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Education

Posterior subscapular dissection: An improved approach to the brachial plexus for human anatomy students

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ABSTRACT

Students of human anatomy are required to understand the brachial plexus, from the proximal roots extending from spinal nerves C5 through T1, to the distal-most branches that innervate the shoulder and upper limb. However, in human cadaver dissection labs, students are often instructed to dissect the brachial plexus using an antero-axillary approach that incompletely exposes the brachial plexus. This approach readily exposes the distal segments of the brachial plexus but exposure of proximal and posterior segments require extensive dissection of neck and shoulder structures. Therefore, the proximal and posterior segments of the brachial plexus, including the roots, trunks, divisions, posterior cord and proximally branching peripheral nerves often remain unobserved during study of the cadaveric shoulder and brachial plexus. Here we introduce a subscapular approach that exposes the entire brachial plexus, with minimal amount of dissection or destruction of surrounding structures. Lateral retraction of the scapula reveals the entire length of the brachial plexus in the subscapular space, exposing the brachial plexus roots and other proximal segments. Combining the subscapular approach with the traditional antero-axillary approach allows students to observe the cadaveric brachial plexus in its entirety. Exposure of the brachial dissection in the subscapular space requires little time and is easily incorporated into a preexisting anatomy lab curriculum without scheduling additional time for dissection.

1. Introduction

The brachial plexus is a complex network of nerves that, in humans, originates from spinal levels C5-T1 and innervates the arm and shoulder. In medical and other allied health profession schools, much emphasis is traditionally placed on the brachial plexus during human gross anatomy instruction. Students are often encouraged to commit the anatomy of the brachial plexus to memory and often use well-known mnemonic devices to learn its detailed branching pattern from the proximal roots to the peripheral branches. The brachial plexus receives the attention that it does because it is well-suited to teaching principles of embryological segmentation, limb development, the relationships between motor innervations and skin dermatomes, and the differential clinical manifestations of proximal and distally located nerve injuries (Miller, 1934, 1939; Miller and Detwiller, 1936; Dubuisson et al., 1993; Uysal et al., 2003; Agur and Dalley, 2012; Drake et al., 2010; Clemente, 2011).

The brachial plexus is well-suited to teaching these learning objectives in the cadaver lab because it can be exposed by students with minimal dissection and destruction of surrounding tissues, unlike the lumbosacral plexus, which is found in the deep concavity of the pelvis.

Students frequently learn the brachial plexus via conventional diagrams, which convey the branching patterns of the nerves that contribute to the plexus. However, such diagrams neither adequately convey the complex spatial arrangement of the brachial plexus nor the relationship of the brachial plexus to the surrounding structures. Dissection enables students to gain a more sophisticated 3-dimensional understanding of brachial plexus anatomy. Nonetheless, in traditional human dissection classes, the brachial plexus is often incompletely exposed and studied due to the limitations of the conventional approach.

The human brachial plexus is traditionally divided into five components (from proximal to distal): roots, trunks, divisions, cords, branches (Drake et al., 2010). Popular human gross dissection manuals instruct students to dissect the peripheral branches of the brachial plexus through the axilla, and to view these branches from an anterior–axillary perspective (Morton et al., 2007; Tank, 2012).

