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An anatomical study of the arterial and nerve supply of the infrahyoid muscles

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A precise knowledge of the sources of the arterial and neural supply of the sternohyoid (SH), sternothyroid (STM), and superior belly of omohyoid (OM) is of value to surgeons using the infrahyoid muscles in reconstruction procedures of the head and neck. This study was designed to define the anatomical bases of the variable sources of the arterial and neural supply of these muscles. Fourteen cadavers were unilaterally dissected in the neck region, and the arterial pedicles of these muscles were followed and accurate measurements were taken. For the SH, two arterial pedicles (superior and inferior) originated from the superior thyroid artery ST and supplied the muscle in 57.1% of cases. The inferior pedicle was absent in 42.9% of cases. As regards the STM, one arterial pedicle from the ST supplied its upper end by multiple branches in 57.1% of cases. In 14.3% of cases, branches from the inferior thyroid artery (IT) supplied the STM in addition to its supply from the ST. As regards the OM, two arterial pedicles originated from the ST and supplied its upper and lower ends in 57.1% of cases. The main artery from the ST to the superior belly of OM entered at its superior portion. The ansa cervicalis (AC) innervated the infrahyoid muscles. SH usually had a double nerve supply. In 57.1% of cases, its superior part was innervated by the nerve to the superior belly of OM. Its inferior part received branches from the AC. In 35.7% of cases, its superior part received direct branches from the AC. As regards the STM, in (71.4%) of cases, a common trunk arose from the loop and supplied the inferior part of both the SH and STM. The nerve supply to the superior belly of OM originated from the AC below the loop in 64.3% of cases. These data will be useful for preserving the neuro-vascular supply of the infrahyoid muscles during flap preparation. (Folia Morphol 2009; 68, 4: 233–243)

Key words: sternohyoid, sternothyroid, omohyoid, superior thyroid, ansa

INTRODUCTION

The infrahyoid myocutaneous flap is obviously of interest in head and neck reconstruction surgery given its versatility, reliability, and the quality of its cosmetic results. It represents today the golden standard for reconstruction of extensive defects after resection of head and neck cancer [6]. This flap consists of sternohyoid (SH), sternothyroid (STM), superior belly of omohyoid (OM), and a skin pad from the medial infrahyoid area. Its arterial supply comes from the superior thyroid artery [11]. Thanks to its arc of rotation, this flap is suitable for the repair of mucosal defects of the tongue, floor of the mouth to the trachea, retromolar region, interior side of the cheek, oropharynx, and hypopharynx, and in the face, skin defects of the exterior side of the cheek, the parotid region, and the lower lip [1, 11].

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Because the circulation of a muscle is derived from the vascular pedicles that enter the muscle belly between its origin and insertion, knowledge of the number and locations of these vascular pedicles becomes very important for the safe and successful transposition of the muscle or its associated musculo-cutaneous flap [12].

It has been reported previously that the infrahyoid muscles can be used successfully as vascularised pedicles for reconstructive procedures of the head and neck region [8, 10, 15]. Laryngotracheal reconstruction has used a myocutaneous rotator flap of the neck skin based on perforators from the underlying sternohyoid muscle [14]. The sternohyoid muscle in particular has been advocated for reconstruction of partial laryngectomy defects using bipedicled (superiorly and inferiorly based) flaps [2]. Anterior commissure glottis reconstruction with the omohyoid muscle has also been proposed [20].

To date, there are no sufficient pertinent, surgically applicable references on the arterial supply to the infrahyoid muscles. This information would be beneficial to improve the quality and effectiveness of surgical reconstructions as it will aid surgeons in planning and performing their operations.

The purpose of this study was to define the anatomical basis of the various sources of the arterial and neural supply of the sternohyoid, sternothyroid, and superior belly of omohyoid. This information will help in preserving their neuro-vascular supply in surgical reconstruction to prevent loss of tissue and bulk from ischaemia or denervation. The inferior belly of omohyoid and thyrohyoid were excluded from this study because of their limited usage in reconstructive surgery.

Because a precise knowledge of the location of the vascular pedicles is required for the safe and successful transposition of a muscle or musculo-cutaneous flap, this study will be of value to surgeons using infrahyoid muscles in reconstruction procedures of the head and neck.

MATERIAL AND METHODS

Fourteen preserved cadavers obtained from the Anatomy Department were unilaterally dissected in the neck region. All specimens had intact neural and arterial supply to the SH, STM, and superior belly of OM. The human cadavers (8 males and 6 females) were injected with red latex. With the injection of red latex, the arterial territories to the infrahyoid muscles were demonstrated.

The common carotid and subclavian arteries were exposed by removing the mid-portion of the clavicle and were then injected with latex. Two incisions were made from the inferior mental spine, one inferiorly to the jugular notch and the other transversely to the angle of the mandible. To expose the infrahyoid muscles, the cutaneous and subcutaneous tissues covering this region were reflected carefully. Then, the cervical arterial tree, the arterial pedicle, and the neural supply of the SH, STM, and superior belly of the OM muscles were identified and dissected meticulously. The dissection was photographed in stages. The superior thyroid artery and the ansa cervicalis (AC) were examined carefully as they are the main supply for the infrahyoid myocutaneous flap.

The entering sites of the pedicles were determined. By following the arterial pedicles of the muscles toward their roots, the arterial origins of these vessels were identified. Then, the length of the arterial pedicles from their origins to the muscles was measured to the nearest millimetre. The distances of the arterial pedicles from where it entered the muscles to the most lateral superior attachments to either the hyoid bone in cases of SH and OM or the apex of oblique line of thyroid cartilage in case of STM were recorded. The purpose of measuring the length of the arteries was to evaluate their potential application in reconstructive surgery. Blunt dissection of strap muscles was performed from medial to lateral. Infrahyoid muscles were then transsected close to the sternum, hyoid bone, and thyroid cartilage to identify the arterial and nerve supply that run underneath it. After blunt dissection of the AC, transection of the OM muscle was done.

The arrangement of the AC in relation to the neighbouring anatomical structures was studied macroscopically to trace its branches to the previously specified infrahyoid muscles.

RESULTS

Infrahyoid muscles get their arterial supply mainly from the superior thyroid artery. The artery is usually derived from the external carotid artery but may also originate close to the carotid level of bifurcation or from the common carotid artery itself (Figs. 1–3).

