CASE REPORT

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Rare accessory slip of the deltoid muscle conjoined with teres minor

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SUMMARY

Routine dissection of a 69-year-old American Caucasian female revealed a unique accessory slip of the deltoid muscle which was conjoined with the proximal portion of teres minor. The variant muscle bundle was united with the distal portion of the deltoid, but deviated superomedially and fused with the origin of teres minor. This discovery possesses clinical relevance with respect to surgical repair of shoulder pathology or trauma. Shoulder injuries and their respective repairs are very common. Therefore, consideration of this variant is necessary for the correct diagnosis and treatment of massive trauma or other shoulder pathology that is refractory to standard treatments.

Key words: Deltoid – Teres minor – Variant – Muscle – Shoulder pathology

INTRODUCTION

Anatomic variation of the deltoid muscle (DT) is relatively uncommon; however, multiple variations have been reported. DT is composed of anterior, lateral and posterior sections, which have different origins and are responsible for various movements of the humerus at the glenohumeral joint. The most commonly observed variation is the septation of these different portions of DT. As many as seven separate muscle bundles have been described (Albinus, 1734). This configuration was later confirmed and accepted by anatomists in 1908, and again in 1911. More recently, mechanomyographic studies identified DT to be composed of seven separate heads, which can be fine-tuned by the central nervous system to better focus the movement of the respective motor units (Gorelick and Brown, 2007).

Another common DT variant is the absence of one or more segments of the DT muscle. Less commonly, accessory slips may be observed to originate from the infraspinatus or the lateral edge of the scapula and then subsequently insert anywhere from the middle portion of the posterior DT to the deltoid tuberosity of the humerus. Costodeltoideus is a rare accessory slip of DT that originates at the lateral edge of the scapula between the infraspinatus and teres minor (TMi), and inserts along the posterior border of DT (Calori, 1866).

Variation of the origin of the DT is uncommon and infrequently reported in the literature (Bergman et al., 2000). Modern anatomical literature has very few cases of costodeltoideus-like variants. A case of bilateral DT variation was discovered in which the posterior portion was enclosed in a separate fascial sheath (Kayikcioglu et al., 1993). A separate case described a unilateral DT variant whose posterior bundle was enclosed in a fascial sheath, and originated at the medial border of the scapula; however, the distal attachment was not discussed (Kamburoglu et al., 2008).

While DT variants are relatively uncommon, shoulder pathology via trauma or degenerative conditions are very common. Clinical relevance of such anomalies arise when surgical repairs of the upper back or shoulder are undertaken. Understanding anatomy is imperative to surgeons as they dissect the region to successfully accomplish

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the treatment without causing iatrogenic injury. Despite technologic advances, iatrogenic injury of surrounding nerves are among the most commonly reported complications of shoulder surgery (Scully et al., 2013).

The clinical significance of anatomic variation is evident in that manufacturers of modular prosthetic devices designed for implantation during shoulder reconstruction are engineered to accommodate such anomalies (Caniggia et al., 1999). A surgical study detailed the impact of anatomic variation and adverse outcomes from back surgery. In that study, the investigators showed that discrepancy between expected and actual anatomy was a significant source of complications (Ali et al., 2010). The rare deltoid variant observed in our case could provide confusion during the surgical repair of massive shoulder injury, as the normally expected landmarks were distorted. The extremely rare DT variant found in our cadaver has yet to be described in the respective literature and warrants unique consideration based on its clinical and anatomic implications.

CASE REPORT

During a routine dissection of a 69-year-old American Caucasian female cadaver at the Department of Integrative Physiology and Anatomy, University of North Texas Health Science Center, Texas College of Osteopathic Medicine (UNTHSC-TCOM), Fort Worth, Texas, USA, we discovered an anatomical variant of the right deltoid muscle. The dissection was meticulously performed to trace the origin and insertion of the variant, as well as the neurovascular supply. Dissection was performed bilaterally, and typical anatomy was observed on the left. High definition photographs were taken to document observations.

