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CASE REPORT

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A case of atypical insertion of the levator scapulae

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Anatomical variations in the musculature of the spine have the potential to cause functional and postural abnormalities, which in turn could lead to chronic myofascial and skeletal pain. We present a unilateral case of a 71-year-old Caucasian female in which the left levator scapulae muscle gave rise to an accessory head that inserted, by way of a flat aponeurotic band, to the ligamentum nuchae, the tendon of the rhomboideus major and the superior aspect of the serratus posterior superior muscle. The innervation was provided by a branch of the dorsal scapular nerve. By exerting unilateral traction on the vertebrae and surrounding musculature, this unusual variation might have resulted in clinical consequences including scoliosis and movement abnormalities of the head and neck as well as myofascial pain syndrome.

Key words: levator scapulae, serrratus posterior superior, *occipitoscapularis*, cervical musculature, scoliolis, myofascial pain syndrome

INTRODUCTION

For centuries anatomists and clinicians have been assiduous in their study of detailed anatomy, including variations in the human musculoskeletal system, and yet anatomical anomalies which have not previously been reported in the literature continue to be found. In standard anatomical texts the levator scapulae is described as a band-like muscle, originating from the transverse processes of C1–C4 and inserting on the superior angle and medial border of the scapula [7, 10]. According to Bergmann et al. [2], the levator scapulae muscle is enclosed by two major connective tissue fasciculi, each with varied and independent attachments. These two parts have been classified in the following way by Wood. The dorsal fasciculus arises from the dorsal portion of the cervical vertebrae and inserts into the serratus posterior superior, the rhomboids or onto the spinous processes of the vertebrae [11–13]. The ventral fasciculus arises from the cervical vertebrae and runs downward to insert on the ventral surface of the subscapularis or serratus posterior superior. In addition, a fasciculus can arise from the mastoid process, run with the splenius capitis and insert onto the medial angle of the scapula [13].

Several variations on this pattern have been reported in the literature. Most commonly the levator scapulae may arise from an expanded or narrowed range of cervical vertebrae [2]. In addition, slips may extend to the temporal or occipital bones, the rhomboids, serratus anterior, serratus posterior superior and the trapezius muscles [13]. Other variations include extensions to the clavicle, first and second ribs and spinous processes of the thoracic vertebrae. In many cases these variations consist of small bands of muscle or tendon that are clinically insignificant. However, reports exist in the literature which describe chronic upper or shoulder pain possibly associated

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with deviations from the common pattern of origin or insertion [6].

Myofascial pain syndrome (MPS) in the cervical and upper thoracic regions is a common medical problem. The muscles involved include the trapezius, multifidi, the splenius cervicis, levator scapulae, supraspinatus or infraspinatus [4]. Considering the delicate mechanical balance required to maintain proper posture and vertebral column alignment, a muscular variation could lead to structural changes which in turn may lead to soft tissue skeletal pain.

We present a case in which the left levator scapulae gave rise to an accessory head with broad insertion by way of a flat aponeurotic band to the ligamentum nuchae, the tendon of the rhomboideus major and the superior aspect of the serratus posterior superior muscle.

CASE REPORT

The variation was discovered during a faculty prosection of the posterior cervical and upper thoracic region in the Medical Gross Anatomy Laboratory at St. George's University School of Medicine during the autumn semester of 2005. The anomaly was found in a 71-year-old Caucasian female who died of pulmonary embolism. The specimen had previously been fixed in formalin-phenol-alcohol solution and showed no evidence of cervicospinal or thoracic procedures or any other major musculoskeletal abnormalities.

During the dissection, the left trapezius muscle was detached from its origin and reflected laterally toward its insertion upon the scapula. By reflecting the splenius capitis and rhomboidius major and minor muscles medially, the levator scapulae could be visualised. After arising from the transverse processes of the axis and the posterior tubercles of the transverse processes of the third and fourth cervical vertebrae, the belly of the levator scapulae split to form two distinct heads. The lateral head inserted upon the superior angle and medial border of the scapula. The medial, or accessory, head initially travelled inferomedially, parallel to the fibres of the splenius cervicis, before widening into a thick aponeurotic band, which inserted broadly upon several structures (Fig. 1).