Sternohyoid (SH)

Two arterial pedicles originated from the superior thyroid artery (ST) and entered this muscle in 8 cases (57.1%). One of the pedicles was located superiorly and the other inferiorly (Figs. 4, 5). Both pedicles branched out into several small inputs that

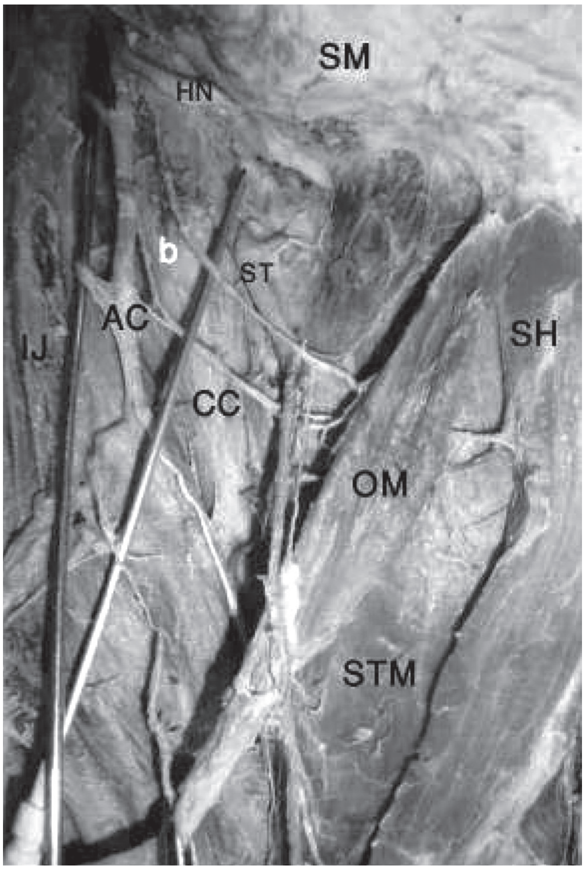

Figure 1. A photograph of the right side of the neck showing the superior thyroid artery (ST) originating from the external carotid artery; hypoglossal nerve (HN), common carotid artery (CC), ansa cervicalis (AC), sternohyoid (SH), sternothyroid (STM), omohyoid (OM), site of bifurcation (b) of common carotid artery, and internal jugular vein (IJ); SM — submandibular gland.

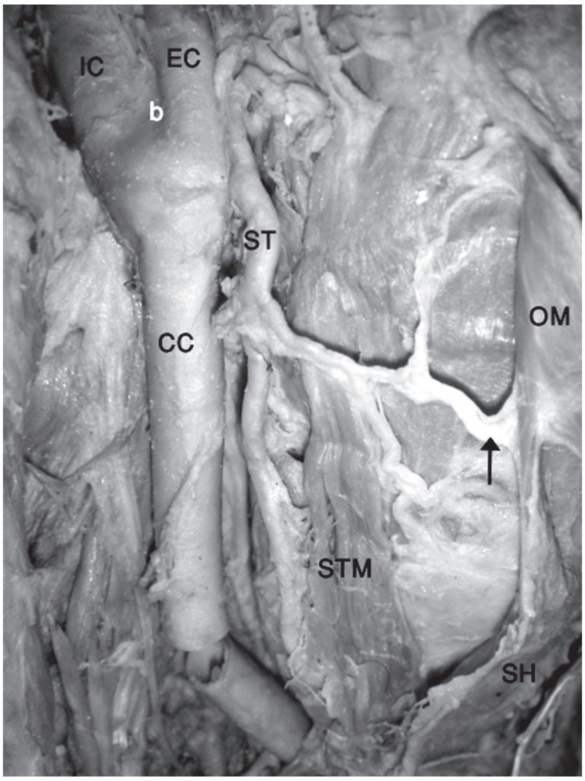

Figure 2. A photograph of the right side of the neck showing the superior thyroid artery (ST) originating from the level of bifurcation (b) of the common carotid (CC); internal carotid (IC), external carotid (EC), sternohyoid (SH), sternothyroid (STM), omohyoid (OM), and arterial supply to SH (big black arrow).

supplied the muscle. In 6 cases (42.9%), the inferior pedicle was absent (Figs. 6–8).

In all cadavers, the superior arterial pedicles originated from the superior thyroid artery and entered the muscle 3.24 ± 1.69 cm (min 1.5 cm, max 8 cm) inferior to its most lateral superior attachment to the hyoid bone. The artery to SH muscle enters laterally and deep to the muscle, most commonly close to the level of the lower border of thyroid cartilage (Figs. 5, 8). The length of the arterial pedicles from their origins to the muscle ranged from 2.5 to 6 cm with a mean of 4.04 ± 1.08.

After giving off its sternocleidomastoid branch (SC), the ST slopes downwards and supplies the infrahyoid muscles by several small twigs that enter directly into the muscles (Fig. 7).

The inferior thyroid artery (IT) gives no branches to the SH in these specimens (Fig. 9).

In one specimen (7.14%), the arterial pedicle of SH originated through a common trunk with the arterial branches that supplied the thyroid gland (Fig. 4). A superior branch supplied the SH of both sides, and the sternothyroid in addition to the upper part of thyroid gland. An inferior branch is seen supplying the lower end of the thyroid gland and then giving a branch to the distal part of the SH (Fig. 4A).

Sternothyroid muscle (STM)

One arterial pedicle from the superior thyroid artery supplied the upper end of the STM by multiple small branches in 8 cases (57.1%) (Fig. 10). In one case (7.1%), three pedicles supplied the STM; two originating from the superior thyroid artery supplied the upper part of this muscle. One passed medial and the other lateral to the STM. The third pedicle was located inferiorly and originated directly from the common carotid artery, and supplied the muscle laterally by two small twigs (Figs. 11A, B).

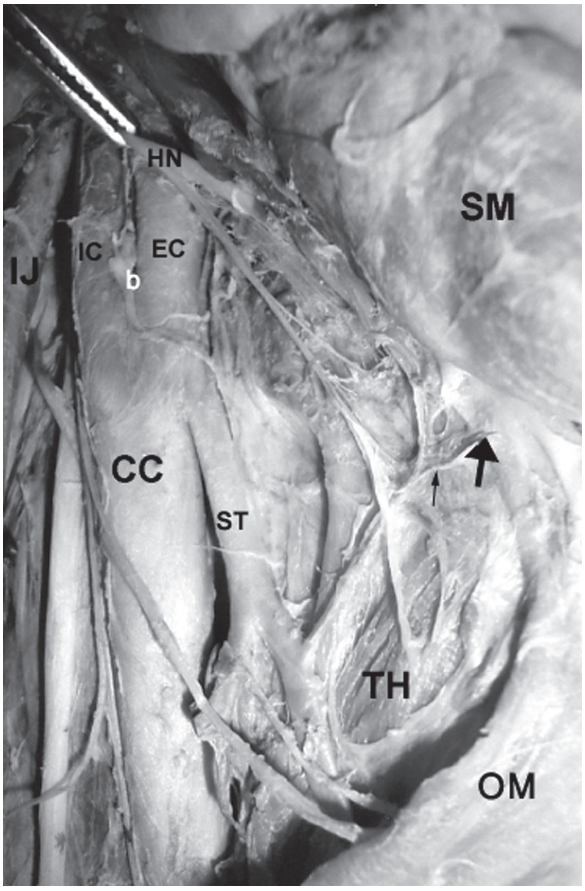

Figure 3. A photograph of the right side of the neck showing the superior thyroid artery (ST) originating from the common carotid artery (CC); thyrohyoid muscle (TH), site of bifurcation (b) of common carotid artery, internal carotid artery (IC), external carotid artery (EC), internal jugular vein (IJ), hypoglossal nerve (HN), submandibular gland (SM), arterial supply to omohyoid (OM) (big black arrow), and nerve supply to OM (small black arrow).

