# The Dorsal Scapular Artery as a Recipient Vessel in the Vessel Depleted Neck During Free Tissue Transfer in Head and Neck Reconstruction

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## ABSTRACT

**Background:** The vessel depleted neck poses a unique challenge to the microvascular surgeon. Using 3D modeling and cadaveric dissection, we describe the approach and advantages of a known but less frequently used recipient vessel, the dorsal scapular artery, during free tissue transfer.

**Methods:** Three patients with vessel-depleted necks required reconstruction with free tissue transfer. The dorsal scapular artery was used as a recipient vessel. Three-dimensional anatomic models were created and cadaveric dissections were performed to characterize the anatomy.

**Results:** The dorsal scapular artery was successfully used in three patients as the recipient pedicle for free tissue transfer. The vessel was identified deep in the posterior triangle after emerging through the brachial plexus. In all cases the artery was in a previously undissected field, and had a large caliber and favorable geometry for microvascular anastomosis.

**Conclusion:** The dorsal scapular artery is a viable recipient vessel during head and neck reconstruction in the vessel depleted neck.

## INTRODUCTION

The vessel depleted neck, whether due to surgery, radiation, or chemoradiation poses a difficult problem for the reconstructive surgeon in the salvage setting. Reconstructive strategies in this challenging group of patients include the use of regional pedicled flaps as well as microvascular reconstruction using alternate recipient vessels. Commonly reported recipient arteries in the vessel-depleted neck include the superficial temporal artery, the transverse cervical artery, and the internal mammary artery.[1-10 5,11-15] The dorsal scapular artery is a known branch off the subclavian that courses through the posterior triangle, however, has not yet been described as a recipient vessel during free tissue transfer. This article provides an anatomic description utilizing cadaver dissection and 3D reconstructions of CT scans to illustrate the location and vessel characteristics of the dorsal scapular artery. We also describe 3 cases of microvascular reconstruction using the dorsal scapular artery as the recipient artery in patients with vessel depleted necks.

## MATERIALS AND METHODS

### Cadaver dissection

After obtaining permission from the anatomic procurement services at the University of Michigan, a cadaveric prosection was performed. **Figure 1** shows the planned curvilinear incision in the supraclavicular triangle for vessel exploration. The incision begins lateral to the clavicular insertion of the sternocleidomastoid muscle and extends approximately 4-5 centimeters, parallel to the clavicle. The external jugular vein is skeletonized and retracted medially. Blunt dissection is then carried out lateral to

this, and the brachial plexus is identified. The dorsal scapular artery is identified superior and lateral to the brachial plexus after it passes between either the inferior and middle, or middle and superior trunks. It runs with the vein of the same name. **Figure 2** shows the intraoperative appearance of the dorsal scapular artery and its relationship to the brachial plexus. **Figure 3** shows the dissected neck with the relationship of the dorsal scapular artery to critical surrounding structures. The take-off of the dorsal scapular artery from the subclavian artery and its course through the brachial plexus to the rhomboid attachments to the scapula, which it supplies, is shown in **Figure 4.**

**Radiologic Evaluation utilizing 3D Reconstruction**

We performed 3-D reconstruction of CT images in order to analyze pedicle length, vessel diameter, and distance from related structures. We utilized the CT scans from the 3 cases presented (below). The takeoff of the dorsal scapular artery from the subclavian artery was an average of 39.2 mm lateral to the carotid artery, 32 mm posterior to the clavicle, at the level of the superior border of the clavicle (**Figure 5A**). The dorsal scapular artery diameter had a mean of 1.8mm at 42mm from the subclavian artery and decreased to 1.3mm at 65 mm from the subclavian artery (**Figure 5B**).

