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Original Article

Syndrome of fascial incarceration of the long thoracic nerve: winged scapula☆

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ABSTRACT

Objective: To analyze the results from early intervention surgery in patients with the syndrome of fascial incarceration of the long thoracic nerve and consequent winged scapula.
Methods: Six patients with a syndrome of nerve trapping without specific nerve strain limitations were followed up.
Results: The patients achieved improvement of their symptoms 6–20 months after the procedure. The motor symptoms completely disappeared, without any persistent pain. The medial deformity of the winged scapula improved in all cases, without any residual esthetic disorders.
Conclusion: The approach of early surgical release seems to be a better predictor for recovery from non-traumatic paralysis of the anterior serratus muscle.

Síndrome do aprisionamento fascial do nervo torácico longo: escápula alada

Palavras-chave:
Escápula
Tórax
Síndromes de compressão nervosa

RESUMO

Objetivo: Analisar os resultados de cirurgia de intervenção precoce em pacientes com síndrome do aprisionamento fascial do nervo torácico longo e consequente escápula alada.
Métodos: Acompanhamos seis pacientes com uma síndrome de aprisionamento sem restrições específicas de estiramento ao nervo.
Resultados: Pacientes tiveram melhoria em seus sintomas seis a 20 meses após o procedimento. Sintomas motores melhoraram completamente sem qualquer dor persistente. A deformidade medial da escápula alada melhorou em todos os casos sem distúrbios estéticos residuais.

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Conclusão: A abordagem de liberação cirúrgica precoce parece ser um melhor preditor na recuperação de paralisia não traumática do músculo serrátil anterior.

Introduction

Winged scapula is an uncommon condition that affects the scapulothoracic stabilizer muscles that cause separation of the scapula from the ribcage.[1] The anterior serratus, which is innervated by the long thoracic nerve, is involved in abduction and elevation of the shoulder and attaches the scapula to the ribcage. Any type of strain or force on this nerve may result in paralysis of the muscle.[2,3] In situations without signs of trauma or force, the etiology may be insidious and compressive, caused by the muscle itself and its superficial fascia.[4,5]

The clinical history and physical examination are a reliable basis for the diagnosis, although electromyography can also demonstrate the impact on the nerve.[1,6] The present article focuses on occurrences of winged scapula due to paralysis of the anterior serratus, with secondary consideration given to the compression syndrome of the long thoracic nerve.

In our case series, we present a syndrome of incarceration without any specific restrictions due to nerve strain. Our intention was to analyze early surgical intervention, which consists of full release of the fascia that compresses the entire path of the long thoracic nerve, performed within six months of the appearance of the initial symptoms, even though some authors have recommended conservative treatment for this condition.[3] Through this approach, we believe that the risk of developing sequelae is diminished, which therefore allows patients to return to their routine more rapidly.

Methods

Six patients were chosen through the inclusion criteria, i.e. those who presented a syndrome of fascial incarceration without any specific restrictions of nerve strain were used as controls. Traumatic events were not associated with this and other etiologies of effort were discarded. All the cases in this series presented at least three months of symptoms consistent with pain, a certain degree of deficiency of the shoulder and paralysis of the anterior serratus alone induced by a winged scapula. No comorbidities and no relevant medical findings were recorded in any of the cases and a complete examination of the shoulder was performed in each case.

None of the patients were able to determine exactly when their symptoms had started and none of them reported having suffered any type of trauma or physical stress relating to their condition. Surgical treatment was considered six months after the start of the symptoms in each case.

An approach involving a medial axillary incision was used in all the cases to identify the long thoracic nerve and release it from its course along the anterior serratus muscle, between the superficial fascia and the digitations of the muscle. The mean length of follow-up was 24 months, with a range from 18 to 32. The patients' mean age was 28 years, with a range from 16 to 34. There were four female patients and two male patients. Four patients made a living doing work with low manual impact, while the other two were adolescents without any athletic activities. Only two of the six patients underwent electromyography, which we had not indicated, since we believe that the diagnosis can be made purely from the clinical examination findings.

Results

In all the cases, the patient's dominant side was compromised. All the patients present pain and a certain degree of limitation of the scapular belt, which was exacerbated through frontal elevation and abduction. All of them presented scapular deformation that distressed them esthetically (Figs. 1 and 3).

The long thoracic nerve was found to be currently in its usual position. No specific compressive site was identified. Thus, no ischemic alteration was noted in any specific portion of the nerve. Neurolysis was performed along the entire course of the nerve, from proximal to distal and over its top surface, which released the fascial compression over the muscle, thereby carefully preserving the intermuscular and end branches.

The patients presented improvements in their symptoms 6–12 months after the procedure. The length of the recovery period ranged from 6 to 12 months. The motor symptoms improved completely, without any prolonged pain. The medial scapular deformity improved in all the cases, without any residual esthetic disorders (Figs. 1–5).

Fig. 1 – Case 1, before the operation. Unstable winged scapula.

Fig. 2 – Case 1, nine months after the operation with stabilization of the scapula.