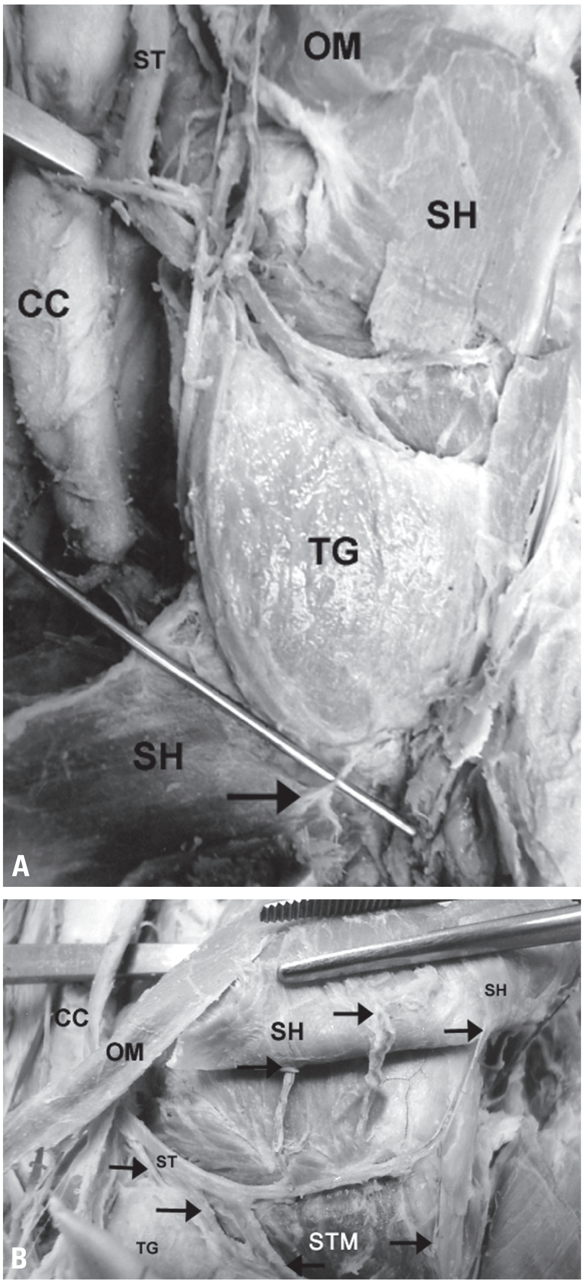

Figure 4. A. A photograph of the right side of the neck showing the superior thyroid artery (ST) supplying the sternohyoid (SH). The inferior pedicle is seen piercing the SH (big black arrow); thyroid gland (TG), omohyoid (OM), common carotid artery (CC), and arterial supply to SH (big black arrow); **B.** A photograph of the right side of the neck of the same specimen showing the superior pedicle of superior thyroid artery (ST) supplying sternohyoid (SH) of the same side by two branches. A third branch supplied SH of the opposite side; thyroid gland (TG), sternothyroid (STM), omohyoid (OM), common carotid artery (CC); arterial supply to SH of both sides, STM, and TG (big black arrow).

In one case (7.1%), a common trunk coming from the ST supplied the right and left sternohyoid, the sternothyroid, and the upper part of the thyroid gland (Fig. 4). In two specimens (14.3%), a common trunk coming from the ST supplied the sternohyoid and sternothyroid (Figs. 8, 11C).

In two cases (14.3%), a branch from the IT supplied the STM (Fig. 12). The inferior thyroid artery ascends cranially to the level of the 6th cervical vertebra then turns medially and crosses behind the carotid sheath. Finally, it curves caudally before reaching the lower pole of the thyroid gland sending out its terminal branches. The IT, just before entering the thyroid gland, sends an arterial branch which supplies the sternothyroid.

The arterial supply to the STM entered the muscle (3.26 ± 1.61 cm; min 1 cm, max 6.2 cm) inferior to its superior attachment to the apex of the oblique line of the thyroid cartilage. The length of the arterial pedicles from their origins until the point at which they entered the muscle ranged from 1.3 to 6 cm with a mean of 3.86 ± 1.37 cm.

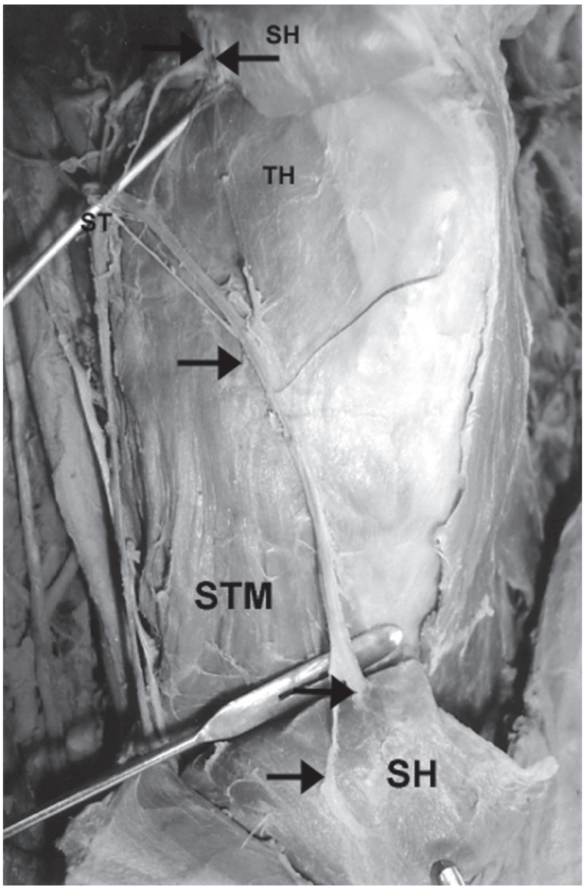

Figure 5. A photograph of the right side of the neck showing the same specimen of Figure 1. The superior thyroid artery (ST) gave a superior and inferior pedicle to the sternohyoid (SH); thyrohyoid muscle (TH), and sternothyroid muscle (STM); arterial supply to SH and STM (big black arrows).

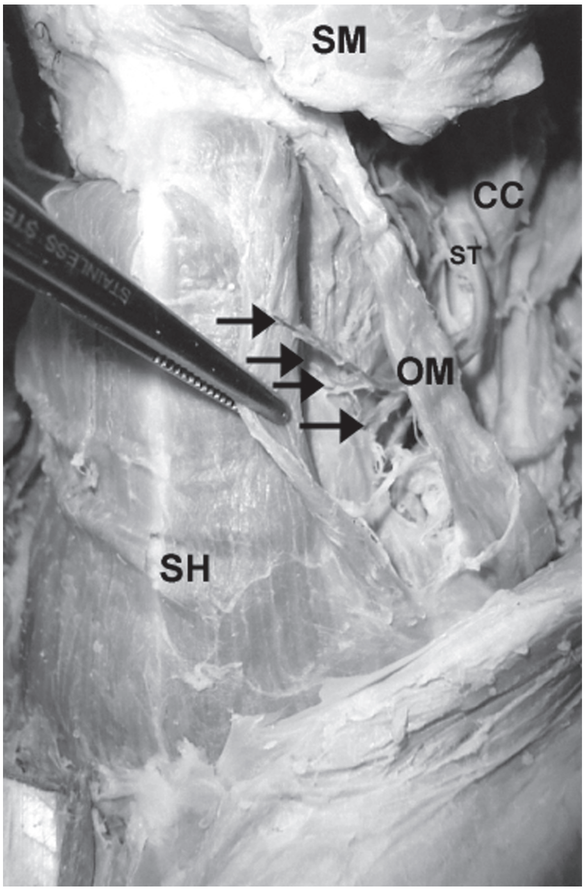

Figure 6. A photograph of the left side of the neck showing the superior thyroid artery (ST) giving a superior pedicle to the sternohyoid (SH); arterial supply to the SH and neighbouring structures (big black arrow); SM — submandibular gland, CC — common carotid artery, OM — omohyoid.