**Case 1:**

A 68-year-old male presented with a distant history of laryngeal squamous cell carcinoma treated at an outside institution with chemoradiation. He was free of disease but had a nonfunctional larynx and had remained tracheostomy and G-tube dependent since his treatment ten years prior. He was not able to tolerate his secretions and required frequent suctioning. His voice quality was poor. On exam, he was noted to

have supraglottic laryngeal stenosis and complete hypopharyngeal and cervical esophageal stenosis. The patient elected to undergo narrow-field laryngopharyngectomy using a tubed radial forearm free flap reconstruction with the goal of improving his voice and swallow function. Given the degree of fibrosis, no suitable recipient artery was identified in the lateral neck. The right dorsal scapular artery and right transverse cervical vein were therefore used as recipient vessels. The free tissue remained healthy and viable, however the patient's hospital course was complicated by a pharyngocutaneous fistula, which healed spontaneously. Postoperative evaluation with transnasal esophagoscopy (TNE) demonstrated an intact reconstruction without stricture. A trachea-esophageal prosthesis (TEP) was subsequently placed in clinic; this patient now has excellent voice quality and is able to eat an oral diet.

**Case 2:**

A 58-year-old male was treated with chemoradiation therapy for a T3N2bM0 squamous cell carcinoma of the hypopharynx. A hypermetabolic focus was noted in the hypopharynx on a post-treatment PET scan. Direct laryngoscopy and biopsy demonstrated persistent invasive, moderately differentiated squamous cell carcinoma. The patient then underwent salvage laryngopharyngectomy and bilateral neck dissection with a tubed anterolateral thigh free flap for pharyngeal reconstruction. The right superior thyroid artery and internal jugular vein were used as recipient vessels. The postoperative course was complicated by necrosis of the proximal esophagus. Thus, the patient underwent reconstruction of the proximal esophageal defect using a

tubed left radial forearm and was exteriorized to facilitate healing. The right transverse cervical artery and vein were used as recipient vessels.

Three months later, the patient underwent pharyngostome closure. A right radial forearm free flap was used to close the pharyngostome. The left dorsal scapular artery and left transverse cervical vein were used as recipient vessels. The patient recovered well from this surgery with resolution of his pharyngocutaneous fistula. A TEP was subsequently placed in clinic, and he has excellent voice quality and is taking an oral diet.

**Case 3:**

A 59-year-old male was treated with induction chemotherapy and then concurrent chemoradiation for a TXN3M0 left neck squamous cell carcinoma. His neck mass persisted following treatment and a PET scan showed mild avidity with an ultrasound guided FNA positive for squamous cell carcinoma. He then underwent left salvage neck dissection (levels II-V). He did well initially but subsequently developed new left neck fullness five months after his salvage neck dissection. Ultrasound guided FNA again showed squamous cell carcinoma and thus the patient underwent a second salvage surgery including resection of neck skin, revision neck dissection, superficial parotidectomy, and removal of the mastoid tip. The internal carotid artery was adjacent to, but not involved with the recurrent disease. Reconstruction of the neck skin and soft tissue was performed using a left radial forearm free flap. Given his history of radical neck surgeries, options for recipient vessels remained limited as the transverse cervical vessels had previously been dissected and sacrificed. The left dorsal scapular artery

and vein were used as recipient vessels. There were no complications and the patient was discharged after a routine hospital stay.

## DISCUSSION

With advances in the care of head and neck cancer, patients commonly present with a prior history of chemotherapy, radiation therapy, and previous surgical intervention. The use of free tissue transfer is often required for reconstruction in these salvage settings, and the availability of vessels is an important consideration during surgical planning. This is the first description of the dorsal scapular artery being used in head and neck reconstruction, and will hopefully expand the options for the reconstructive microsurgeon in this group of complex patients.

The dorsal scapular artery has been considered in head and neck reconstruction since the pedicled lower trapezius musculocutaneous flap was first introduced in 1980 by Baek et al.[19] While this artery has been used as a pedicle for regional tissue reconstruction, this is the first report of the dorsal scapular artery being used as a recipient vessel during free tissue reconstruction. The major advantage of this vessel is the location outside of the treatment field, and given its anatomic location, it is very rare that it has been ligated during previous neck dissection. Additionally, in our experience, the vessel has a relatively large caliber with favorable geometry for reconstruction. The major disadvantage of this vascular system is the long pedicle required to reconstruct defects in the oral cavity or oropharynx given the location of the dorsal scapular artery low in the neck. In patients with oral cavity or oropharyngeal defects, a vein graft may be necessary. Additionally, in a proportion of patients, the dorsal scapular artery may

arise from the transverse cervical vessel. This is reported in up to 1/3rd of cases, and in these patients, the vessel may have been damaged during a previous neck dissection.[16,17] Pre-operative imaging with a contrasted CT scan, however, should help to delineate the vessel and ensure flow when considering these cases.