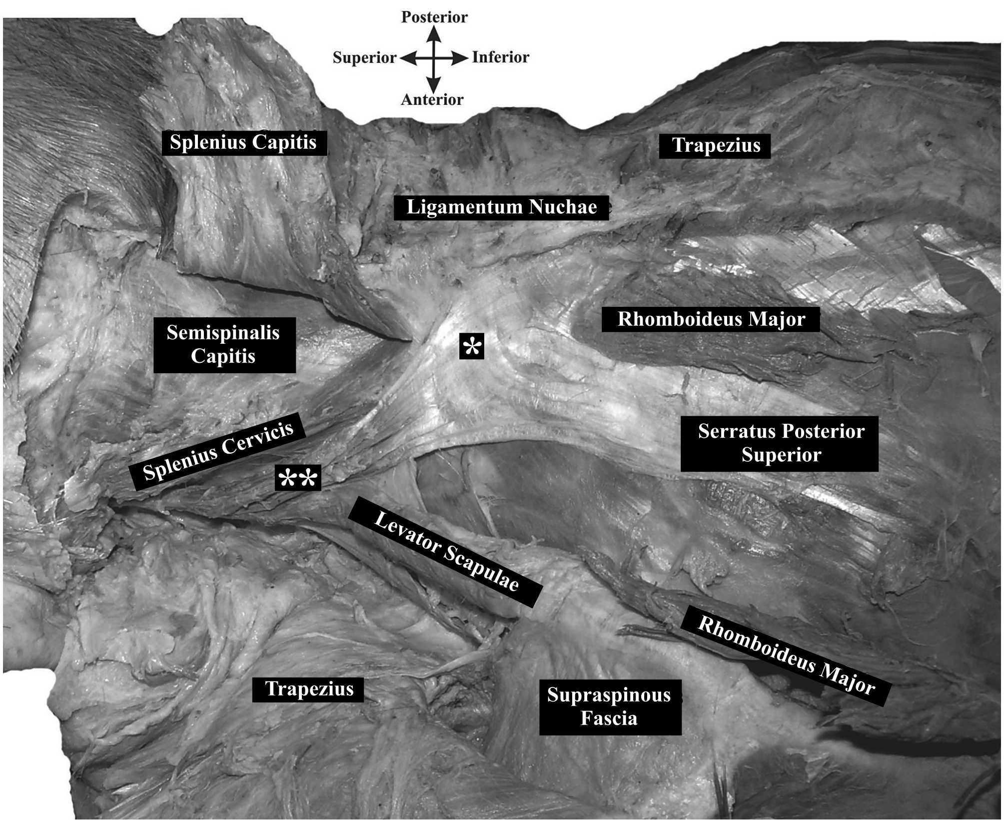

Figure 1. Figure demonstrates the levator scapulae including the accessory head with its broad aponeurotic insertion to the *ligamentum nuchae*, *rhomboideus major* muscle and the serrratus posterior superior muscle. A single star indicates the flat, broad, triangular aponeurosis of the accessory levator scapulae. A double star indicates the muscular head of the accessory levator scapulae.

The most superior portion of this aponeurosis fused with the ligamentum nuchae at the level of C6 (Fig. 2). More inferiorly, the muscle inserted into the tendon of the rhomboideus major as well as the fibres of the serratus posterior superior. The aponeurosis of the medial head was tough and required sharp dissection in order to expose the innervation, which arose deeply from a small branch of the dorsal scapular nerve. No other anomalies or variations of cervical, thoracic or lumbar musculature were noted.

DISCUSSION

When anatomical anomalies are reported, a thorough search of the literature is essential, not only for comparison with other reports but also to determine the appropriate nomenclature. Considering both the common origin of this muscle from the cervical transverse processes and its innervation by the dorsal scapular nerve, the authors have decided to describe this structure as an accessory head of the levator scapulae.

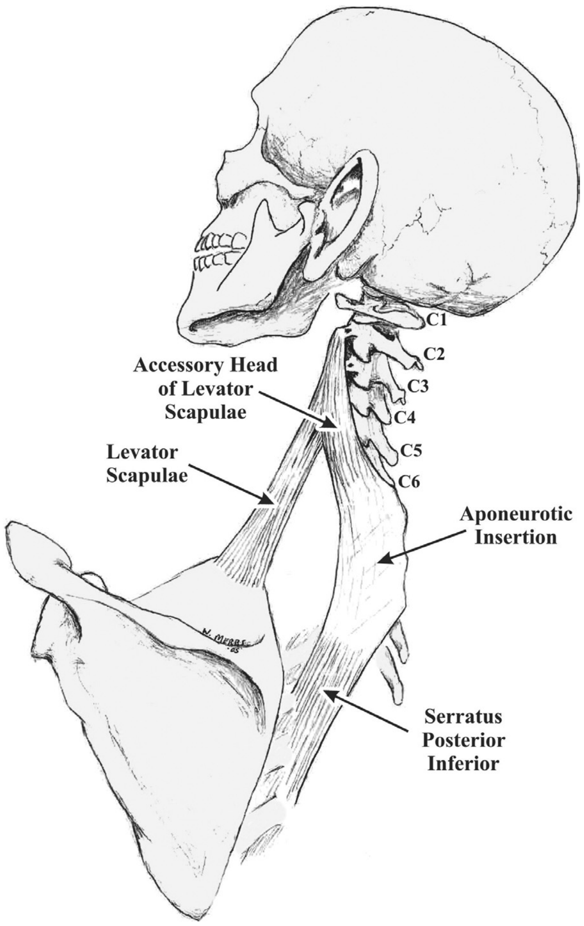

Figure 2. Figure is a diagrammatic representation of the accessory head of the levator scapulae. Clearly visible is the broad aponeurotic insertion of the accessory head of the levator scapulae.