Superior belly of omohyoid

One arterial pedicle originated from the ST and entered the muscle from its inner surface in 3 cases (21.4%) (Fig. 8). Two arterial pedicles originated from the ST and supplied the upper and lower ends of the OM in 8 cases (57.1%) (Figs. 11A, C, 13). In one of them, the inferior pedicle to the OM originated from the sternocleidomastoid branch (Fig. 13A). In two specimens (14.3%), three pedicles originated from the superior thyroid artery and supplied the OM (Fig. 14). The main artery from the ST to the superior belly OM entered at its superior portion (Figs. 8, 11A, 13A, 14).

The hyoidal artery arises directly from the ST. It runs medially and inferior to the hyoid bone to supply the OM muscle near its hyoidal attachment in three specimens (21.4%) of the two pedicles pattern (Fig. 13A).

A duplicated OM was observed. The first belly is attached to the clavicle and the second belly is attached, along with the usual inferior belly of OM, to the transverse scapular ligament. Two vascular pedicles originated from the ST. The superior pedicle supplied the upper-most part of one of the bellies and the inferior pedicle supplied the lower-most part of the two bellies (Fig. 15).

The distance between the entering sites and the lateral end of its superior attachment to the hyoid bone was 3.69 ± 1.39 cm (min 1.1 cm, max 6 cm). The length of the pedicles from their origins to the muscle ranged from 1.2 to 4.4 cm with a mean of 3.06 ± 1.10 cm.

Nerve supply to sternohyoid, sternothyroid, and superior belly of omohyoid

Regarding the nerve supply, the AC was identified in 5 cases (35.7%) lateral (superficial) to the internal jugular vein when the inferior root ran anterior to the vein to form the AC on the anterior surface of carotid sheath; thus it is known as lateral type (Fig. 15A). In 8 cases (57.1%), it lay between

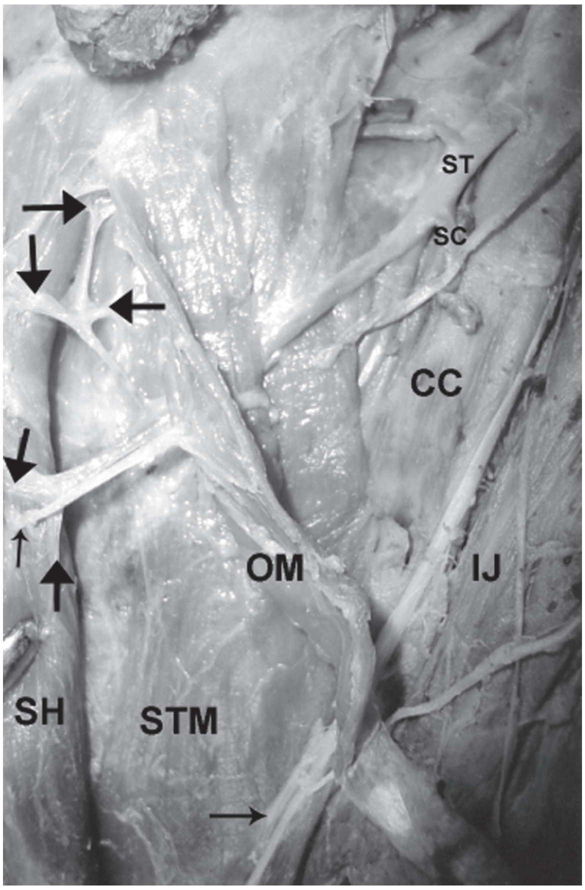

Figure 7. A photograph of the left side of the neck showing the superior thyroid artery (ST) giving a superior pedicle to the sternohyoid (SH), which divided into several branches. Some of them supplied the SH and the rest supplied the omohyoid (OM) (big black arrows); common carotid artery (CC), internal jugular vein (IJ), sternocleidomastoid branch (SC), sternothyroid (STM); nerve supply to SH and STM (small black arrows).

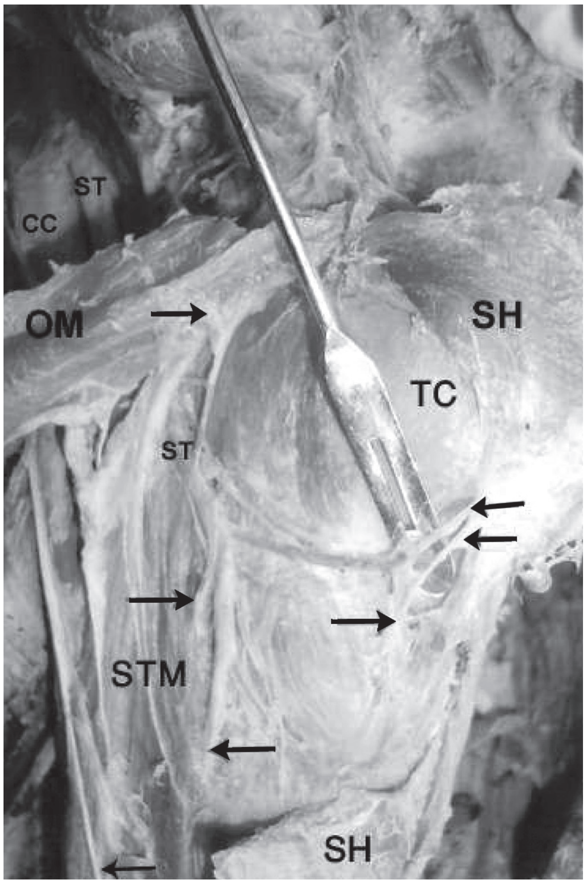

Figure 8. A photograph of the right side of the neck showing that the superior thyroid artery (ST) giving a superior pedicle to the sternohyoid (SH), which divided into several branches (big black arrows). Another pedicle from the ST supplied the omohyoid (OM) (big black arrows), and the third pedicle supplied the sternothyroid (STM); thyroid cartilage (TC), and common carotid artery (CC).

the internal jugular vein and the common carotid artery when the inferior roots ran posterior to the internal jugular vein, thus forming the AC deep to it, such an ansa is known as medial type (Fig. 11C).

The sternohyoid usually had a double nerve supply. Its superior part was innervated by the nerve to the superior belly of OM in 8 cases (57.1%). After supplying the OM, the nerve went on to supply the SH. Its inferior part received branches from the ansa cervicalis. The nerve usually passed over the STM to reach the SH (Fig. 16). In 5 cases (35.7%), its superior part received direct branches from the AC. The usual point of entry was close to its lateral border (Fig. 10).