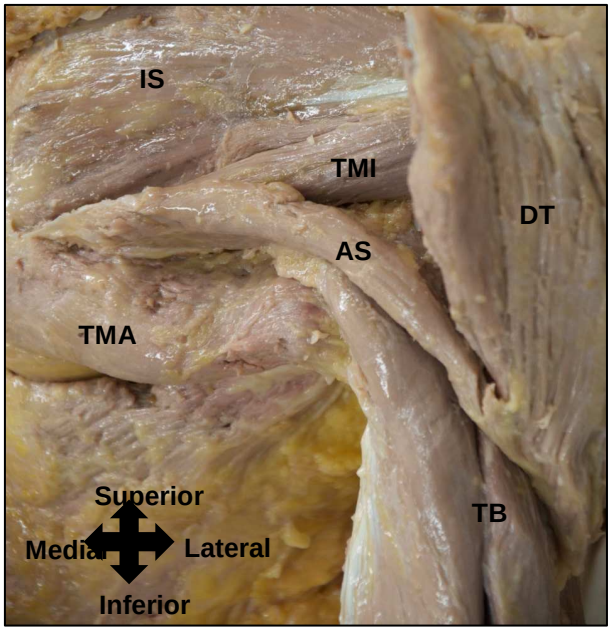

Fig. 1. Illustration of the additional slip of DT (AS) originating at the posterolateral edge of the scapula along with TMI (1) and inserting at the inferior aspect of the distal deltoid. Infraspinatus (IS), teres major (TMA), TMI, triceps brachii (TB), and the main bundle of the posterior DT can be observed in their expected positions. The proximal portion of TB is seen inferior to DT, and the medial head deviates medially from its normal path (*).

An atypical portion of the DT muscle was discovered on the right upper extremity and back of the cadaver consisting of an accessory slip (AS) of muscle complete with its own fascia and tendons. The origin of the AS was fused with the teres minor (TMi) at the middle third of the posterolateral border of the scapula. The muscle belly curved inferiorly and laterally toward the deltoid muscle. The distal end of the AS fused with the inferior aspect of the posterior division of the DT and continued caudally as part of the DT, where its tendon inserted into the deltoid tuberosity of the humerus. The configuration of the AS took on a comma-like shape (Fig. 1).

The anatomic spaces generally found in the posterior shoulder and back were also distorted. The triangular space was not found initially, but later discovered under the fused aponeuroses of the TMi and teres major (TMa) in the proximal third position. The circumflex scapular artery was located superior to its expected position, and deep to the TMi. The quadrangular space (QS) was also out of expected position and not quadrangular. Instead, it was triangular and covered completely by the AS. The expected contents of the QS, i.e. the axillary nerve and posterior circumflex humeral artery, were typical in appearance and structure. The proximal portion of the long head of triceps brachii was slightly displaced medially by the variant. The profunda brachii artery and radial nerve were found in the space formed by the common tendon of the AS, DT, and the triceps brachii tendon. Innervation of the AS was provided by ventral rami of spinal nerves C5-6 via the posterior branch of the axillary nerve. A dual blood supply from the circumflex scapular artery and the posterior circumflex artery was observed for the AS.

DISCUSSION

Variations of the DT muscle are relatively common. However, the specific variant described in this report is extremely rare. Similar variants were described by two separate anatomists in the late 1800's (Macalister, 1875; Le Double, 1897). More recently, Bergman et al. documented an accessory slip referred to as costodeltoideus originating between the infraspinatus and TMi. Among the most frequently reported DT variants are variations of septation including accessory slips and missing segments of the DT. In 1734, the German-born Dutch anatomist, Bernhard Siegfried Albinus, was likely the first to describe as many as seven sepa-

rate segments of the DT muscle. Reports of these types of atypical anatomy are well documented, and are easily located in review of current literature, unlike our discovery. The AS found in our dissection most closely resembles costodeltoideus, with the exception that the origin is seen between TMi and teres major, and almost directly on top of the origin of TMi. Therefore, we believe it is a unique variant that warrants clinical consideration.

Variants of this nature are important with respect to surgical interventions, as anatomical spaces and structures are used as landmarks for incisions and instrument placement. Previous studies have revealed that anatomic variations can complicate surgery (Ali et al., 2010). Neurovascular structures such as the axillary nerve and posterior circumflex humeral artery are particularly vulnerable in cases of traumatic injuries. Appropriate understanding of *in situ* anatomy is essential for achieving an accurate diagnosis and treatment of surgical shoulder pathology. Unexpected anatomic variations can delay treatment or extend surgical times for such a patient. Prolonged surgical times can lead to less favorable outcomes, such as treatment failure and/or iatrogenic injury (Scully et al., 2013). Any of these previously mentioned outcomes would have a negative impact on the patient, the provider's schedule, healthcare costs, and utilization of healthcare resources. Shoulder and upper back injuries are common among athletes, physical laborers, and the elderly (Knesek et al., 2013). These groups represent a large portion of the population; therefore, these injuries are an important source of lost income and represent some of the most common causes of shoulder pain (Kemp et al., 2011).

Future work will focus on a non-invasive, inexpensive technique to locate abnormal anatomy prior to surgery in complicated cases. Ultrasound with 3D Doppler has been shown to be effective at locating *in situ* anatomic variation of the shoulder (Kim et al., 2008). Location of these anomalies would likely reduce complications and improve surgical outcomes with respect to fewer iatrogenic injuries, less pain, and decreased recovery time.

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