A Novel Approach to Identifying the Spinal Accessory Nerve in Surgical Neck Dissection

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Sponsorships or competing interests that may be relevant to content are disclosed at the end of this article.

Abstract
Intraoperative identification of the spinal accessory nerve (SAN) is key in reducing nerve injury. This study aims to explore the surgical anatomy of the SAN and 2 landmarks for its identification—the sternocleidomastoid branch of the occipital artery (SBOA) and superior sternocleidomastoid tendon (SST)—to propose a novel method of identifying the SAN during surgical neck dissections. Twelve cadavers underwent bilateral level II-V neck dissection identifying the SAN, SBOA, and SST. Variation was documented and distance between landmarks and the SAN measured. The most common arrangement had the SST most superficially followed by the SBOA and then the SAN. The SAN was 3.63 ± 4.02 mm from the artery and 2.31 ± 1.72 mm from the tendon. A triangle—bordered by the tendon laterally, artery medially, and digastric muscle superiorly—contained the SAN in 95.8% of cases. This relationship translated into a reliable technique to identify the SAN intraoperatively, which has been used successfully in practice.

Keywords
surgical neck dissection, spinal accessory nerve, surgical landmarks, surgical anatomy

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N eck dissections have been key in managing head and neck cancers since described by Crile in 1906.¹ Knowledge of nodal drainage basins from known upper aerodigestive primary sites has allowed more selective approaches, improving functional outcomes without compromising oncologic clearance.²⁻⁴ Selective neck dissections require preservation of the spinal accessory nerve (SAN).⁵ Identifying the SAN intraoperatively in level II can prove challenging, and failure to preserve it leads to the debilitating “shoulder syndrome.”⁶ SAN injury may be avoided by safely identifying it in lymph node levels II and V.⁷⁻⁹ Most existing literature surrounds methods of identifying the SAN in level V. However, the SAN’s course in this area results in a higher risk of nerve injury; therefore, dissections in this region are frequently avoided.⁸,¹⁰ Added to this fact is the increasing evidence to avoid elective dissection of level V in occult disease.¹¹

As a result, a repeatable and reliable method of identifying the SAN between levels IIA and IIB is needed. Numerous methods are proposed that utilize the SAN’s relationship to structures such as the transverse process of C1,¹²,¹³ perforating veins draining the sternocleidomastoid (SCM),¹⁴ SCM branch of the occipital artery (SBOA),¹⁵ and superior SCM tendon (SST).¹⁶ However, much of the literature supporting these landmarks is purely descriptive of technique or limited to small-scale anatomic studies.

This study builds on preexisting literature for 2 promising landmarks in lymph node level II—the SBOA and SST—highlighting key variants and quantifying their relationship to the SAN. From this, we propose a novel method of identifying the SAN during neck dissections.

Methods
Ethics approval was granted by the Keele University Ethics Committee. Twelve cadavers—10 formalin fixed and 2 fresh frozen (24 heminecks)—with no documented neck pathology or surgery were included. Specimens underwent standardized bilateral level II-V neck dissection with aid of surgical loupes (3.5× magnification).¹⁶,¹⁷ In level II, the SAN, SST, and SBOA were identified and skeletonized. Observations regarding structure and position were documented and photographed. The distances between the SAN and landmarks were measured with digital calipers (accuracy, ±0.03 mm). All measurements were repeated 3 times and the mean taken.

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Results

This study identified variability in all structures. The SAN divided into a trapezius and an SCM branch in 29.1% of cases. The SST terminated in a single tendinous slip in 62.5% (Figure 1), 2 slips in 33.3% (Figure 2), and 3 slips in 4.2%. The SBOA demonstrated a single branch in 50%, 2 branches in 45.8%, and 3 branches in 4.2%.

The most common arrangement of structures saw the tendon most superficially, followed by the SBOA and then the SAN inserting deep at the junction with the SCM. This occurred in 62.5% of cases. In 20.8%, the SAN was level with the tendon and superficial to the artery. In 16.6%, the artery and SAN were level but deep to the tendon. Both landmarks had a comparable distance from the SAN, with the artery being 3.63 ± 4.02 mm and the tendon 2.31 ± 1.72 mm away. A triangle in level II was identified, bordered by the SBOA medially, SST laterally, and the digastric muscle superiorly (Figure 3). This contained the SAN in all but 1 side, where the SAN was medial to the SBOA.

From these observations, a method of identifying the SAN was developed that can be replicated in the theater environment: (1) Across a broad front, unwrap the investing fascia over the anterior surface of the SCM. (2) Continue clearing the fascia covering the deep surface of the SCM, revealing the SST. (3) Trace the tendon inferiorly to identify the SBOA entering the muscle. (4) Bisect the angle between the tendon and SBOA to identify the SAN running deep in the fascia between these structures.

Discussion

This study explored the surgical anatomy of the SAN and 2 promising landmarks to aid its identification. Focusing on landmarks in level II is key, as there is increasing evidence to avoid elective dissection of level V in occult disease due to the higher rates of nerve injury in this area.10,11

Despite a small study population, the anatomic variability identified was comparable to the existing literature: 29.1% of SANs branched, in keeping with 22% to 29% in other studies.18,19 Similarly, the SBOA had a proportion of branching vessels comparable to that of Kierner et al20.
however, it was significantly higher than that of Rafferty et al., who identified branching in 0.05%. This may be explained by the lack of magnification equipment used in the latter study, which is useful for identifying small branches. Interestingly, this study also highlights that the nerve is not always deep to the tendon as described previously, as 20.8% of cases were level with the tendon.

This is the first study describing variability of the SST’s structure and quantifying its distance from the SAN. Importantly, this is the first description of a triangle containing the SAN and its use in a simple method of SAN identification intraoperatively.

The small sample size is a significant limitation of this study; however, variation appears similar to existing literature. Also, the use of embalmed specimens may limit the accuracy of measurements. This is evidenced by the shorter distance between the SBOA and SAN in this study as compared with other studies, possibly caused by tissue shrinkage and discoloration.

**Conclusions**

The SBOA and SST are consistent landmarks for the SAN. When used together, they represent a reliable method of SAN identification, which has been repeatedly employed successfully at our tertiary head and neck unit.

**Author Contributions**

Michael James Eastwood, study design, data acquisition, data analysis, drafting work, final approval of work, accountable for all aspects of the work; Ajith Paulose George, study design, critical review and drafting of work, final approval of work, accountable for all aspects of the work.

**Disclosures**

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