As regards the STM, a common trunk arose in 10 cases (71.4%) from the loop of ansa cervicalis and supplied the inferior part of both SH and STM. The usual point of entry was the lower part of the STM near its lateral border (Fig. 10). In three cases

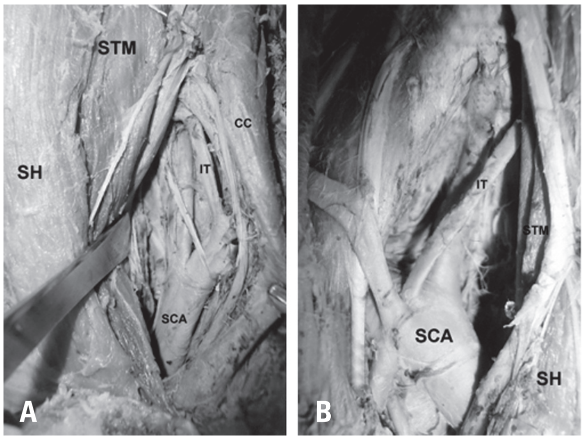

Figure 9. A. A photograph of the left side of the neck showing the inferior thyroid artery (IT) giving no branches to the sternohyoid (SH); sternothyroid (STM), common carotid artery (CC), subclavian artery (SCA); **B.** A photograph of the right side of the neck showing inferior thyroid artery (IT) giving no branches to sternohyroid (SH); sternothyroid (STM), subclavian artery (SCA).

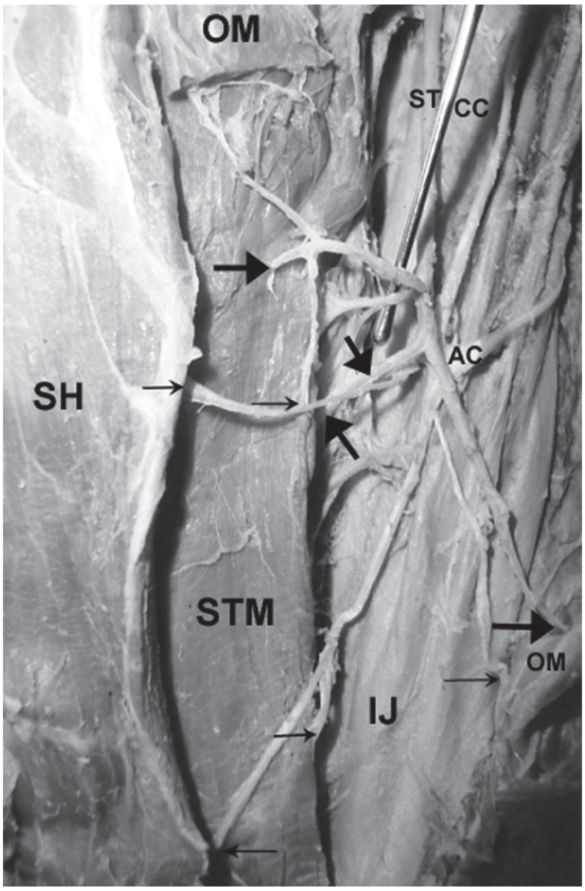

Figure 10. A photograph of the left side of the neck showing that the sternohyoid (SH) received double nerve supply from the ansa cervicalis (AC). The sternothyroid (STM) received its nerve supply near its lateral border (small black arrows); common carotid artery (CC), sternohyoid (SH), omohyoid (OM), superior thyroid artery (ST), internal jugular vein (IJ); arterial supply to STM and OM (big black arrows).

(21.4%), a common trunk supplied the SH, STM, and OM (Figs. 13B, 16).

As regards the OM, the nerve to the superior belly of OM originated from the superior root of the AC in three cases (21.4%) (Fig.14). In one case (7.1%), the nerve to the superior belly of OM originated from the hypoglossal nerve (Fig. 3). In nine cases (64.3%), it originated from the AC below the loop (Figs. 10, 15A, 16).

In one case (7.1%), the vagus replaced the AC and joined the hypoglossal nerve. It was joined by cervical roots (C2, C3) beneath the carotid arteries. It gave a common trunk which supplied the SH, STM and OM muscles (Fig. 17).

DISCUSSION

This study defines the arterial pedicles of the infrahyoid muscles and their exact points of entry based on measurements taken in reference to the muscle attachments. This study confirmed that the superior thyroid artery supplied the infrahyoidal musculature in its whole extension from the hyoid bone to the sternum through perforators, similar to the results of Remmert et al. [14] and Rojananin et al. [15].

Gormus et al. [7] found that the SH and STM were supplied by one superior and one inferior vascular pedicles. The superior pedicle originated from the superior thyroid artery and the inferior pedicle from the IT. Inferior thyroid artery supplied these muscles below the upper border of the anterior cricoid cartilage to the sternal notch caudally. The IT formed anastomoses with twigs of ST. In contrast, this study demonstrated that these two pedicles frequently originated from the superior thyroid artery in the case of SH and STM, but in 2 cases only the inferior pedicle to the STM originated from the inferior thyroid artery.

Wang et al. [19] noticed that the artery to the upper part of the sternohyoid entered it at the level of the inferior border of the thyroid cartilage but sometimes also at a lower level, and that the main artery to the superior belly of omohyoid entered at its inferior portion. Collateral supply may enter its middle or superior aspect. Arteries to omohyoid originated mainly from the superior thyroid artery, but in rare cases it came from the lingual or superior laryngeal arteries. The present study confirmed the first finding but demonstrated that the main arterial supply to the superior belly of omohyoid entered its superior portion and was only from the superior thyroid artery.

Eliachar et al. [5] stated that the superior thyroid artery is the dominant source of blood to the infrahyoid muscles, supplying them by its sternocleidomastoid branch, the hyoid branch, and by direct muscular twigs. He found that the superior belly of omohyoid muscle received a branch from the inferior thyroid artery. The present findings suggest that after ST gives off its sternocleidomastoid branch, it slopes downwards and directly supplies the infrahyoid muscles by several small twigs, and that the hyoidal branch supplies the omohyoid in some specimens. In one specimen, the sternocleidomastoid branch of ST gave a supply to the OM. As regards the superior belly of omohyoid, its arterial pedicle originated from the superior thyroid artery in this study.

Wang et al. [19] investigated the arterial supply of the infrahyoid muscles and found that the arterial pedicle to the superior belly of OM entered its inferior portion, and that branches of the inferior thyroid artery supplied the STM muscle. The current research,

