ISSN 2563-7142

CASE REPORT

Inferior Trapezius Muscle Agenesis and Scapular Dyskinesis in a 58-Year-Old Male Donor: A Cadaveric Case Report

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Samuel A, Wands K, Granite G, et al. Inferior Trapezius Muscle Agenesis and Scapular Dyskinesis in a 58-Year-Old Male Donor: A Cadaveric Case Report. Int J Cadaver Stud Ant Var. 2024;5(1):18-23.

Abstract

A functionally significant abnormality was observed in a 58-year-old male donor with a cause of death of thyroid cancer. He exhibited left inferior trapezius muscle agenesis as well as scapular dyskinesis. The left scapula is shown pressing into the adjacent vertebral bodies of C7 and T1, which resulted in deviations in the location of the left semispinalis capitis, semispinalis cervicis, and splenius cervicis muscles. This resulted in compromise of the left levator scapulae muscle. It is suspected that these abnormalities would have resulted in functional limitations in arm movement and shoulder asymmetry. A literature review was completed to understand the significance of these abnormalities.

Key Words: *Trapezius muscle; Agenesis; Scapular dyskinesis; Semispinalis capitis muscle deviation; Abnormality*

Introduction

The trapezius is a triangular muscle involved in head and neck stabilization and shoulder movement [1]. It supports the pectoral girdle by suspending it from the axial skeleton [2]. The trapezius originates from the superior nuchal line, external occipital protuberance, nuchal ligament, and C7-T12 spinous processes [2]. It can be divided into three parts: the superior part inserts into the lateral third of the clavicle and elevates and rotates the scapula, the middle part inserts into the acromion of the scapula and retracts it, and the inferior part inserts on the spine of the scapula and provides depression and rotation of the scapula [1-3]. In this case, the donor has agenesis of the inferior part of the trapezius (Figures 1a and 1b). Agenesis of a muscle implies that it never developed and that a person was born with the muscle completely missing, partially missing, or underdeveloped. This can be due to a variety of factors and can be found in isolation or combined with other abnormalities [1]. Due to unilateral agenesis of the inferior trapezius, the donor would be expected to have had a functional limitation, specifically a limited ability to depress and

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Received: February 14, 2024, Accepted: February 29, 2024, Published: March 09, 2024

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rotate the scapula. Additionally, while it is assumed that this donor's lack of a left inferior trapezius is the result of agenesis, the donor also has left scapular dyskinesis, which is defined as a physical impairment in which the scapula's position and motion are altered. Scapular dyskinesis in this donor is likely a malformation, resulting in deviations seen in the left semispinalis capitis muscle and splenius cervicis muscle. Congenital elevation of the scapula is known as Sprengel's deformity or Sprengel's shoulder, an eponym for deformity of the pectoral girdle that causes symptomatic cosmetic and functional disability, which should be considered as an underlying deformity in this donor [4].

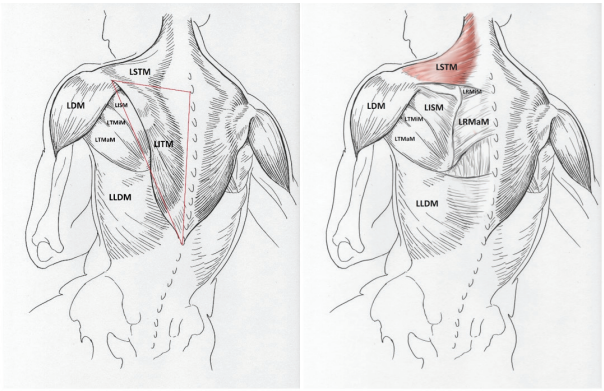

Figure 1) a (Left) *Schematic depiction of typical anatomy of superficial musculature of the back.*

LDM=Left Deltoid Muscle; LISM=Left Infraspinatus Muscle; LITM=Left Inferior Trapezius Muscle; LLDM=Left Latissimus Dorsi Muscle; LSTM=Left Superior Trapezius Muscle; LTMaM=Left Teres Major Muscle; LTMiM=Left Teres Minor Muscle.

