, ix.
14. Mah JY, Otsuka NY. Scapular winging in young athletes. J Pediatr Orthop 1992;12:245-7.
15. Makin GJ, Brown WF, Ebers GC. C7 radiculopathy: Importance of scapular winging in clinical diagnosis. J Neurol Neurosurg Psychiatry 1986;49:640-4.
16. Marin R. Scapula winger's brace: A case series on the management of long thoracic nerve palsy. Arch Phys Med Rehabil 1998;79:1226-30.
17. Martin RM, Fish DE. Scapular winging: Anatomical review, diagnosis, and treatments. Curr Rev Musculoskelet Med 2008;1:1-11.
18. Noland SS, Krauss EM, Felder JM, Mackinnon SE. Surgical and clinical decision making in isolated long thoracic nerve palsy. Hand (N Y) 2018;13:689-94.
19. Novak CB, Mackinnon SE. Surgical treatment of a long thoracic nerve palsy. Ann Thorac Surg 2002;73:1643-5.
20. Ogino T, Sugawara M, Minami A, Kato H, Ohnishi N. Accessory nerve injury: Conservative or surgical treatment? J Hand Surg Br 1991;16:531-6.
21. Parsonage MJ, Turner JW. Neuralgic amyotrophy; the shoulder-girdle syndrome. Lancet 1948;1:973-8.
22. Perlmutter GS, Leffert RD. Results of transfer of the pectoralis

major tendon to treat paralysis of the serratus anterior muscle. J Bone Joint Surg Am 1999;81:377-84.
23. Phillips LH 2nd. Familial long thoracic nerve palsy: A manifestation of brachial plexus neuropathy. Neurology 1986;36:1251-3.
24. Pugliese GN, Green RF, Antonacci A. Radiation-induced long thoracic nerve palsy. Cancer 1987;60:1247-8.
25. Ray WZ, Pet MA, Nicoson MC, Yee A, Kahn LC, Mackinnon SE. Two-level motor nerve transfer for the treatment of long thoracic nerve palsy. J Neurosurg 2011;115:858-64.
26. Saunders JR Jr., Hirata RM, Jaques DA. Considering the spinal accessory nerve in head and neck surgery. Am J Surg 1985;150:491-4.
27. Seckel BR. Enhancement of peripheral nerve regeneration. Muscle Nerve 1990;13:785-800.
28. Segonds JM, Alnot JY, Asfazadourian H. Paralysie isolée du muscle serratus antérieur d'origine traumatique [Isolated traumatic serratus anterior muscle palsy]. Rev Chir Orthop Reparatrice Appar Mot 2002;88:751-9.
29. Sharp WJ, Nowak LR, Zamani T, Kresowik TF, Hoballah JJ, Ballinger BA, *et al*. Long-term follow-up and patient satisfaction after surgery for thoracic outlet syndrome. Ann Vasc Surg 2001;15:32-6.
30. Sunderland S. The anatomy and physiology of nerve injury. Muscle Nerve 1990;13:771-84.
31. Vastamäki M, Kauppila LI. Etiologic factors in isolated paralysis of the serratus anterior muscle: A report of 197 cases. J Shoulder Elbow Surg 1993;2:240-3.
32. Warner JJ, Navarro RA. Serratus anterior dysfunction. Recognition and treatment. Clin Orthop Relat Res 1998;349:139-48.
33. Watson CJ, Schenkman M. Physical therapy management of isolated serratus anterior muscle paralysis. Phys Ther 1995;75:194-202.
34. Weisberger EC, Kincaid J, Riteris J. Cable grafting of the spinal accessory nerve after radical neck dissection. Arch Otolaryngol Head Neck Surg 1998;124:377-80.
35. Wiater JM, Flatow EL. Long thoracic nerve injury. Clin Orthop Relat Res 1999;368:17-27.

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