A large review of vessel availability was performed by Hanasono et al. who evaluated 226 patients who underwent 261 free flaps.[2] They identified 44 flaps (17%) in which the ipsilateral external carotid artery or one of its branches was not available. The ipsilateral internal and external jugular veins were not available in 38 flaps (15%). These rates were significantly higher in patients with a history of prior neck dissection and radiation. These data show the importance of understanding alternate vascular supply in the vessel-depleted neck as approximately one of six patients required an alternate recipient vessel.

The relationship of the dorsal scapular artery to the brachial plexus can be variable. Typically, the dorsal scapular artery passes between the middle and inferior trunks or between the middle trunk and the superior trunk of the brachial plexus. In a small minority of patients it also may pass between the roots of C8 and T1 or between the posterior and lateral cords.[17] Even more rarely, the dorsal scapular artery may pass directly over the plexus. In the instance where the dorsal scapular artery arises from the transverse cervical artery, its origin is near the superior border of the scapula. In this variant, the origin of the vessel is both posterior and superior to the brachial plexus and lateral to the scalene muscles.[17,18] Once the dorsal scapular artery passes through the brachial plexus, it passes over the superior margin of the serratus anterior muscle prior to descending medially to reach the medial border of the scapula near base of the

scapular spine. [17]

In all of our patients, and in our cadaveric dissections, the dorsal scapular artery arose as a direct branch of the subclavian artery and in no cases was it a branch off of the transverse cervical artery. The artery was identified superior and lateral to the brachial plexus after it passed between either the inferior and middle, or middle and superior trunks.

In terms of venous anatomy, several vessels may be available for use as recipient vessels. In deciding on an appropriate recipient vein, it is important to examine the vessel caliber, wall and flow as well as the pedicle geometry. There can be variability in the venous anatomy in this region and thus familiarity with several recipient vessels is necessary, especially in the vessel depleted neck. In many cases, the dorsal scapular vein can be used as a recipient vein. Additionally, the transverse cervical vein is in close proximity and was used in 2 of our 3 patients. This vein may be a viable option even if the artery was previously in a surgical resection bed or radiation field, or is of inadequate caliber. Lastly, depending on the venous anatomy and the dissected pedicle length, the external jugular vein or internal jugular vein may also be feasible options though these were not used in these cases and may not have as favorable of geometry.

There may be apprehension that dissection this low and lateral in the neck may predispose patients to complications such as brachial plexus injury, pneumothorax, chyle leak, or uncontrollable bleeding deep in the neck. We did not encounter any of these complications in our 3 patients and it is our experience that careful dissection in this region can be safely performed, especially went blunt dissection is employed.

In summary, the dorsal scapular artery is a viable recipient vessel during microvascular reconstruction in the vessel-depleted neck. Advantages include a previously undissected field, large caliber vessel, and favorable geometry for microvascular anastomosis. Disadvantages include a location low in neck requiring a long vascular pedicle, especially if the planned reconstruction involves the oral cavity or oropharynx.