The comparative study of musculature can present many challenges as a result of the variability between and within species, as well as the changes that occur in functionality. Phylogenetically, the epaxial trunk musculature may be considered as arising from a single dorsolateral trunk muscle, the dorsalis trunci, which exists in fish. In tetrapods this trunk musculature is reduced, possibly owing to the dominant role of limb musculature in the propulsion of these species. In this case the accessory head of the levator scapulae appears to be reminiscent of the costocervicalis in the Sphenodon [9]. Because of their jagged appearance most of the muscles of this group came to be known as the "serratus" muscles. However, the most anterior portion was termed the "levator scapulae" according to its insertion and function. The time frame in which this change occurred is difficult to pinpoint, but the transition probably coincided with the appearance of a more developed pectoral girdle, as these animals slowly made their exodus from the ocean.

Several authors have performed studies that have examined the normal anatomy and variations of the levator scapulae muscle. According to Mori [8], a deviant slip can arise from the medial margin of the levator scapulae, which runs medially and downward to insert onto the spinous process of the second thoracic vertebra, on the dorsal surface of the serratus posterior superior or on the dorsolumbar fascia.

Macalister also reported several variations for the levator scapulae, including an origin from the temporal and occipital bones as well as a number of possible slips to various structures in the cervical and upper thoracic regions [5]. It is interesting to note, however, that none of the aforementioned authors have described any cases in which the levator scapulae had a broad insertion by way of a thick aponeurotic band. It is with this key difference that the present report becomes clinically significant. Just as thoracolumbar aponeurosis has the potential to affect spinal alignment, so too this large aponeurotic component may lead to an increased likelihood of disruption of the normal curvature and stability of the vertebral column [10].

Although some anatomical data are present, there are few reports in the literature which address the clinical consequences of such variations. A study by Menachem et al. [6] examined patients presenting with a common clinical picture of pain over the upper medial angle of the scapula. In these patients pain radiated to the neck and shoulder but rarely to the arm. Additionally, movements that stretched the levator scapulae on the affected side aggravated the symptoms. According to Menachem et al. [6], this syndrome may be caused by anatomical variations in the insertion of the levator scapulae and origin of the serratus anterior. Because of the post-mortem nature of our discovery we are unable to determine whether the patient suffered from any complications. However, it is possible that in the present case the broad aponeurotic insertion of the levator scapulae could have led to MPS.

It is important to consider that there may be multiple aetiological agents which can independently cause the common symptoms of MPS, namely cervicogenic headache, neck and shoulder pain and decreased cervical range of motion. Support for the anatomical basis of MPS derives from the study by Ferrante et al. [3], who report that direct injection of botulinum toxin type A (BotoxA) into trigger points did not improve cervicothoracic MPS. By using an agent known to cause muscle paralysis those authors hoped to gain some insight into the aetiology of MPS. The failure of BotoxA to relieve symptoms suggests that the symptoms are not myopathic and may, in fact, be more structurally derived.

Further evidence for this theory is provided by the study of Arokoski et al. [1], who employed a novel computerised soft tissue stiffness meter to evaluate, amongst other features, the levator scapulae muscle. Soft tissue stiffness values of the myofascial trigger points in the levator scapulae muscles were evaluated bilaterally and a linear positive relationship was found between the indenter force and the dynamic compressive modulus of elastomer stiffness [1]. By using this method to evaluate the present case, it stands to reason that the increased stiffness could be a direct result of the increased amount of fibrous tissue present within the aponeurotic insertion of the levator scapulae.

Another study by Kung et al. [4] found that acupuncture is a fairly effective method for pain relief of patients with chronic MPS in the cervical and upper back regions. Unfortunately, no data were provided as to the degree of soft tissue stiffness prior to treatment. An interesting study might focus on a combination of these two seemingly effective techniques in order to provide data regarding the relationship between the degree of soft tissue stiffness and the effectiveness of BotoxA or acupuncture in treating MPS. In view of the potential for clinical consequences and the various possibilities for treatment, it remains important to report unusual anatomical variations as they arise.

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