JKIMSU, Vol. 12, No. 2, April-June 2023 ISSN 2231-4261

ORIGINAL ARTICLE

Morphological and morphometric study of the subscapular arterial tree with its clinical implications

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Abstract

Background: Knowledge of anatomy of the subscapular arterial tree is very important as it is commonly used for microvascular grafting to substitute injured portions of the arteries of hands and forearm. So, the study aims to examine the subscapular arterial tree and its variants. *Aim and Objectives*: To observe the subscapular arterial tree and its variants in the origin and branching pattern as well as to locate the distance of origin of subscapular artery and circumflex scapular artery from various anatomical landmarks. *Material and Methods*: Twenty-six upper limbs were used in the study. The origin and branches of subscapular artery were noted down. Distance between the various anatomical landmarks and the origin of subscapular and circumflex scapular artery were noted down. Variants in the origin and branching pattern were noted. *Results*: In five limbs, the 2nd part of axillary artery gave rise to subscapular artery. On the right and left side, the mean distance between the origins of subscapular artery from pectoralis minor was 2.92 and 3.17 cm, respectively. In five limbs, subscapular artery was originating along with posterior circumflex humeral artery and in three limbs with lateral thoracic artery. In two limbs, the 3rd part of axillary artery was giving rise to circumflex scapular artery directly. The mean distance of the origin of circumflex scapular artery from pectoralis minor was 3.53 and 3.83 cm away on right and left side, respectively. On both right and left side, the mean distance of the origin of circumflex scapular artery was 2.18 cm away from the origin of subscapular artery. *Conclusion*: The measurements on the subscapular artery and its variations will help the surgeons in identifying subscapular artery easily for microvascular arterial grafting.

Keywords: Subscapular artery, Circumflex scapular artery, Upper extremity, Pectoralis minor, Grafting

Introduction

The subscapular artery is the major branch of the 3rd part of axillary artery. After originating it divides into 2 branches- circumflex scapular artery which enters the upper triangular space and thoracodorsal artery which goes along with the thoracodorsal nerve (nerve to latissimus dorsi) to supply latissimus dorsi muscle and adjoining area [1]. Circumflex scapular branch of subscapular artery forms anastomosis around the scapular region along with other arteries like the transverse cervical and suprascapular. This anastomosis becomes important when there is any blockage happening in the subclavian or axillary artery [2]. Currently reconstructive surgeons are generally using subscapular arteries in replacing injured or diseased portions of arteries of forearm and hand. As this artery is present in the area which is easily accessible, grafts from this artery can be easily harvested. Subscapular arterial tree is rarely affected by arteriosclerosis. Some authors found in their study that the length of subscapular artery and its branching patterns are favorable to be used

as graft for various microvascular reconstructive surgeries [3].

Sometimes orthopedic surgeons put ligature in the 3rd part of axillary artery thinking that the collateral pathway formed by circumflex scapular artery or suprascapular artery will supply blood into the artery distal to the ligature. But they should be aware before putting the ligature that sometimes the 2nd part of the axillary artery can give rise to subscapular artery. Otherwise it can lead to possible ischemia and gangrene of that limb. So, the high origin of subscapular artery should also be known to all surgeons before doing surgery in that area. Ariyo reported a case in which there was a high origin of subscapular artery and as a common trunk to lateral thoracic and common circumflex humeral trunk. This variant trunk originated posterior to the pectoralis minor muscle about 2-3 cm posteroinferior to that of the thoracoacromial artery [4].

In some cases, subscapular artery can be absent as in a study reported by Khaki *et al*. in a case report where he noted that the subscapular artery was absent on both sides and the circumflex scapular artery was directly arising from axillary artery and the thoracodorsal artery was separated from circumflex scapular artery as a thin and short branch [1]. So, the objective of our study was to observe the subscapular arterial tree and its variants in the origin and branching pattern as well as to locate the distance of origin of subscapular artery and circumflex scapular artery from various anatomical landmarks.

Materials and Methods

Study setting: The study was conducted in the Department of Anatomy, Kasturba Medical College, Manipal.

Study period: 1 year (August 2021-August 2022)

Study sample: Ten cadavers and few separate dissected upper limbs were included in the study. So, a total of 26 upper limbs were studied.

Inclusion criteria: All upper limbs where subscapular artery and its branches were clearly seen were included in the study.

Exclusion criteria: All damaged limbs where artery was injured, and branches torn were excluded from the study.

