

# Unusual variations of the lateral and posterior cords in a female cadaver

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**ABSTRACT** The presence of anatomical variations of the peripheral nervous system often accounts for unexpected clinical signs and symptoms. We report unusual variations of the lateral and posterior cords of the brachial plexus in a female cadaver. Such variations are attributed to a faulty union of divisions of the brachial plexus during the embryonic period. The median nerve lay medial to the axillary artery (AA) on both sides. On the right, the lateral root of the median nerve crossing the AA and the median nerve in relation to the medial side of the AA was likely the result of a faulty development of the seventh intersegmental artery. We discuss these variations and compare them with the findings of other researchers. Knowledge of such rare variations is clinically important, aiding radiologists, anaesthesiologists and surgeons to avoid inadvertent damage to nerves and the AA during blocks and surgical interventions.

*Keywords:* axillary nerve, lateral cord, median nerve, posterior cord, radial nerve  
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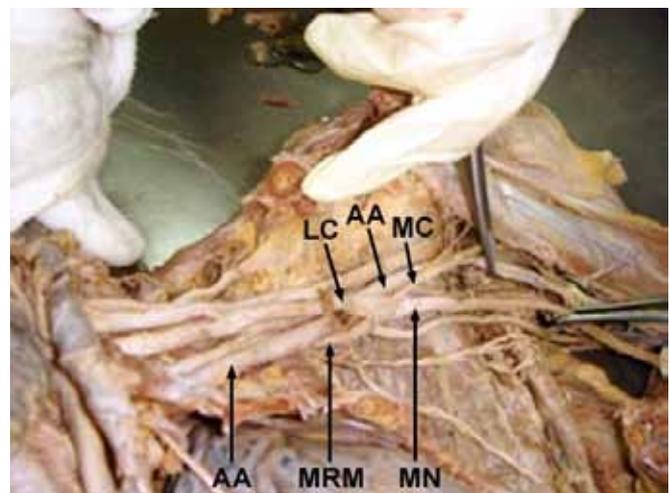
## INTRODUCTION

The brachial plexus is a complex network of nerves that innervates the upper limbs. Variations of the brachial plexus are common, as it is the point of formation of many nerves.<sup>(1)</sup> These variations of the plexus pattern may be due to factors that influence the formation of limb muscles and peripheral nerves during the embryonic period.<sup>(2)</sup> As the embryonic somites migrate to form the limb, they bring their own nerve supply. Some of these nerves come in close proximity with each other and fuse in a particular pattern, forming a plexus.<sup>(3)</sup> Advanced technology in radiology is useful for nerve localisation, especially when variation exists. Ultrasonography imaging guidance using a high-frequency probe can improve success during interscalene brachial plexus block.<sup>(4)</sup> Three-dimensional volume-rendered magnetic resonance neurography image of the entire brachial plexus can be used to evaluate the accuracy of infraclavicular block.<sup>(5)</sup>

Knowledge of these variations is clinically important to anaesthesiologists and surgeons in order to avoid inadvertent damage to the nerves and axillary artery (AA) during regional blocks and surgical interventions.<sup>(6)</sup> Certain surgical treatment failures of brachial plexus lesions are related to anatomical variations.<sup>(7)</sup> Therefore, understanding of anatomical variations of the peripheral nervous system is vital for explaining unexpected clinical signs and symptoms.<sup>(1,8)</sup> Due to the clinical importance of the brachial plexus, the present case serves to highlight and describe the anatomical variations of the cords and their relationship with the associated artery.

## CASE REPORT

Routine dissection was performed on the right and left brachial plexuses of a 60-year-old female cadaver, using a conventional

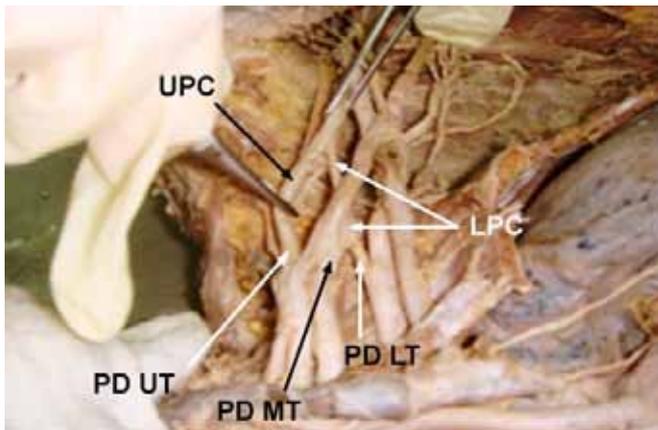


**Fig. 1** Photograph shows the left brachial plexus with the lateral cord (LC) crossing the axillary artery (AA) anteriorly to join the medial root of median nerve (MRM). The median nerve (MN) lies medial to the AA and gives off the musculocutaneous nerve (MC).