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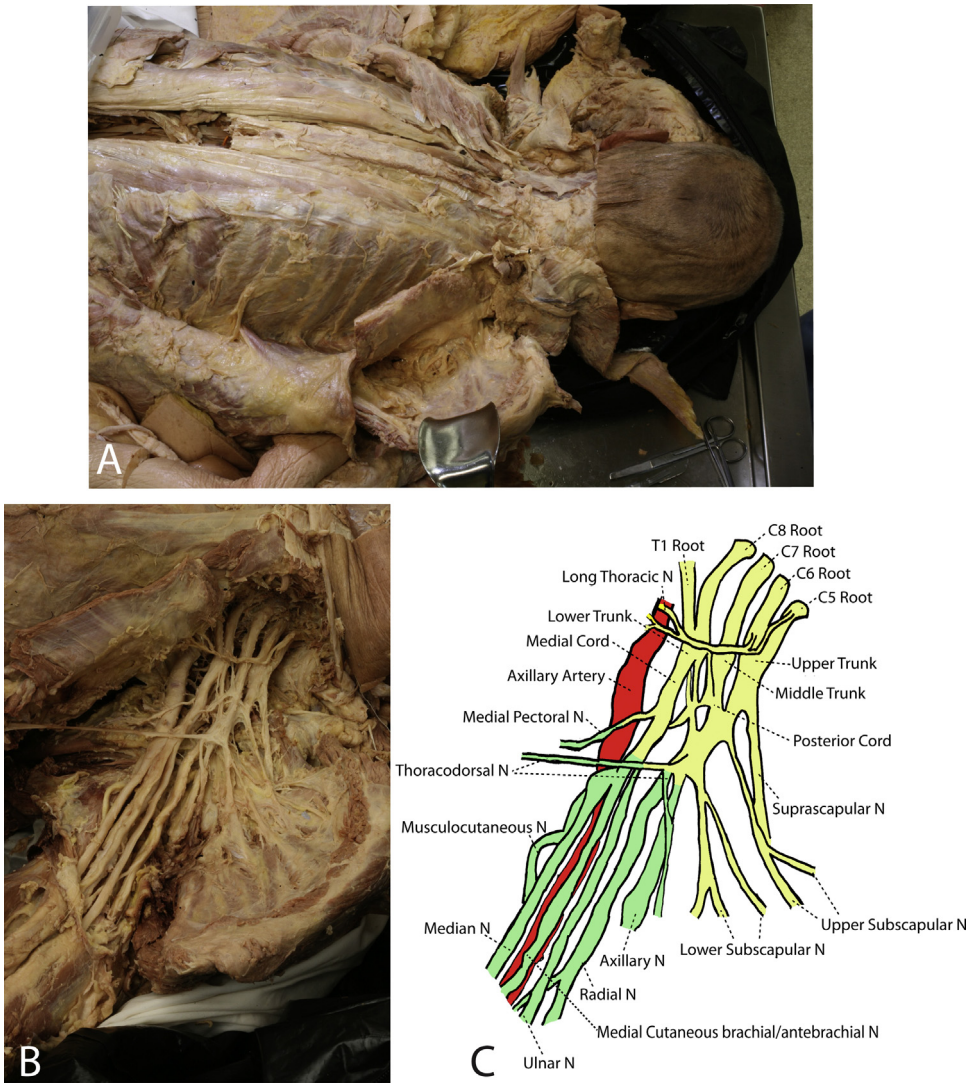

Fig. 1. (A) Cadaver with laterally retracted left scapula showing unexposed brachial plexus in the subscapular space. (B) Dissected brachial plexus in the subscapular space with deep back muscles removed to show brachial plexus roots. (C). Diagram of figure B. The portion of the brachial plexus most easily seen from the anterior–axillary approach is green. The portion most easily seen from the posterior approach is yellow.(For interpretation of the references to color in this figure legend, the reader is referred to the web version of the article.)

This standard approach fails to expose the proximal sections of the plexus (roots, trunks, divisions) and leads to inadequate of the posterior cord and many of its branches. Dissection of the complete brachial plexus from the anterior view would involve removal of the clavicle and would require extensive dissection of structures in the neck and root of the neck including infra-hyoid and scalene muscles, the ansa cervicalis, and numerous branches of the subclavian and axillary arteries and veins. Standard dissection manuals avoid providing instructions for dissecting the proximal regions of the brachial plexus. Rather, important neck structures are generally left intact for subsequent dissections of the head and neck. Nonetheless, the roots, trunks, divisions, and cords of the brachial plexus are thoroughly described in common anatomy texts (Schuenke et al., 2006; Drake et al., 2010; Clemente, 2011; Rohen et al., 2011), have significant clinical relevance (Dubuisson et al., 1993), are tested on medical school board examinations, and ideally, should be studied by anatomy students.

In an earlier project involving dissection of quadrupedal animals, we found that the complete brachial plexus is readily exposed via an incision between the medial border of the scapula and the spine, thus exposing the subscapular space and the total brachial plexus and all of its branches. This posterior subscapular approach results in complete exposure of the brachial plexus with a minimal amount of dissection and requires minimal damage to surrounding structures. Similar methods are used in some surgical approaches to the human brachial plexus (Dubuisson et al., 1993), although they have not been widely adopted in human gross anatomy labs. We suggest that a modified version of the posterior approach will yield an improved perspective of the brachial plexus in the human cadaver. Simultaneously, it will increase similarity between methods used in the anatomy lab and surgical methods.

2. Materials and methods

Brachial plexuses of four human cadavers were dissected using the posterior approach. The first step required disarticulation of the acromio-clavicular joint with the cadaver in a supine position to ensure maximum upper limb mobility. Sterno-clavicular joint disarticulation or bisection of the clavicle are alternative methods for increasing upper limb mobility. When joint disarticulation was completed, the cadaver was turned to a prone position and the dissection begun. After removing skin and subcutaneous fat in each human cadaver, the medial border of the trapezius was released from the spinous processes and retracted laterally. The

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