b (Right) *Schematic depiction of left inferior trapezius muscle agenesis.*

LDM=Left Deltoid Muscle; LISM=Left Infraspinatus Muscle; LLDM=Left Latissimus Dorsi Muscle; LRMaM=Left Rhomboid Major Muscle; LRMiM=Left Rhomboid Minor Muscle; LSTM=Left Superior Trapezius Muscle; LTMaM=Left Teresa Major Muscle; LTMiM=Left Teres Minor Muscle. (Schematics drawn by Dr. Gary Wind)

Case Description

During a routine anatomical dissection of 64 human donors in 2021-2022 first-year medical student gross anatomy and nursing anatomy courses at the Uniformed Services University of the Health Sciences, the following anatomical variation was observed: inferior trapezius agenesis and left scapula fused to a vertebra, resulting in semispinalis capitis, semispinalis cervicis, and splenius cervicis muscle deviation (Figures 2,3a, and 3b). The left rhomboid muscles could not be observed due to student dissection. The cadaver from the Maryland State Anatomy Board was a 58-year-old Black male donor whose cause of death was thyroid cancer. Medical students completed the initial dissection, and assistance was provided by anatomy faculty when the abnormality was found.

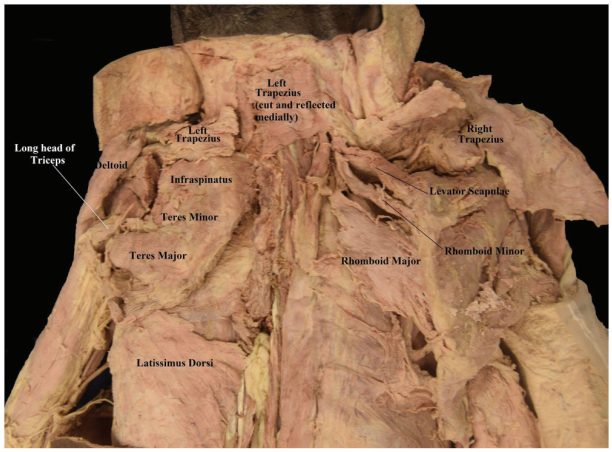

Figure 2) *Dissection of musculature of the back shows agenesis of the left trapezius. Rhomboid major and rhomboid minor muscles not seen - likely atrophied due to scapular deviation.*

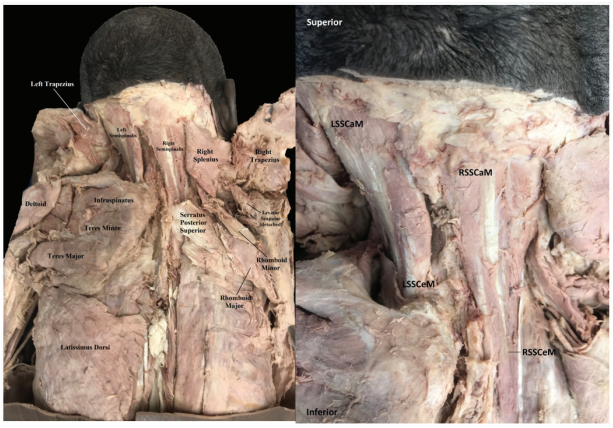

Figure 3) a (left) *This view of the dissection shows the left scapula deviated toward the midline, showing abnormal position of the scapula.* ***b (right):*** *A close-up view highlighting the deviated path of the semispinalis cervicis muscle. LSSCaM=Left Semispinalis Capitis Muscle; RSSCaM=Right Semispinalis Capitis Muscle; LSSCeM=Left Semispinalis Cervicis Muscle; RSSCeM=Right Semispinalis Cervicis Muscle.*

Discussion

The embryologic origin of the trapezius is established by its innervation, which is the branchiomotor nerve, making it a branchiomeric muscle [5]. Muscles innervated by the branchiomotor nerves are derived from the branchial arches, otherwise known as the pharyngeal arches [6]. The trapezius and sternocleidomastoid are derived from a common anlage that splits caudally into the former and cranially into the latter [1]. Unlike other skeletal muscles, this particular anlage does not originate from the somites but from the occipital lateral plate mesoderm [5,7]. This process occurs under the control of Tbx1, a gene implicated in negative and mutagenic effects on the branchial arches, especially as it has been linked to 22q11 deletion found in DiGeorge syndrome [5]. An article by Badura et al. echoes this stating that the "isolated lack of the trapezius may result from an incomplete failure of occipital or cervical somites" [1]. Moreover, another syndrome commonly associated with trapezius abnormalities is Poland's syndrome, which arises due to interrupted blood flow from the subclavian artery during fetal development [8]. This donor did not have the expected unilateral pectoral or hand abnormalities often seen in Poland's syndrome, so it is not likely that that would be the etiology of his abnormalities [5].