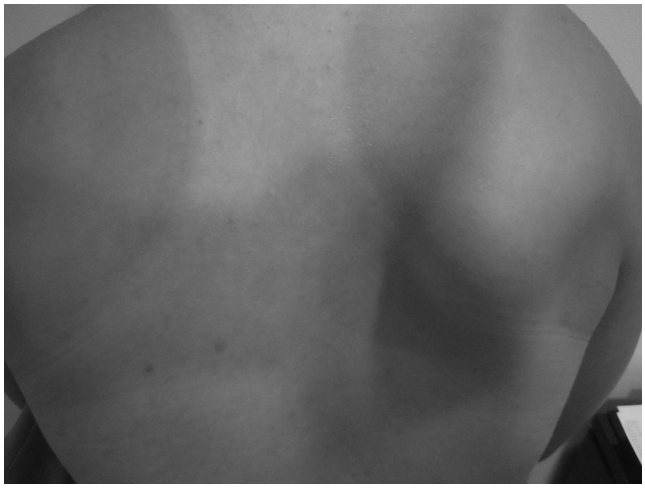

Fig. 3 – Case 2, before the operation. Winged scapula of idiopathic origin.

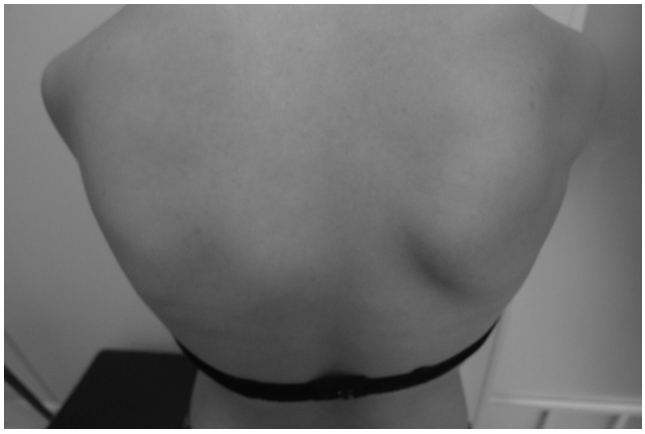

Fig. 4 – Case 2, two months after the operation.

Fig. 5 – Case 2, nine months after the operation.

No complications occurred during the procedure or as a consequence of it, and no recurrences have been documented up to the present date. The incision scars evolved in a normal manner, without adherences or restrictions.

Discussion

Winged scapula is an uncommon condition that it little diagnosed. It is often caused by dysfunction of the scapulothoracic stabilizer muscles, i.e. the anterior serratus, trapezius and rhomboid muscles. Impairment of the long thoracic and accessory spinal nerves is the commonest cause of winged scapula, while several etiologies involving the integrity of the nerve have also been discovered.[1]

The anterior serratus muscle has three portions and is inserted in the medial portion of the scapula. It is primarily innervated by the long thoracic nerve, which characteristically arises from three roots between the fifth, sixth and seventh cervical nerves (C5–C7).[2]

In an anatomical study on cadavers, Hamada et al.[7] meticulously demonstrated the innervation, insertion and function of the anterior serratus. The upper part is innervated mainly by the root of C5 and may receive branches from C4, C6 and C7, while the middle and lower parts are innervated by the roots of C6 and C7. The specific functions of the parts of this muscle are stabilization, abduction and upward rotation, respectively.

Because the nerve runs superficially to the muscle, this makes it vulnerable to any type of trauma. Thus, winged scapula due to paralysis of the anterior serratus alone is always medial and lengthening the muscle makes it possible to separate the scapula from the ribcage.[5,8]

Other conditions that cause winged scapula include paralysis of the trapezius and rhomboid muscle, and these involve the accessory nerve and dorsal scapular nerve, respectively. These paralyzes result in a lateral winged scapula, which thus differs from paralysis of the anterior serratus alone.[1,3,9,10]

Paralysis of the anterior serratus has been well documented among professional and amateur athletes and can also be described as an occupational injury among many mechanical and technical workers.[11]

In relation to the physiopathology, contusive trauma that produces neuropraxia is reported in the majority of the cases in which paralysis of the anterior serratus occurs. Other forms of trauma may be caused by repetitive movements, such as those that are common in manual labor activities or domestic activities.[4]

Other common causes of traumatic aggression to nerves include invasive procedures such as mastectomy with resection of axillary nodules, thoracostomy, use of axillary crutches and use of chiropractic. The non-traumatic etiologies associated with paralysis of the anterior serratus include viral diseases, poisoning, muscular dystrophy and mechanical injuries such as prolonged abduction of the arm when lying down or certain positions relating to anesthesia.[12]

Compressive complaints in muscle structures alongside proximal nerve segments have been well documented, given that the nerve perforates the scalene muscle. However, this indicator of the cause is not very reliable, given that the dorsal scapular nerve also perforates the scalene without affecting the rhomboid. A scapular bursa or enlarged and inflamed subcoracoid may also cause nerve compression.[3,13,14]

Hester et al.[13] proposed an internal mechanical etiology that involves the forces created by abduction and external rotation of the arm, which causes the long thoracic nerve to extend like an arch around the extended fascia between the plexus, scalene muscle and first rib. This theory arose from a study on a small number of cadavers.