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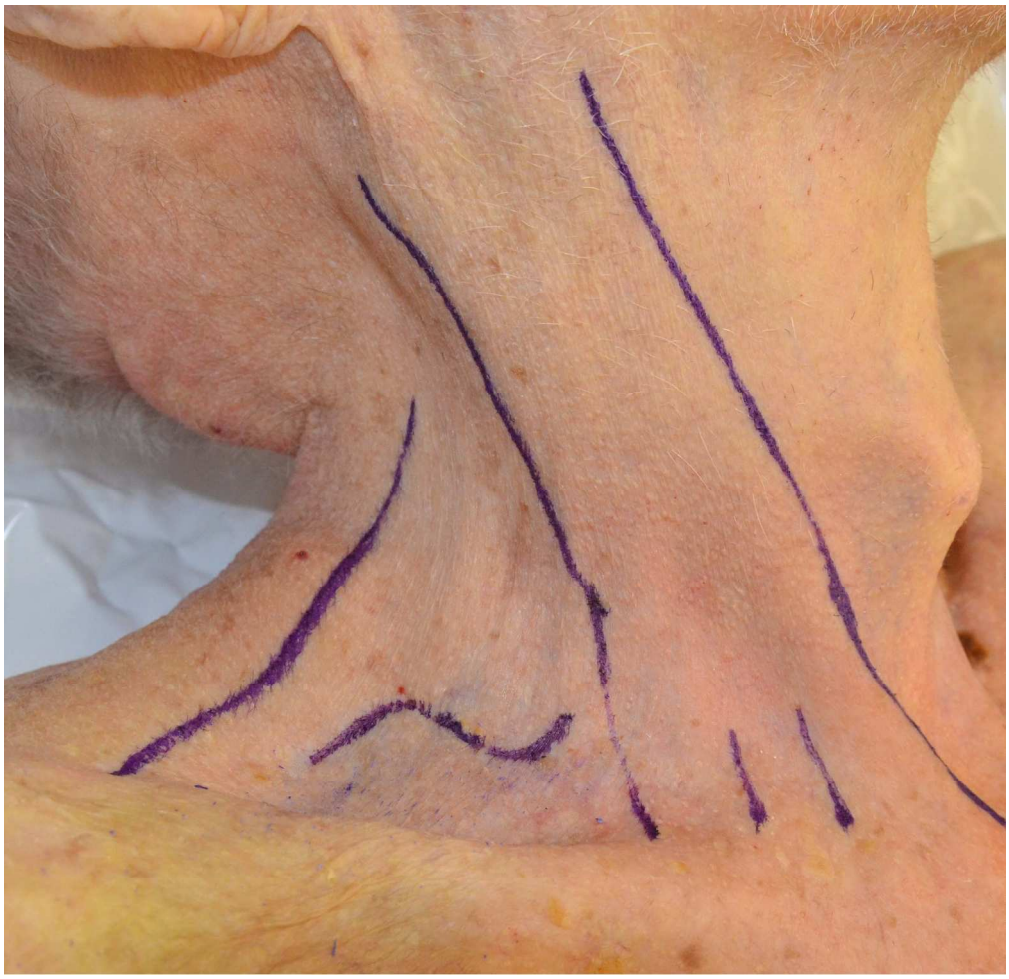

Figure 1. Planned Incision for the dissection of the dorsal scapular artery. A curvilinear incision was used in the supraclavicular triangle.
Figure 1
1045x1013mm (72 x 72 DPI)