An implication of trapezius agenesis, besides the functional limitations of decreased depression and rotation of the scapula, is that since the trapezius helps facilitate respiration, its compromise, if significant, could affect breathing [1]. Given the surrounding musculature abnormalities and scapular dyskinesis, the left levator scapulae muscle function would also be compromised. Finally, knowledge of this variation is surgically significant because such variations would affect surgical planning in various surgeries of the back musculature and spine. However, in reviewing the literature, most cases of unilateral agenesis are discovered on cadavers; there are a few clinical reports of patients with hypoplasia or inferior trapezius agenesis, which were discovered due to shoulder asymmetry [9-11]. The majority of cases being found on cadavers implies that limitations in function that are debilitating are not expected. The prevalence of trapezius agenesis is rare but expected to be underreported since its absence can be compensated for by other muscles, leading to few, if any, symptoms [8]. In addition, it is noted that the reason it is often not seen in patients with Poland's syndrome is due to the occipital and posterior intercostal arteries supplying the trapezius, making it impervious to any bloodflow interruptions of the subclavian artery [8,12].

The semispinalis and splenius muscles seem not to have been implicated developmentally but appear to have a deviated path in this cadaver due to the abnormal location of the trapezius and scapula. In essence, the assumption is that these muscles were not the causative factors of the abnormalities found in this cadaver, but that the deviation of these muscles is secondary to the left scapula being more medial than average. This resulted in abnormal separation of the semispinalis and splenius muscles, thereby exposing the muscles of the suboccipital triangle (Figures 4a and 4b).

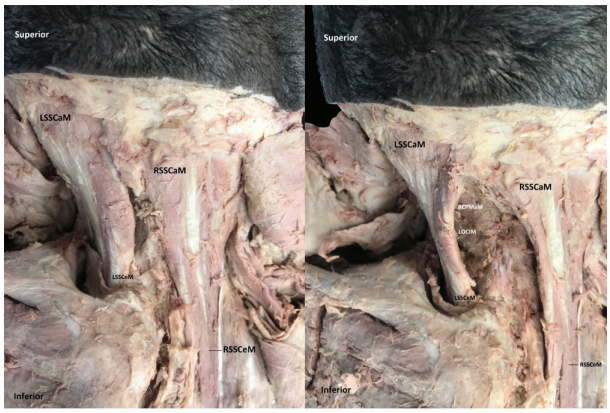

Figure 4) a (left) and 4,b (right) *It show the left and right semispinalis muscles, along with the suboccipital triangle beneath the deviated left semispinalis muscle.*

LOCIM=Left Obliquus Capitis Inferior Muscle; LSSCaM=Left Semispinalis Capitis Muscle; LSSCeM=Left Semispinalis Cervicis Muscle; LRCPMiM=Left Rectus Capitis Posterior Minor; RSSCaM=Right Semispinalis Capitis Muscle; RSSCeM=Right Semispinalis Cervicis Muscle.

Left Obliquus Capitis Superior Muscle not visible (underneath LSSCaM) and Left Rectus Capitis Posterior Minor not visible (still covered by fat).

Additionally, the absence of the left rhomboid major and minor muscles is thought to be due to atrophy in the setting of scapular dyskinesis. The rhomboid minor and major muscles function to retract the scapula toward the vertebral column [13]. This function would likely not be fully intact in this donor due to the scapula nearly fusing to the vertebral body. The combination of a rhomboid muscle variation observed in concert with trapezius agenesis was documented by Ulkir and Sargon as well [13].