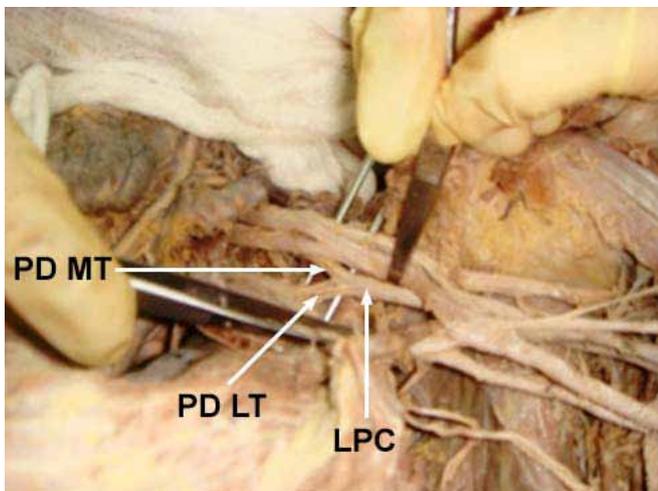
dissecting set and Cunningham's Manual of Practical Anatomy.<sup>(9)</sup> Morphological variations of the brachial plexus were determined and photographed. Variations were observed in the lateral and posterior cords of the brachial plexus on the left side. Slight variation of the right median nerve in the lateral cord of the right brachial plexus was also found. On the left side, the lateral cord, after giving off the lateral pectoral nerve, immediately crossed anterior to the AA to join the medial root of the median nerve, forming the median nerve. Hence, the left median nerve lay medial to the AA (Fig. 1). In the axilla, the median nerve normally lies lateral to the AA. In this case, the left median nerve gave off the musculocutaneous nerve near its origin, which pierced the coracobrachialis (Fig.1). The lateral root of the right median nerve crossed the AA anteriorly and joined the medial root of the

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**Fig. 2** Photograph shows the left brachial plexus with the posterior division of the upper trunk (PD UT) forming the upper posterior cord (UPC). The lower posterior cord (LPC) is formed by the union of the posterior division of the middle trunk (PD MT) and the posterior division of the lower trunk (PD LT).



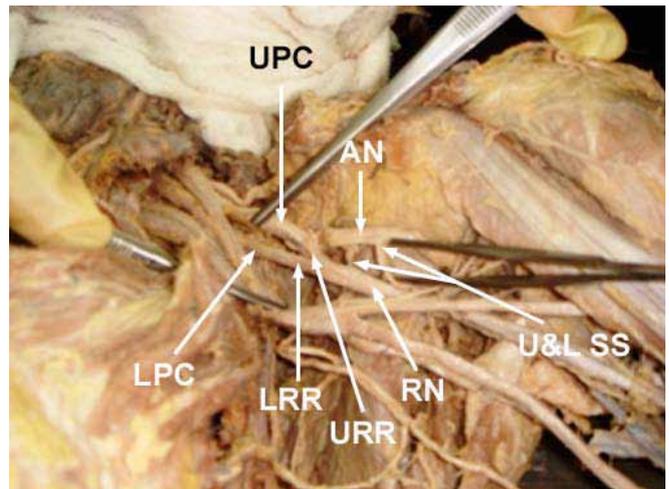
**Fig. 4** Photograph shows the left brachial plexus with the posterior division of the middle trunk (PD MT) joining the posterior division of the lower trunk (PD LT) to form the lower posterior cord (LPC).

median nerve to form the right median nerve. Therefore, the right median nerve was also found on the medial side of the AA.

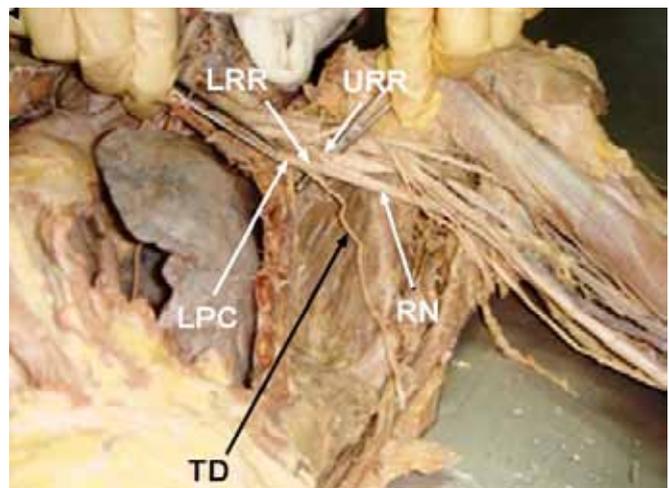
The posterior cord on the left side was formed by two parts; the upper and lower posterior cords (LPCs). The upper posterior cord was from the posterior division of the upper trunk (Fig. 2), which gave off the upper root of the radial nerve and the axillary nerve. The axillary nerve gave off the upper and lower subscapular nerves before continuing its course into the quadrangular space (Fig. 3). The LPC was formed by the union of the posterior divisions of the middle and lower trunks (Figs. 2 & 4). The LPC also gave off the thoracodorsal nerve and the lower root of the radial nerve (Fig. 5), and the upper root of the radial nerve joined the lower root of the radial nerve to form the radial nerve proper (Figs. 3 & 5).