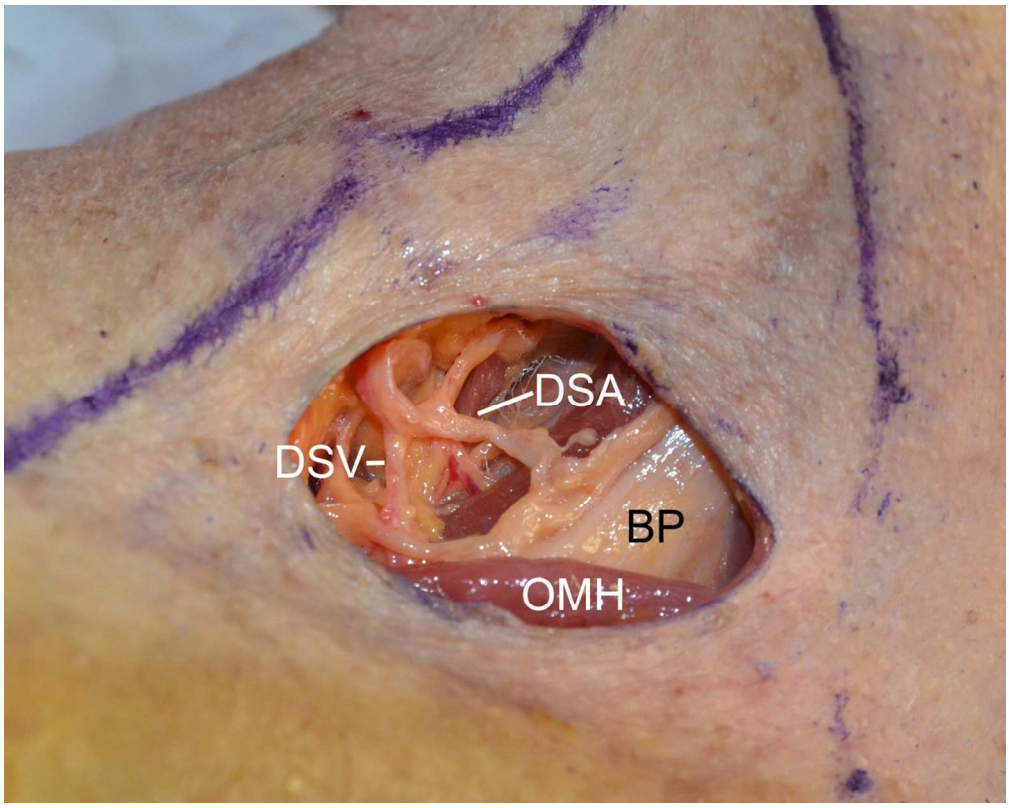


Figure 2. Cadaveric dissection of a right neck showing the intraoperative view of the dorsal scapular artery and vein. Note the relationship of the vessel to the brachial plexus as it is identified superior and lateral to the plexus. (DSA – Dorsal scapular artery; DSV – Dorsal scapular vein; BP – Brachial plexus; OMH – Omohyoid)
Figure 2
165x131mm (220 x 220 DPI)

