

## A brachial plexus variation characterized by the absence of the superior trunk

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### ABSTRACT

During routine dissection of a 55-year-old female cadaver, a variation of the brachial plexus characterized by the absence of the superior trunk on the left side was observed. The ventral rami of the C5 and C6 nerve roots, without joining to form the superior trunk, independently divided into anterior and posterior divisions, which joined the lateral and posterior cords, respectively. Additionally, the suprascapular nerve that normally originates from the superior trunk initiated exclusively from the C5 nerve root in this variation. Similar variations in the brachial plexus were not observed on the contralateral side. The details of this variation and its clinical significance are discussed herein. © *Neuroanatomy*, 2009; 8: 4–6.

**Key words** [brachial plexus] [anomaly] [superior trunk] [suprascapular nerve] [anatomy]

### Introduction

The brachial plexus is formed by the union of the ventral rami of the inferior four cervical (C5–C8) and first thoracic (T1) nerves (Figure 1). The C5 nerve usually receives a small contribution from the fourth-cervical nerve and the T1 nerve normally receives one from the second thoracic nerve. The brachial plexus supplies cutaneous and muscular innervation to the upper limb(s) and any injury at this level can lead to significant disability. The plexus extends from the inferior lateral portion of the neck downward and laterally over the first rib, posterior to the clavicle, and enters the axilla. Upon exit from the intervertebral foramina, the ventral rami of C5 and C6 cervical nerves unite to form the superior trunk. That of C7 nerve runs alone as the middle trunk and those of C8 and T1 nerves unite to form the inferior trunk; each of the trunks then bifurcates into anterior and posterior divisions as they pass beneath the clavicle. The anterior divisions of the superior and middle trunk form the lateral cord. The anterior division of the inferior trunk continues as the medial cord. The posterior divisions of all three trunks unite to form the posterior cord. From the cords arise the terminal branches of the brachial plexus including the musculocutaneous, median, ulnar, axillary, and radial nerves [1].

Anomalies of the cords and terminal branches of the brachial plexus are relatively common and have been well documented [2], however, anomalies of the roots and trunks are comparatively rare and have been

reported in only a few cases. As the brachial plexus supplies cutaneous and muscular innervation to the upper limb, its anatomical variations have important clinical implications. Therefore, it is important for the anatomist, surgeon, anesthesiologist, and radiologist to be aware of anatomical variations that deviate from the classic anatomy.

### Case Report

During routine dissection of the left upper limb for teaching purposes, a variation of the typical brachial plexus organization was found in a 55-year old female cadaver. Complete dissection of the neck, anterior and posterior shoulder, axillary region, arm, and hand was performed. The total course of the brachial plexus was documented in a proximal to distal direction. Dissection of the right upper limb found no such variation.

Dissection revealed the absence of the superior trunk on the left side. The ventral rami of C5 and C6 did not join to form the superior trunk but the formations of the other trunks were normal. After receiving a small contributing branch from C4, C5 independently bifurcated into an anterior and posterior division. The ventral ramus of C6 also independently split into anterior and posterior divisions. This deviated from the typical brachial plexus anatomy where there is a single anterior and posterior division from the superior trunk that includes the nerve fibers from both C5 and C6. Although traveling independently, the anterior divisions of both C5

and C6 united with the anterior division of the middle trunk (C7) to form the lateral cord. This resulted in a lateral cord containing the classically expected nerve fiber arrangement. The anterior division of the inferior trunk (C8 and T1) continued as the typical medial cord. Furthermore, the independent posterior divisions of both C5 and C6 united with the posterior divisions of the middle trunk (C7) and posterior division of the inferior trunk (C8 and T1) to form the posterior cord. This resulted in a posterior cord containing the anticipated nerve fiber arrangement. Although the superior trunk is missing, the arrangement of the division from the ventral rami of C5 and C6 was such that the anatomy normalized to the classic picture of the brachial plexus at the level of the cords (Figure 2).

Another variation from the classic anatomy was observed, in that the suprascapular nerve arose exclusively from the ventral ramus of the C5 nerve root. The suprascapular nerve normally arises from the superior trunk and contains nerve fibers from the ventral rami of both C5 and C6 and it innervates both the supraspinatus muscle and the infraspinatus muscles [1]. In this variation, the suprascapular nerve only contained the nerve fibers from C5 but not C6 (Figure 1). Furthermore, the formation of the median nerve was created by three branches instead of the expected two. Lateral and medial roots that originate from the lateral and medial cords normally unite to form the median nerve [1]. The left side of the cadaver had a second terminal branch from the lateral cord that joined the median nerve distal to the union of the lateral and medial roots of the median nerve (Figure 1).