As a result, this would limit the full and proper usage of the left arm, implying that those muscles would likely not have been used as frequently or vigorously as those of a person without musculoskeletal abnormalities. Thus, this results in a functional limitation and atrophy, likely related to abduction being impacted in the setting of this abnormality impacting normal scapular rotation [14]. Furthermore, the scapular dyskinesia and abnormal elevation of the shoulder can affect the nerves associated with the scapula, such as the suprascapular nerve, leading to shoulder pain and dysfunction [15]. In terms of the serratus posterior superior muscle, it seems smaller on the left side, but it was cut during student dissection before photographs were taken.

Other than the muscular anomalies previously discussed, it is interesting to note the donor's scapular dyskinesis. The left scapula is more medial and superior than expected, and upon closer inspection, it shows that it has almost fused to the vertebral column. This nearly bone-to-bone fusion can be better observed upon hemisection, which also showed an indentation in the vertebral body on the right side due to the left scapula pushing on it (Figures 5a and 5b).

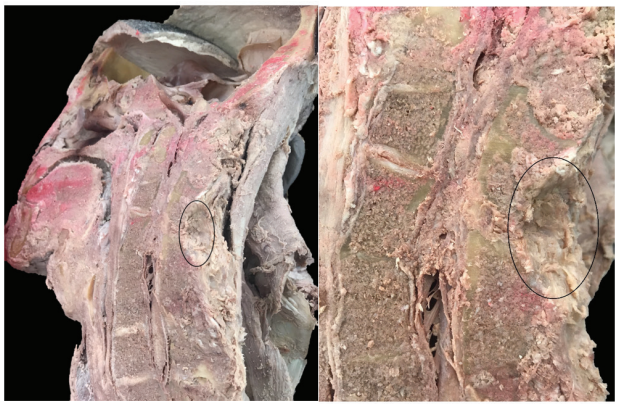

Figure 5) ***a (left)*** *shows the cadaver after hemisection, demonstrating the indentation of the scapula.*

b (right) *is a closer view. The site of the indentation is highlighted by a black circle in both figures.*

The hemi section was done slightly to the right of midline to preserve the left side of the vertebrae's connection with the scapula. The implication is that if it had pressed farther, it could have caused neurologic effects. Regarding congenital scapula elevation, there are many associated syndromes and deformities, such as torticollis and scoliosis [4]. If not congenital, several factors can lead to the development of scapular dyskinesis, ranging from imbalance within the joint due to labral tears, acromioclavicular separation, or glenohumeral instability to weakness of serratus anterior, scapular muscle, or lower trapezius [16-18]. Thus, lower trapezius weakness due to a lack of the lower trapezius is the likely explanation for this donor in that their inferior trapezius agenesis promoted the occurrence of scapular dyskinesis.

To attempt correction of cosmetic and functional disability, there are several procedures relating to congenital scapula elevation. Still, direct comparison is difficult due to varied procedures, techniques, and outcomes measured [4]. In diagnosing such an anomaly, it is often found in combination with muscle hypoplasia or atrophy, which is congruent with the findings of this donor: muscular agenesis with scapular dyskinesis [4]. McClure et al., however, noted the lack of a validated method for diagnosing scapular dyskinesis and proposed a Scapular Dyskinesis Test (SDT), which they found had

moderate interrater reliability [16]. The SDT involves clinician observation of the patient raising the arms in forward flexion, with or without weights, followed by notation of any abnormalities in movement [17]. This is important for clinicians because scapular dyskinesis can contribute to shoulder instability and injury [16].

Conclusion

In summary, the agenesis of part of the trapezius is a functionally significant abnormality that could impact shoulder movement and respiration, if it were a significant amount of agenesis. This article discussed the case of a 58-year-old male donor with a listed cause of death of thyroid cancer who was found to have left inferior trapezius agenesis and scapular dyskinesis, which led to the aberrant locations for the left semispinalis capitis muscle and splenius cervicis muscle. This was unlikely to have been a part of a syndrome like Poland's syndrome and may have been due to interrupted blood flow in the fetus or failed migration of somites.

Acknowledgment

We would like to thank the family of our donors for their beneficent contribution. Without their generosity, this article would not have been possible.

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