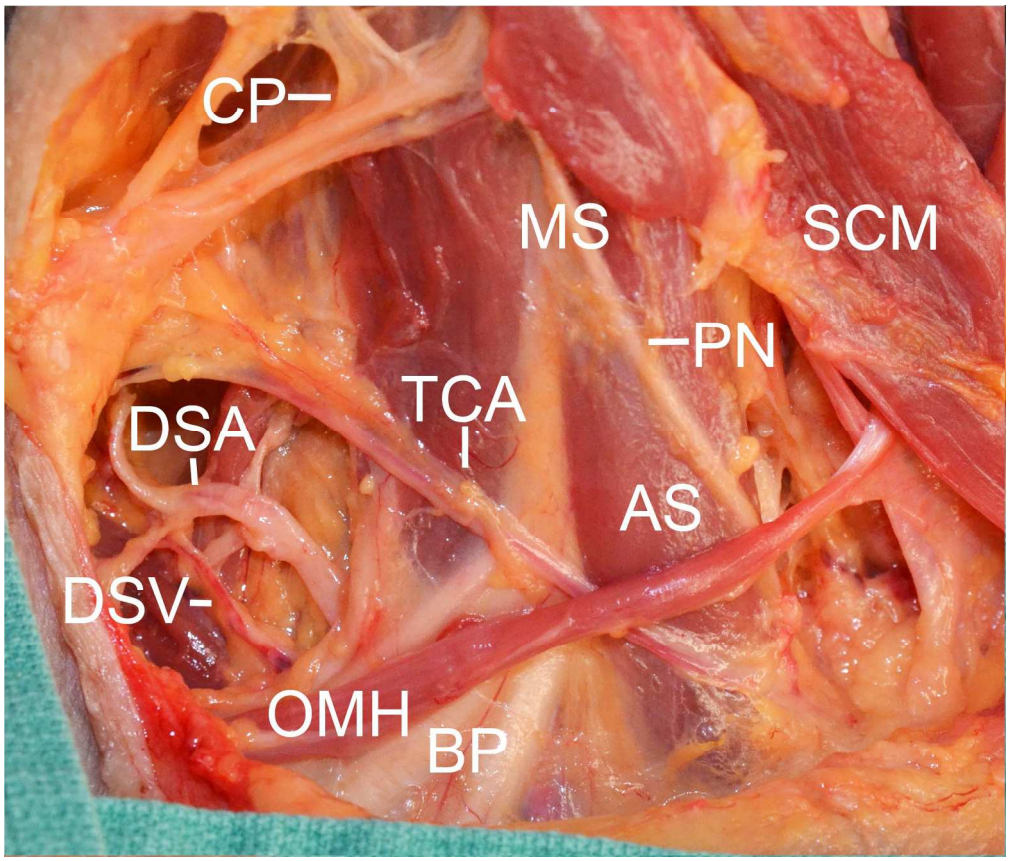


Figure 3. Cadaveric dissection of a left neck showing the anatomic relationships of the dorsal scapular artery and vein to surrounding structures. (DSA – Dorsal scapular artery; DSV – Dorsal scapular vein; TCA – Transverse cervical artery; OMH – Omohyoid; SCM – Sternocleidomastoid; AS – Anterior scalene; MS – Middle scalene; BP – Brachial plexus; CP – Cervical plexus)
Figure 3
842x716mm (72 x 72 DPI)