The different physiopathological mechanisms that have been described explain the progressive constrictive effect of the fascia of the anterior serratus by the thoracodorsal nerve. These can be considered to be constrictive repetitive injuries or dysfunction through exertion, thereby causing a defined syndrome. Active contractility of the fascia, along with overlapping of the nerve, may help in explaining the altered dynamics of the muscle. This theory may explain how the fascia would contract in a smooth muscle-like manner so as to produce a constrictive effect. The myofascial tonus at rest may be another factor involved in the physiopathological explanation of the syndrome. Independent of the activity of the central nervous system, passive muscle tension at rest is transmitted in a complex manner to the fibrils of the matrix of the surrounding fascia and to the connective tissue.[15–18]

It needs to be understood that a winged scapula is not simply an esthetic problem, given that the muscle activity required in order to compensate for the stability of the shoulder is associated with secondary pain and spasms caused by muscle imbalance and irritation of the tendon around the shoulder joint.[3,19]

Electromyography is a useful tool for attempting to identify the etiologies of different peripheral neurological conditions, including compressive syndromes.

Paralysis of the anterior serratus is a specific entity that is capable of producing a winged scapula of medial appearance, in which all the muscle insertions are present.[20]

As mentioned earlier, none of the patients treated had any history of trauma or repetitive physical stress on the lateral part of the chest, which added difficulty to identify the etiology. Many studies have proposed different points at which the nerve might be trapped between different structures, such as the scalene muscle or roots of the thoracodorsal artery, with fascial strain and muscle abnormalities.[4,7,13,21]

In our case series, no particular structures other than the fascia itself were involved in compression of the long thoracic nerve along its entire course. Laulan et al.[2] proposed different etiologies, such as overlapping of the roots of the thoracodorsal artery onto the distal nerve.

The main etiological factors and mechanisms involved in paralysis of the anterior serratus alone were described well by Vastamaki and Kauppila.[9] Moreover, in a study on cadavers, Kauppila[4] demonstrated the implications of scapular abduction movement on stretching of the lower segments of the nerve and arteries that supply the lower digitations, where these segments seem to be looser. This author also suggested that there might be a deficiency of blood supply in the subscapular artery, which would affect this inferior epineural segment via the lower angle of the scapula.

Hester et al.[13] identified fascial strain between the lower aspect of the brachial plexus and the upper portion of the muscle, which would have the capacity to compress the nerve during abduction and external rotation of the arm.

Several studies have recommended that non-surgical methods should be used to resolve cases of winged scapula caused by force on the nerve, repetitive trauma (such as from activities relating to sports) or accidents. However, other studies have shown that there is a significant improvement rate through surgery performed at early stages of the symptoms. It is known that only a few of these patients will recover spontaneously. Some may show partial improvement or may even not improve, thus continuing to present debilitating sequelae. This may be a decisive argument for proposing surgery during the early stages.[2,14]

All the patients in our case series underwent surgical release six months after the symptoms started, given that we strongly suspected nerve incarceration on the basis of the clinical findings, among which there was no history of trauma or force.

The different surgical methods attempt to reestablish the physiological mechanics of the scapular belt, given that definitive sequelae are present. Muscle transfers, especially using flaps from the pectoralis major, and also scapulothoracic arthrodesis, were useful for obtaining partial improvements. Novak and Mackinnon[22] presented a single case in which transfer of the thoracodorsal nerve to the long thoracic nerve resulted in good functional recovery of the anterior serratus muscle.[19,23]

Conclusions

Even though our case series involved a small number of patients, it could be demonstrated that the origin of incarceration of the long thoracic nerve was purely fascial, and that this induced a complete syndrome. Early surgical release seems to be a good predictor for recovery from non-traumatic paralysis of the anterior serratus.

Given the complexity of the condition and knowing that debilitating limitations may be perpetuated over the long term, we proposed an early surgical intervention for fascial

release of the nerve, not more than six months after the start of the symptoms.

Paralysis of the anterior serratus is a well-recognized form of paralysis that arises from a medial winged scapula. It is caused by elongation of the insertion of three portions of the muscle at the medial border of the scapula. The clinical history and examination provide sufficient basis for making the diagnosis and planning surgical treatment in all cases.

The syndrome of fascial incarceration seems to be a specific entity that involves myofascial dynamics and tension, and it leads to a vicious circle in which microvascular insufficiency, fascial fibrosis, friction and restrictions on sliding perpetuate the constriction, as is seen in other types of compressive neuropathy of the upper limbs. Studies taking into consideration the myofascial physiological mechanics and their relationship with the long thoracic nerve need to be conducted.

Conflicts of interest

The authors declare no conflicts of interest.

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