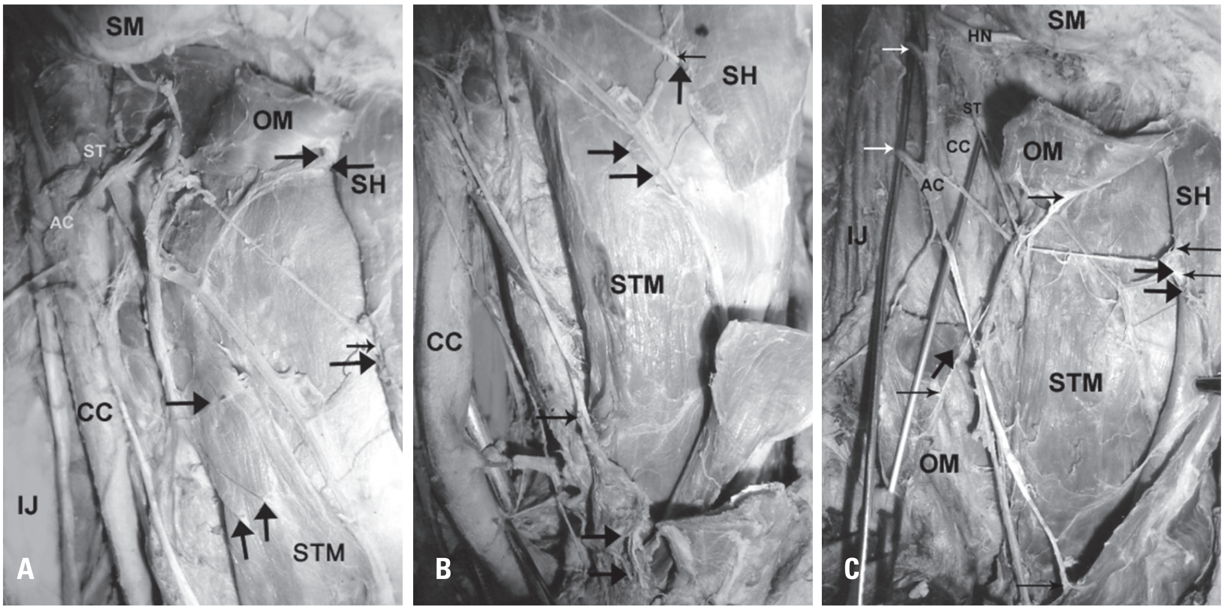

Figure 11. A photograph of the right side of the neck of the same specimen as in Figures 1 and 5, showing the three pedicles that supplied the sternothyroid (STM). Two of them arose from the superior thyroid artery (ST), one passed medial to the STM and the other lateral to it. They supplied the STM by several branches (**A**, **C**); the 2nd and 3rd cervical nerves (white arrows) enter the descending branch to form ansa cervicalis. Another, third pedicle originated directly from the common carotid artery (CC) and supplied its lower part. Nerve supply to SH and OM (small black arrows) and arterial supply to SH, STM, and OM (big black arrows) (**B**); sternohyoid (SH), omohyoid (OM), ansa cervicalis (AC), hypoglossal nerve (HN), internal jugular vein (IJ), submandibular gland (SM), nerve supply to SH and STM (small black arrows), and arterial supply to SH, OM, and STM (big black arrows).

however, differs. It was found that the arterial pedicle of the superior belly of OM penetrated the muscle approximately at its upper or middle portion, and that there were one to five arterial pedicles for the STM muscle originating from the superior thyroid artery. In two specimens, a pedicle also originated from the inferior thyroid artery and supplied this muscle. In contrast, Gormus et al. [7] found that the arterial pedicle of the superior belly of OM always penetrated the muscle only at its middle portion, and that there were two vascular pedicles for the SH, one originating from the superior thyroid artery and the other from the inferior thyroid artery.

Variations of the OM muscle are clinically important because of its relation to the internal jugular vein as well as its significance in radical neck dissection. Knowledge of the anomalies of this muscle is important to minimize the complications during surgical procedures of the cervical region [13]. In this study, a duplicated OM was seen in one specimen. This variation should be taken into consideration before operation.

This work demonstrates that the arterial supply to infrahyoid muscles is segmental, a fact that should be taken into account when applying these muscles as flaps in reconstructive procedures. No longitudinal axial vessels were found. Eliachar et al. [5] noticed the same observation and found that anastomoses of considerable size were observed within and around the strap muscles between the branches of the superior and inferior thyroid arteries. These intersegmental anastomoses have been proven as competent in various surgical applications of infrahyoid muscle flaps. Considering the segmental vascularization of the incorporated muscles, the infrahyoid myocutaneous strap flaps ought to be of rotational nature rather than axial.

Ansa cervicalis of medial type occurs more frequently than the lateral type in the Japanese population [9]. This finding was similar to that of the present research. The lateral type is more frequent in Europeans and Americans [16]. Kikuchi [9] stated that the medial type occurred more on the right side, and the lateral type on the left side, as noticed in this study.

Chetri and Berke [3] and Remmert et al. [14] stated that the terminal branches from the ansa cervicalis loop innervate the SH and STM mostly below the level of cricoids, as was observed in this study.

Wang et al. [19] noticed that the nerve to the superior belly of OM originated either from the descendens hypoglossi, from separate branches from the hypoglossal nerve, or from the loop of AC. This coincided with the results of the current research.

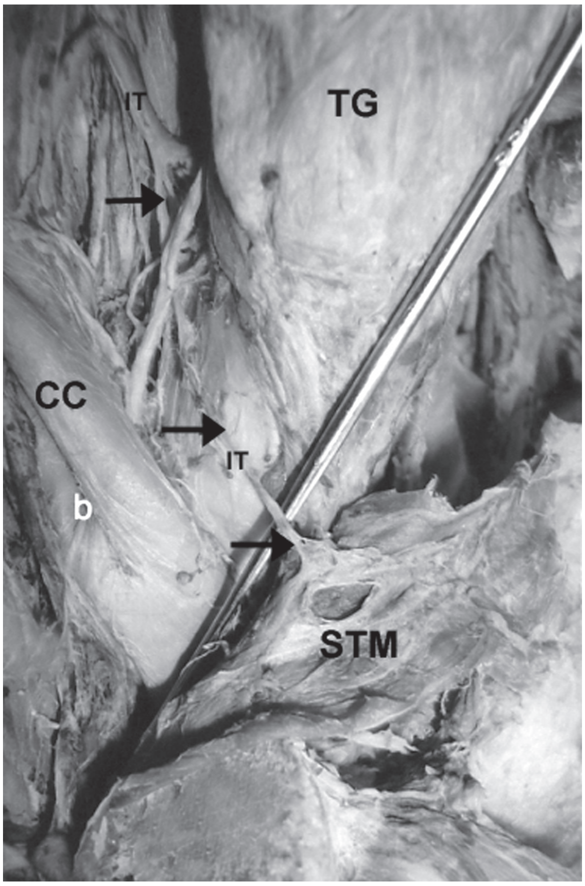

Figure 12. A photograph of the right side of the neck showing the inferior thyroid artery (IT) supplying the sternothyroid (STM); thyroid gland (TG), common carotid artery (CC), and arterial supply to the STM (big black arrows); b — bifurcation.

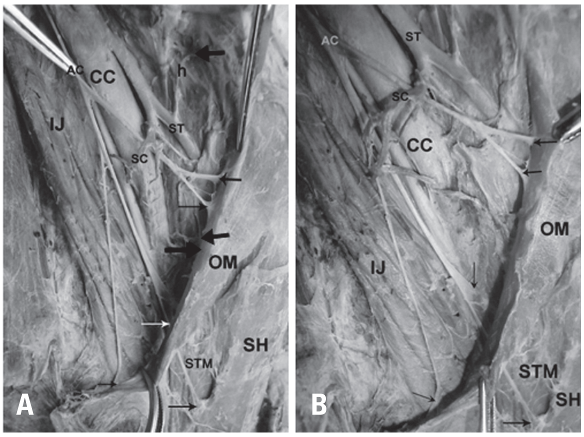

Figure 13. A photograph of the right side of the neck showing that the superior thyroid artery (ST) gave a hyoidal artery (h) which supplied the omohyoid (OM). A sternocleidomastoid branch (SC) gave arterial twigs to the middle part of the OM (**A**). A common trunk from the ansa cervicalis (AC) supplied the sternohyoid (SH), sternothyroid (STM), and OM (**B**); common carotid artery (CC), AC, internal jugular vein (IJ), sternocleidomastoid branch (SC), sternohyoid (SH), arterial supply to OM (big black arrow), nerve supply to SH and OM (small black and white arrows).