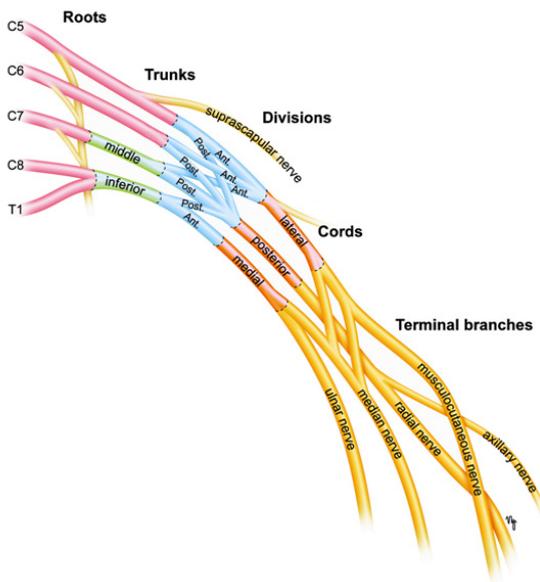
**Discussion**

Although uncommon, trunk variations have been noted in the literature. In particular, the absence of the inferior

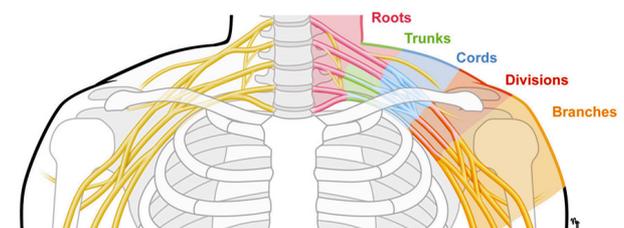
trunk characterized by the nonunion of C8 and T1 nerve roots has been reported [2,3]. The absence of the middle trunk has also been observed. The ventral rami of the C5, C6, and C7 nerve roots have been found to form the superior trunk at the expense of an absent middle trunk [3-5]. The C7, C8 and T1 nerve roots have been shown to form the inferior trunk with the absence of the middle trunk [3]. Unilateral upper trunk variations similar to the one observed in this case has been reported [2,3]. A study by Uysal et al. revealed that the absence of the superior trunk was less common than the absence of the inferior trunk. The superior trunk was not formed in two plexuses (1%) while the inferior trunk was not formed in eighteen plexuses (9%) [2].

Variation of the suprascapular nerve characterized by direct origin from the C5 nerve root, similar to that found in this case, has been reported in the literature [6-8]. In theory, this may have clinical implications in the setting of a cervical nerve root impingement. The suprascapular nerve (C5 and C6) normally innervates the supraspinatus muscle [1]. Thus, in an individual with normal supraclavicular nerve anatomy, a C5 nerve root impingement may result in partial paralysis of the supraspinatus muscle. A similar nerve root impingement in an individual with the variation demonstrated in this case would likely cause complete supraspinatus muscle paralysis.

The trunk variation presented in this case did not result in abnormalities of the terminal branches of the brachial plexus distal to the level of the cords. Therefore, it is unlikely that the variation would negatively affect the normal function of the upper limb although this cannot be proven with certainty. The variation of the superior trunk corrected itself at the level of the cords to preserve



**Figure 1.** Illustration of the brachial plexus variation. There is an absence of the superior trunk and the suprascapular nerve originates exclusively from the C5 nerve root. The C5 and C6 nerve roots independently divide into anterior and posterior divisions.



**Figure 2.** Photograph and corresponding illustration of the brachial plexus variation on the left side.

the usual nerve root fiber arrangement of the posterior, medial, and lateral cords. Although normal function of the upper limb was likely preserved with this variation, there were clinical implications that may apply.

The absence of the superior trunk in this variation may increase the chance of nerve root avulsion due to traction injury of the brachial plexus. A downward traction force of the upper limb can cause a breaking strain expended on the brachial plexus from above and result in a lesion of the C5 nerve root [9]. Thus, a blow from above on the neck or shoulder may cause the integrated cord to be stretched and this stress to be transmitted to the sites of cord attachment. One of these risk sites is where the nerve roots meet the spinal cord [9]. In an article by Stevens, it was described that five cords combined as one will withstand a greater amount of strain than the same cords divided [9]. Thus, in a normal brachial plexus, a portion of the stress applied to the lateral cord will be transferred back to the spinal cord where it would then be disseminated to both C5 and C6 by way of the superior trunk. This division of force decreases the strain on C5 and may prevent an avulsion. Absence of the superior trunk results in the full force of strain being applied to the C5 nerve root. As a result, a similar force that does not cause a C5 avulsion in a normal plexus may cause an avulsion in a plexus without a superior trunk.

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## Conclusions

The trunk variation presented in this case did not result in abnormalities of the terminal branches of the brachial plexus distal to the level of the cords. Therefore, it is unlikely that the variation would negatively affect the normal function of the upper limb. Variation of the suprascapular nerve characterized by direct origin from the C5 nerve root may have clinical implications in the setting of a cervical nerve root impingement. The absence of the superior trunk may increase the likelihood of nerve root avulsion in the context of traction injury of the brachial plexus. Moreover, the variation may have clinical implications during the anesthetic administration of an intrascalene nerve block.

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