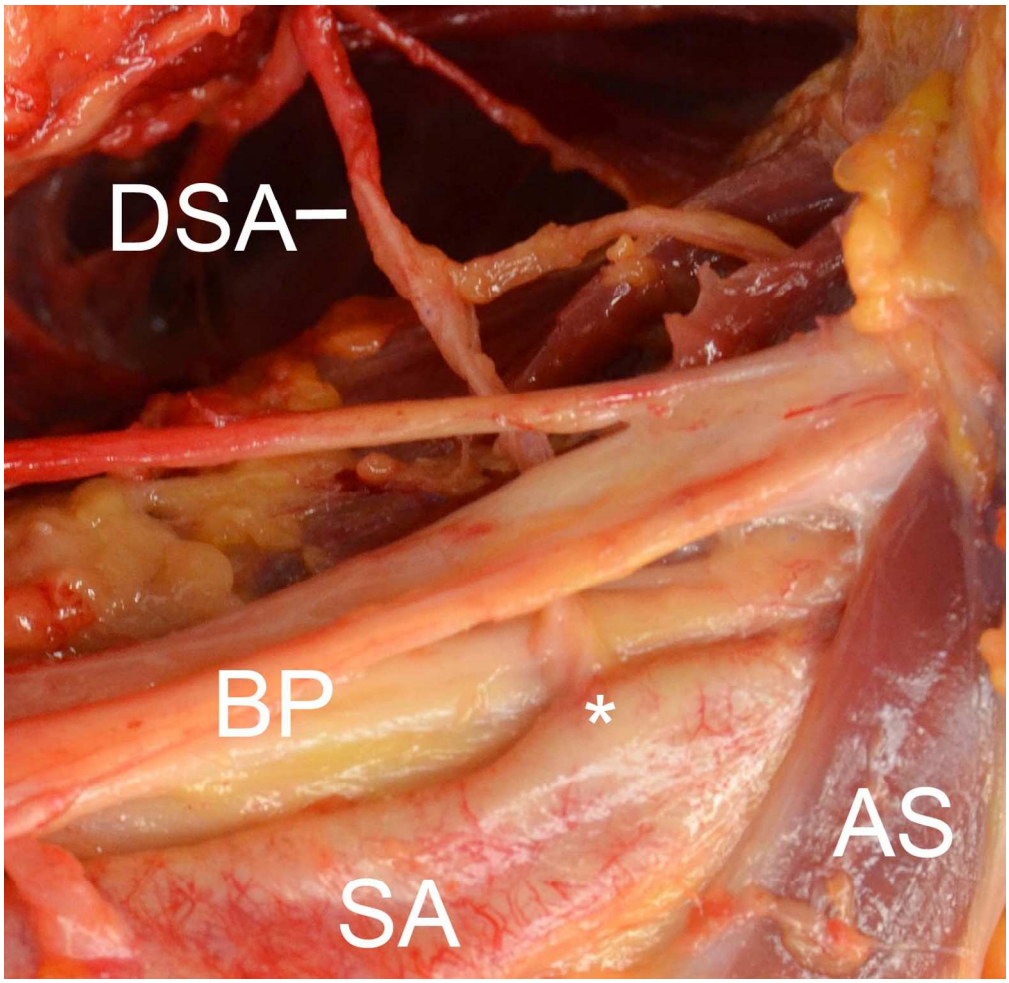


Figure 4. Cadaveric dissection of a right neck showing the takeoff of the dorsal scapular artery (*) directly from the subclavian artery and passing between the middle and superior trunks of the brachial plexus. (DSA – Dorsal scapular artery; SA – Subclavian artery; BP – Brachial plexus; AS – Anterior scalene)
Figure 4
569x552mm (72 x 72 DPI)

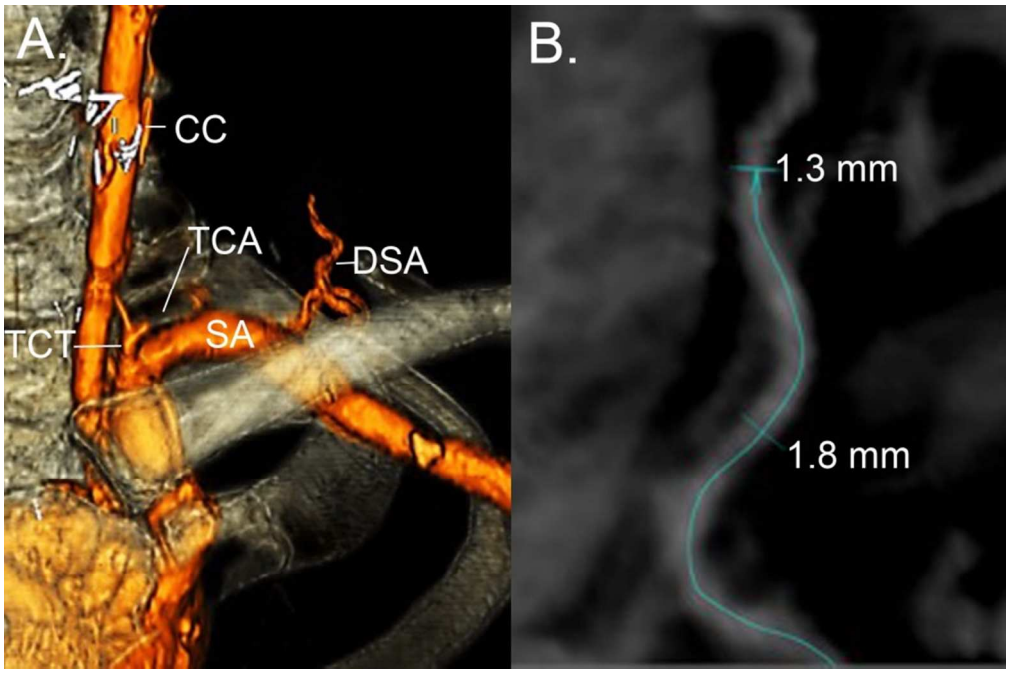


Figure 5. Three Dimensional Reconstruction of vascular anatomy for Case 2. A. The 3-D anatomy of the dorsal scapular artery in relation to surround vascular structures. (DSA - Dorsal scapular artery; SA – Subclavian artery; CC – Common carotid artery; TCT – Thyrocervical trunk; TCA – Transverse cervical artery). B. Dorsal scapular artery length and caliber. The artery has a diameter of 1.8mm at 42mm from the takeoff and decreased to 1.3mm at 65 mm from the takeoff of the dorsal scapular artery.
Figure 5A, Figure 5B
113x74mm (220 x 220 DPI)