Following the steps mentioned in Cunningham's manual the incision was given in the axilla. The skin, superficial fascia and axillary fascia were reflected. Structures in the axilla were cleaned. All the branches of all parts of axillary artery were traced. The origin and branches of subscapular artery were noted down. Distance between the origin of subscapular artery and circumflex scapular artery from pectoralis minor was noted down. Also, the distance of origin of circumflex scapular artery from origin of subscapular artery was noted down. All the measurements were taken with the help of a divider and a scale (Figure 1). Variants in the origin and branching pattern were noted and photographed. Results were analyzed using SPSS 16 software. Mean and percentage were calculated. Unpaired t-test was used to compare the parameters of right and left sides.

Figure 1A: Measurement taken from lower border of pectoralis minor muscle to the origin of subscapular artery

Figure 1B: Measurement taken from the origin of subscapular artery to origin of circumflex scapular artery

Results

In 5 upper limbs (19.2%), subscapular artery was arising from the 2nd part of axillary artery and it lied behind pectoralis minor. All were on the right side (Figure 2).

In 5 upper limbs (19.2%), there was a common stem for both subscapular and posterior circumflex humeral artery with 4 being on the right side and 1 on left side. In 3 upper limbs (11.5%), there was a common stem for both subscapular and lateral thoracic artery. All were on the left side (Figure 3).

In 2 upper limbs (7.6%), circumflex scapular artery was coming directly from the 3rd part of axillary artery. In 2 upper limbs (7.6%), there was a common stem for both circumflex scapular and posterior circumflex humeral artery which was coming from 3rd part of axillary artery. The mean distance of the origin of circumflex scapular artery and subscapular artery from various anatomical landmarks on right and left side is shown in table 1. On comparing the mean distance of the origin of subscapular artery from pectoralis minor on right and left side, it was not significant as the p value was 0.2. On comparing the mean distance of the origin of circumflex scapular artery from pectoralis minor on right and left side, it was not significant as the p value was 0.4. On comparing the mean distance of the origin of circumflex scapular artery from subscapular artery on right and left side, it was not significant as the p value was 0.08.

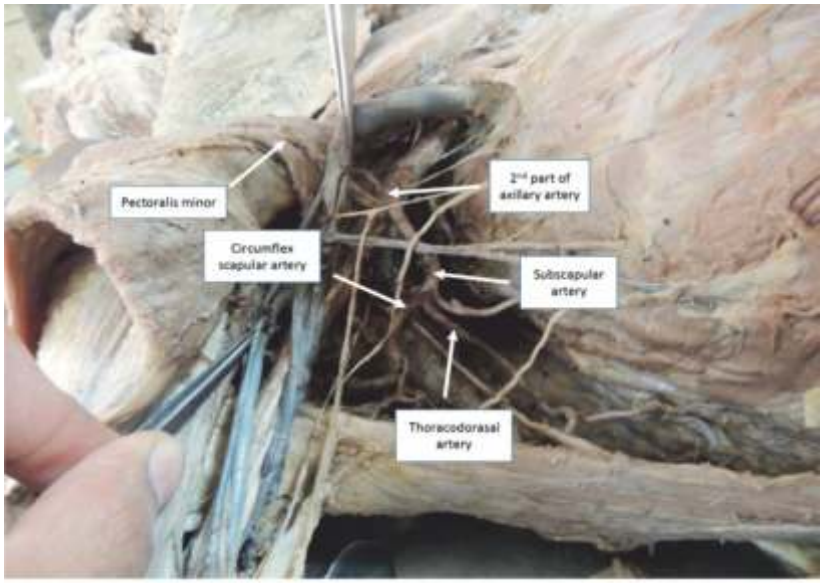

Figure 2: Second part of axillary artery giving rise to subscapular artery

Figure 3A: A common trunk for subscapular and lateral thoracic artery and its origin from the 2nd part of axillary artery

Figure 3B: A common trunk for subscapular and posterior circumflex humeral artery and its origin from 3rd part of axillary artery

Table 1: Mean distance between the origin of subscapular and circumflex scapular artery from pectoralis minor muscle and mean distance between the origin of circumflex scapular artery and the origin of subscapular artery

Parameters	Right (cm)	Left (cm)	*p*
Mean distance between the origin of subscapular artery and pectoralis minor	2.78 ± 0.91	3.17 ± 0.87	0.2
Mean distance between the origin of circumflex scapular artery and pectoralis minor	3.45 ± 0.73	3.53 ± 1.05	0.4
Mean distance between the origin of circumflex scapular artery and the origin of subscapular artery	2.09 ± 0.84	2.16 ± 0.89	0.08

Discussion

Arterial branching tree in the axilla can be clinically important in surgeries like reducing a shoulder dislocation, while handling blockage in the brachial arteries by antegrade perfusion [5]. In most of the reconstructive plastic surgery for soft tissue damage, surgeons generally use a tissue transfer flap that should have a solitary vascular pedicle attached to it for reconstruction of injuries. But for success of that reconstruction, surgeons should have a precise information about the site, size, and variant anatomy of that vessel [6]. One such variety of joint tissue transfer flaps is the scapular free flap, in which the surgeons cut the subscapular artery, and the full scapular skin flap which is supplied by circumflex scapular artery and relocate it. It also requires cutting of inferolateral portion of scapula and latissimus dorsi muscle which is supplied by twigs from the thoracodorsal artery. These types of flaps are generally used for composite defects of the mandible and related overlying tissues [7].