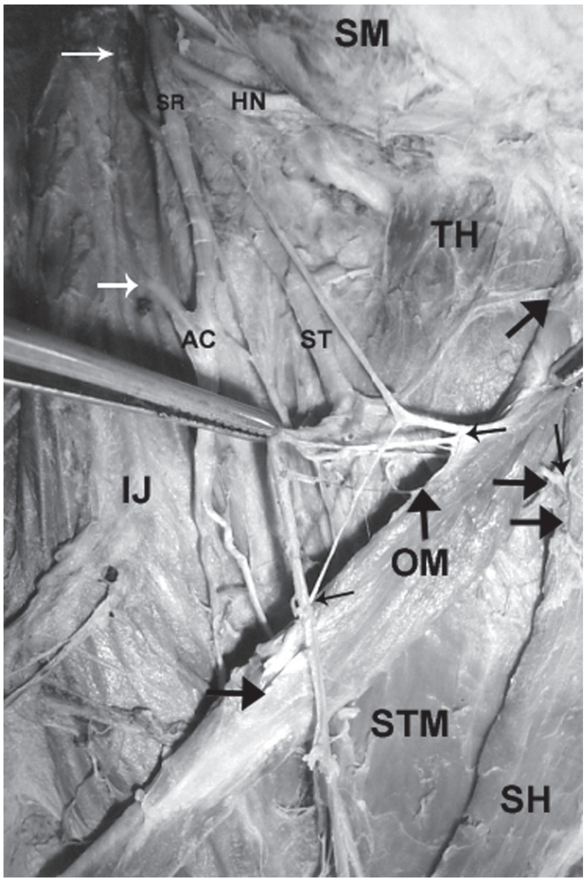

Figure 14. A photograph of the right side of the neck showing the same specimen as in Figure 1. The superior root (SR) of ansa cervicalis (AC) supplied the upper part of the omohyoid (OM) by two branches; sternohyoid (SH), sternothyroid (STM), hypoglossal nerve (HN), submandibular gland (SM), thyrohyoid (TH), internal jugular vein (IJ), superior thyroid artery (ST). The second and third cervical nerves (white arrows) formed the inferior root of AC, arterial supply to OM and SH (big black arrows) and nerve supply to SH and OM (small black arrows).

In one case, the AC was absent and was replaced by the vagus, which was attached to the hypoglossal nerve and received cervical branches that passed behind the carotid arteries. It gave branches to supply the infrahyoid and then passed downwards to continue its course.

The application of infrahyoid muscle flaps is versatile, reliable, and convenient for repairing defects in the head and neck region with interesting plastic qualities. The flap extremity can reach a distance of 15 cm around its rotation axis [4]. The effective region includes the cervical trachea and the soft palate. In the case of soft palate reconstruction, it is useful to preserve the motor innervation of infrahyoid provided by the branches of AC that is kept with the flap during its new position. The main advantage of this voluntary innervated flap is the

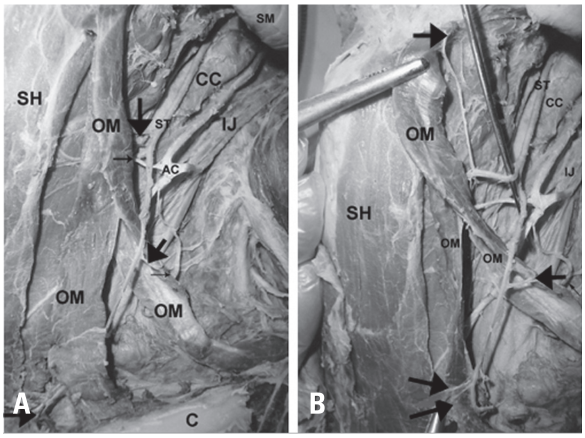

Figure 15. A photograph of the left side of the neck showing the same specimen as in Figure 10. The duplicated omohyoid (OM) had two bellies: the first belly of OM is attached to the clavicle (C), and the second belly is attached, along with the inferior belly, to the transverse scapular ligament (**A**). It received two arterial pedicles from the superior thyroid artery (ST) at its upper and lower ends (big black arrows); common carotid artery (CC), internal jugular vein (IJ), sternohyoid (SH) (**B**), nerve supply to OM (small black arrows).

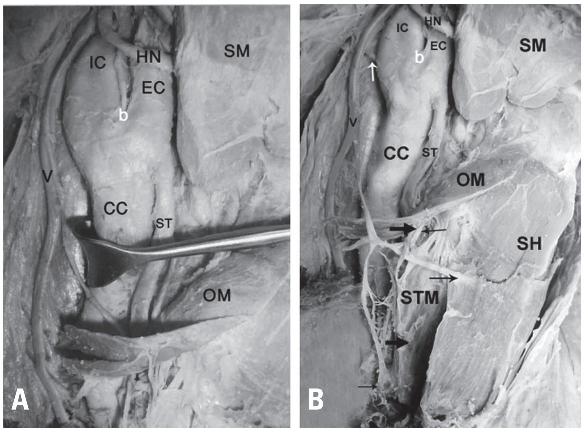

Figure 17. A photograph of the right side of the neck showing that the vagus (V) replaced the ansa cervicalis and joined the hypoglossal nerve (HN). It was joined by the second and third cervical nerves (white arrow) beneath the carotid arteries. It gave a common trunk, which supplied the sternohyoid (SH), sternothyroid (STM), and omohyoid (OM) (small black arrows). Arterial supply to OM and STM (big black arrows); submandibular gland (SM), superior thyroid artery (ST), common carotid artery (CC), external carotid artery (EC), and internal carotid artery (IC); b — bifurcation.

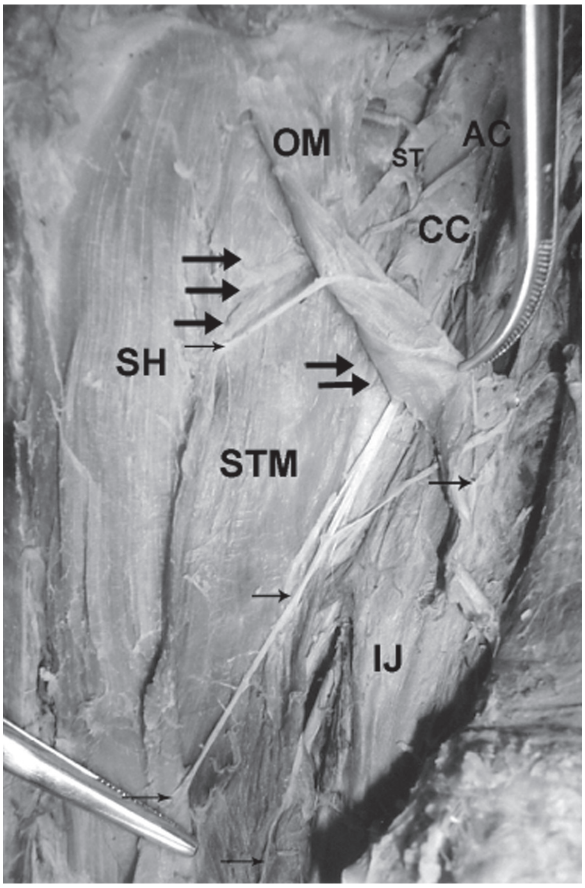

Figure 16. A photograph of the left side of the neck showing the same specimen as in Figure 7. The ansa cervicalis supplied the sternothyroid (STM) and omohyoid (OM) and continued to supply the sternohyoid (SH), by multiple branches (small black arrows); internal jugular vein (IJ), common carotid artery (CC), superior thyroid artery (ST), arterial supply to SH and STM (big black arrows), ansa cervicalis (AC).