## DISCUSSION

Variations of the brachial plexus at the roots, trunks, divisions and cord are common.<sup>(1)</sup> In our cadaver, on the left side, instead of the lateral root of the median nerve, the lateral cord itself united with the medial root of the median nerve to form the median nerve.



**Fig. 3** Photograph shows the left brachial plexus with the upper posterior cord (UPC) giving off the axillary nerve (AN) and the upper root of the radial nerve (URR). The upper and lower subscapular nerves (U&L SS) arise from the AN, while the lower root of the radial nerve (LRR) arises from the lower posterior cord (LPC). The URR and the LRR join to form the radial nerve proper (RN).



**Fig. 5** Photograph shows the left brachial plexus with the lower posterior cord (LPC) giving off the thoracodorsal nerve (TD) and the lower root of the radial nerve (LRR). The upper root of the radial nerve (URR) and the LRR join to form the radial nerve proper (RN).

The left median nerve was found to lie on the medial side of AA. (Fig. 1). Das and Paul have reported how two branches from the lateral cord contributed to the formation of median nerve. First, the upper branch was united with the medial root of the median nerve coming from the medial cord to form the median nerve; this was later joined by the lower branch near its origin.<sup>(10)</sup> In other studies, the median nerve was formed by three branches, with two coming from the lateral cord and one from the medial cord of the brachial plexus.<sup>(11,12)</sup>

In our case, the AA on both sides had an unusual relationship with the median nerve. Typically, the medial root of the median nerve crosses the AA to unite with the lateral root of the median nerve, forming the median nerve that lies lateral to the AA. However, in our cadaver, on the right side, the lateral root of the median nerve crossed the AA anteriorly. It then joined the medial root of the median nerve to form the right median nerve, which

was also located on the medial side of the AA. Singhal et al had observed a similar case on the right brachial plexus of a male cadaver.<sup>(1)</sup> Anomalous branches of the lateral cord crossing the artery anteriorly may cause compression syndrome and result in ischaemia.<sup>(1,10)</sup>

The AA usually originates from the seventh cervical intersegmental artery. Occasionally, it may develop from the sixth, eighth or ninth intersegmental artery.<sup>(1)</sup> The presence of an abnormally placed AA in our case is probably due to faulty development derived from the other neighbouring cervical intersegmental artery, and not from the seventh intersegmental artery. The development of the brachial plexus is altered by this abnormally placed AA.<sup>(1,3)</sup> Knowledge of the relationship of the brachial plexus with the AA is important in order to ensure safe and successful regional anaesthesia of the upper limb.<sup>(6)</sup>

Normally, the lateral cord gives off the musculocutaneous nerve, which supplies the coracobrachialis, biceps brachii and brachialis muscles.<sup>(13)</sup> In our study, the left median nerve gave off the musculocutaneous nerve at its origin, which pierced the coracobrachialis muscle (Fig. 1). According to Tountas and Bergman, the musculocutaneous nerve arose from the median nerve in 2% of cadavers.<sup>(14)</sup> Sontakke et al reported that there exists a branch of the median nerve representing the musculocutaneous nerve that does not pierce the coracobrachialis muscle.<sup>(13)</sup> In addition, usually, three posterior divisions from each trunk combine to form one posterior cord, giving off the upper and lower subscapular, thoracodorsal, axillary and radial nerves. However, in our case, the posterior cord was formed by two parts on the left side. The upper posterior cord was a continuation of posterior division of the upper trunk, and the LPC stemmed from the combination of the posterior divisions of the middle and lower trunks (Figs. 2 & 4).

In our study, the axillary nerve arose from the upper posterior cord while the thoracodorsal nerve arose from the LPC (Figs. 3 & 5). The radial nerve was derived from the union of the upper and lower roots of the radial nerve coming from the upper posterior cord and the LPC, respectively (Figs. 3 & 5). Bertha et al reported a similar variation in the formation of the posterior cord, except that in their study, they found that the upper and lower subscapular nerves were derived from the upper posterior cord.<sup>(15)</sup> However, in our study, both upper and lower subscapular nerves arose from the axillary nerve. Fazan et al stated that the posterior cord was formed by the posterior divisions of upper and middle trunks in 9% of cadavers.<sup>(7)</sup>

Ballesteros and Ramirez reported that 50% of the upper subscapular nerves originated from the posterior division of the upper trunk and 54.4% of the lower subscapular nerves originated from the axillary nerve.<sup>(16)</sup> Kocabiyik et al found that the lower subscapular nerve arose from the posterior division of the upper trunk instead of the posterior cord. They also found that the thoracodorsal nerve originated from the posterior division of the upper trunk.<sup>(17)</sup> Aktan et al reported that the radial nerve arose

from the union of the posterior divisions of the middle and lower trunks in the left upper extremity.<sup>(18)</sup>

Knowledge of such variations of the brachial plexus is important for anatomists, radiologists, anaesthesiologists and surgeons. Information on these unusual and unique variations of lateral and posterior cords is useful for surgeons when performing regional block procedures and surgical approach for brachial plexus region tumours.

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