Rowsell *et al*. found that in 13% and 3% of cases, subscapular artery was arising from the 2nd and 1st part of axillary artery, respectively. They also found that in 3% of cases, circumflex scapular artery was arising directly from the 3rd part of axillary artery [8]. Bhavya *et al*. found in their study that in 7.5% and 5.5% of cases, subscapular artery was arising from the 2nd part of axillary and from deep brachial artery, respectively. They also found that in 11% and in 2% of cases, circumflex scapular artery originated from main trunk of 3rd and 2nd part of axillary artery, respectively, when there was absence of subscapular artery [9]. Valnicek *et al*. found that in 16% of cases, circumflex scapular artery was arising from the axillary artery directly [3]. Khaki *et al*. discussed about a case in which there was absence of subscapular artery on both sides and circumflex scapular artery was coming directly from the axillary artery and had thoracodorsal artery as a thin and short branch [1]. In our study in 19.2% of cases, subscapular artery was arising from the 2nd part of axillary artery. We also found that in 7.6% of cases, circumflex scapular artery was arising from the 3rd part of axillary

artery directly. Our results were similar to other studies.

Ariyo reported a case of "high origin" of subscapular artery along with lateral thoracic and common circumflex humeral trunk as a common stem in the left upper limb. It originated posterior to the pectoralis minor muscle about 2-3 cm posteroinferior to that of the thoracoacromial artery [4]. Ghantabpour *et al*. found a case in which there was a common stem for lateral thoracic artery and subscapular artery with origin from axillary artery and later continuing as a thoracodorsal artery parallel to long thoracic nerve [10]. Tremoulis and Abdulrahman reported a case in which there was a common stem for lateral thoracic artery and subscapular artery originating from the 2nd part of axillary artery [11]. Bhavya *et al*. found in their study that in 20.4% of cases, there was a common stem for both subscapular and posterior circumflex humeral artery. They also found that there was a common stem for lateral thoracic and subscapular artery in 5.6% of cases [9]. In our study also, there were 3 upper limbs where subscapular artery was coming as a common stem along with lateral thoracic artery. While performing grafting, it is important to note variations where some arteries can originate along with subscapular artery as a common stem. Even the orthopedic surgeons should know about the variations of these branching pattern which are seen in this study while doing surgeries in this area because the branches of it take part in collateral circulation around the scapula which might be affected.

Variations in branching pattern and origin of subscapular artery can be due to defects in embryonic development of the vascular plexus of upper limb bud. This can be due to a halt at any phase of development of vessels followed by regression, retention or re-emergence, thus causing variants in the arterial origin and course of upper limb vessels. Such abnormal branching pattern may characterize persisting branches of the capillary plexus of the evolving limb buds [12-13].

Bhavya *et al*. also looked for the mean distance of origin of subscapular artery from lower edge of pectoralis minor which was 3.72 ± 0.7 cm [9]. In our study, the mean distance of origin of subscapular artery from lower edge of pectoralis minor was 2.92 and 3.17 cm on right and left side, respectively, which was almost similar to their study. Distance of subscapular artery from the pectoralis minor is important for a surgeon as it helps in easy identification of the artery while doing grafting.

Valnicek *et al*. found that in cases where the circumflex scapular artery was coming from subscapular artery the mean distance of it from the axillary artery was 2.0 cm [3]. In our study, the distance from the origin of subscapular artery to circumflex scapular artery was 2.18 cm which was similar to their study.

Conclusion

The subscapular arterial tree is a very useful and handy donor site which meets the needs of many microvascular reconstructions. Therefore, the results of this study can be used by reconstructive plastic surgeons while using it as a graft. Knowledge of anatomy of the subscapular arterial tree is very important as it is commonly used for microvascular grafting to substitute injured portions of the arteries of hands and forearm. The

measurements on subscapular artery and its variations will help the surgeons in identifying subscapular artery easily for microvascular arterial grafting.

Acknowledgement

The authors want to acknowledge Dr Antony Sylvan D'souza for giving permission to conduct the study in Anatomy department.

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How to cite this article:

Palimar V, Gupta C, Singh A. Morphological and morphometric study of the subscapular arterial tree with its clinical implications. *J Krishna Inst Med Sci Univ* 2023; 12(2):74-80

Submitted: *25-Jan-2023* ***Accepted:*** *15-Mar-2023* ***Published:*** *01-Apr-2023*