prevention of atrophies and the improvement of scarring qualities of the reconstructed soft palate. Functionally, the flap resection does not induce phonation, respiratory, or swallowing complications. It has the particularity to retain the anatomy after reconstruction [6]. The functional qualities are also improved by this innervation conservation, which allows synchronous contraction of the two sides of the soft palate during swallowing [21].

Due to its thinness and malleability, its use for oral cavity and oro-pharynx defects, particularly after hemi section of the tongue, provides favourable cosmetic and functional outcomes and obviates the need for microvascular reconstruction [17, 18]. Knowledge of the exact point of entry of the vascular pedicles supplying these muscles may guide surgeons in carrying out safe and efficient flap elevations.

The accessibility of the infrahyoid muscles and their overlying skin as potential flaps for the repair of laryngeal defects makes them advantageous over other tissues used in laryngeal reconstruction [2]. Its advantages include the rapid flap elevation close to the original operating field, the ability to use the motor capability of the flap, and the ability to combine it with other local flaps such as the platysma flap. This technique appears to render excellent function for swallowing and speech [8].

The infrahyoid flap is fed by the superior thyroid artery and innervated by the AC. After the infrahyoid muscles have been divided from their origins, the flap can be freely transferred on its pedicle of superior thyroid artery to cover the soft tissue defect created after surgical ablation of cancer of the mid-face, parotid region, oral cavity, buccal mucosa, floor of the mouth, oro-pharynx, or hypo-pharynx. The viability of these muscles in the transposed state is more readily assured when a definite attempt is made to preserve the innervation and arterial supply [15, 19].

The indications of this flap remain numerous for the upper aero-digestive tract as the cervical oesophagus, allowing the repair of large mucous or cutaneous defects with acceptable functional or aesthetic sequelae [4].

Better knowledge and understanding of the arterial supply of this important portion of anatomy would no doubt enable practicing clinicians to work more efficiently and effectively. By determining the length of the arterial pedicles of the infrahyoid muscles, this study confirmed the efficiency of the potential use of infrahyoid muscles in reconstructive surgery.

REFERENCES

1. Backer CL, Pensler JM, Tobin GR (1994) Vascularized muscle flaps for life-threatening mediastinal wounds in children. Ann Thorac Surg, 57: 797–801.
2. Calcaterra TC (1983) Sternohyoid myofascial flap reconstruction of the larynx for vertical partial laryngectomy. Laryngoscope, 93: 422–424.
3. Chetri DK, Berke GS (1997) Ansa cervicalis nerve: review of the topographic anatomy and morphology. Laryngoscope, 107: 1366–1372.
4. Deganello A, Manciocco V, Dolivet G, Leemans CR, Spriano G (2007) Infrahyoid fascio-myocutaneous flap as an alternative to free radial forearm flap in head and neck reconstruction. Head Neck, 29: 285–291.
5. Eliachar I, Marcovich A, Harshai Y, Lindenbaum E (1984) Arterial blood supply to the infrahyoid muscles: an anatomical study. Head Neck Surg, 7: 8–14.
6. Gangloff P, Deganello A, Lacave ML, Verhaeghe JL, Lapeyre M, Maire F, Phulpin B, Guillemin F, Dolivet G (2006) Use of the infrahyoid musculo-cutaneous flap in soft palate reconstruction. EJSO J Cancer Surg, 32: 1165–1169.
7. Gormus G, Bayramoglu A, Aldur MM, Celik HH, Maral T, Sargon MF, Demiryurek D, Aksit MD (2004) Vascular pedicles of infrahyoid muscles: an anatomical study. Clin Anat, 17: 214–217.
8. Hell B, Heissler E, Gath H, Menneking H, Langford A (1997) The infrahyoid flap. A technique for defect closure in the floor of the mouth, the tongue, the buccal mucosa, and the lateral pharyngeal wall. Int J Oral Maxillofac Surg, 26: 35–41.
9. Kikuchi T (1970) A contribution to the morphology of the ansa cervicalis and the phrenic nerve. Acta Anat Nipon, 45: 342–381.
10. Magrin J, Kowalski LP, Santo GE, Walksmann G, Dipaula RA (1993) Infrahyoid myocutaneous flap in head and neck reconstruction. Head Neck, 15: 522–525.
11. Majoufre C, Faucher A (1994) The infrahyoid musculocutaneous flap. Anatomic bases and the results of a preliminary experience in cervicofacial oncology. Rev Stomatol Chir Maxillofac, 95: 319–324.
12. Mathes SJ, Nahai F (1982) Clinical applications for muscle and musculocutaneous flaps. The C.V. Mosby Co., St. Louis.
13. Rai R, Nayak SR, Ranade AV, Prabhu LV, Vadgaonkar R (2007) Duplicated omohyoid muscle and its clinical significance. Rom J Morph Embryol, 48: 295–297.
14. Remmert S, Meyer S, Majocco A (1998) Der neurovaskulare infrahyoidale muskelfaszienlappen. Anatomisch topographische Untersuchung der Innervation und Gefassversorgung. Ann Anat, 180: 281–287.
15. Rojananin S, Suphaphongs N, Ballantyne A (1991) The infrahyoid musculocutaneous flap in head and neck reconstruction. Am J Surg, 162: 400–403.
16. Shvedavchenko AL (1998) Variants in the position of the ansa cervicalis in man. Morphologie, 114: 47–49.
17. Tincani AJ, Del Negro A, Araujo PP, Akashi HK, Neves FS, Martins AS (2006) Head and neck reconstruction using infrahyoid myocutaneous flaps. Sao Paulo Med J, 124: 271–274.
18. Wang H (1991) Ten years experience on infrahyoid myocutaneous flap. Zhonghua Er Bi Yan Hou Ke Za Zhi, 26: 323–324, 382.
19. Wang RC, Puig CM, Brown DJ (1998) Strap muscle neurovascular supply. Layngoscope, 108: 973–976.
20. Windfuhr JP, Remmert S (2006) Infrahyoid myofascial flap for tongue reconstruction. Eur Arch Otorhinolaryngol, 263: 1013–1022.
21. Zuydam AC, Lowe D, Brown JS, Vaughan ED, Rogers SN (2005) Predictors of speech and swallowing function following primary surgery for oral and oropharyngeal cancer. Clin Otolaryngol, 30: 428–437.