



A Failsafe Method to Avoid Injury to the Great Auricular Nerve

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Abstract

Background: The great auricular nerve (GAN) is the most commonly injured nerve during facelift surgery. Although rare, injury can result in long-term sequelae.

Objectives: Previous reports have described the nerve's location at the midbelly of the sternocleidomastoid muscle (SCM) or at its emergence from underneath the SCM. The purpose of our study was to identify the superior course of the great auricular nerve as it applies to facelift.

Methods: Thirteen fresh cadavers were dissected. A vertical line through the midlobule was drawn perpendicular to the Frankfort's horizontal, acting as a reference to the course of the GAN. Transparent paper overlay tracings were then done to record each nerve's location. The distance from the bony external auditory canal (EAC) to the nerve was measured at the anterior muscle border, at the midbelly of the SCM, and as the nerve emerged from under the SCM. Branching patterns of the nerve and its relation to the external jugular vein were identified.

Results: In 100% of the dissections, the superior course of the GAN fell within a 30-degree angle constructed using the vertical limb perpendicular to the Frankfurt horizontal and a second limb drawn posteriorly from the midlobule. The distance from the EAC to the nerve was 4.9 ± 1.1 cm at the anterior muscle border, 7.3 ± 1.0 cm at the midbelly of the SCM, and 9.8 ± 1.2 cm at the GAN's emergence from under the SCM. Four types of branching patterns were identified.

Conclusions: The 30-degree angle described above rapidly and accurately identifies the nerve's location.

Keywords

facelift, rhytidectomy, great auricular nerve, nerve injury, anatomic landmarks, cadaver, SMAS, anatomy, facelift complication, danger zone

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Injury to the great auricular nerve (GAN) during facelift surgery can occur while skin flaps are being undermined or at the time of posterior platysmal suspension. Although not as significant as motor nerve injury, iatrogenic injury of the GAN can have long-term sequelae.¹⁻¹¹

Previous authors have described the location of the great auricular nerve (1) as it emerges from underneath the sternocleidomastoid muscle (SCM) and (2) as it courses along the midbelly of the muscle.^{3,4,12-14} However, during skin flap elevation, the nerve is routinely encountered proximal to McKinney's point and closer to the earlobe. It is here that it is most likely to be injured. The purpose of our report is to describe this distal course of the GAN as it approaches the earlobe and to define consistent boundaries for this danger zone. In addition, anatomic variations of the nerve as well as its relation to the external jugular vein (EJV) will be described.

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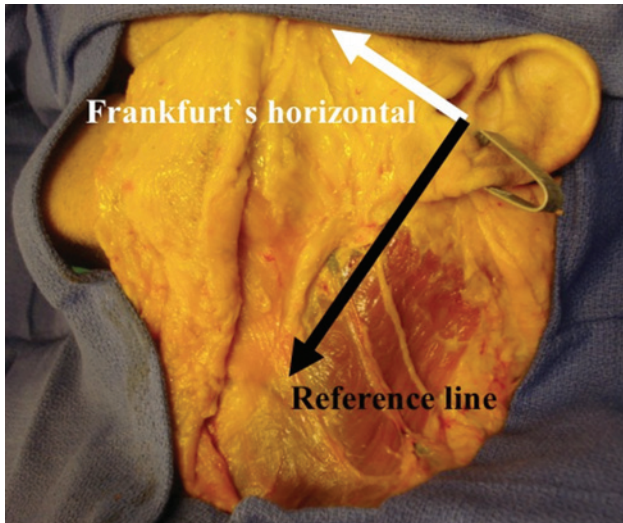


Figure 1. A vertical line through the midlobe (black arrow) was constructed perpendicular to the Frankfurt's horizontal plane (white arrow) in this 85-year-old male cadaver.

METHODS

Dissections were carried out in 13 fresh white cadavers (26 heminecks). Surgical loupes with $\times 2.5$ magnification were used. Surgical exposure was initiated via elevation of the lateral neck skin. The superficial fascial layer was then incised posterior to the SCM, and this layer was elevated from lateral to medial. Care was taken to leave the SCM fascia intact to protect the GAN. The inferior border of the dissection was 1 to 2 cm beyond the emergence of the GAN, behind the SCM. The superior border of dissection was the earlobe. The anterior and posterior borders of the dissection extended 2 to 3 cm from the SCM borders to allow sufficient exposure. All measurements were carried out with the subject's head in the facelift position.

A vertical line was drawn through the midlobe, perpendicular to the Frankfurt's horizontal, to act as a reference for the course of the nerve (Figure 1). This also corresponded to the posterior border of the platysma. Transparent paper overlay tracings were then used to record the course of each nerve (Figure 2). Twenty-six tracing papers were overlapped to yield the nerve's distribution pattern, taking care to align the tracings according to the previously described reference line and to the earlobe. The angle incorporating all of the nerve tracings was then calculated. For demonstration purposes, the overlapped tracings were transposed on a cadaver photograph via computer software (Figure 3).

The distance from the bony external auditory canal to the GAN was measured (1) at the anterior muscle border, (2) at the midbelly of the SCM, and (3) as the GAN emerged from under the SCM. All measurements were performed parallel to the reference line described above

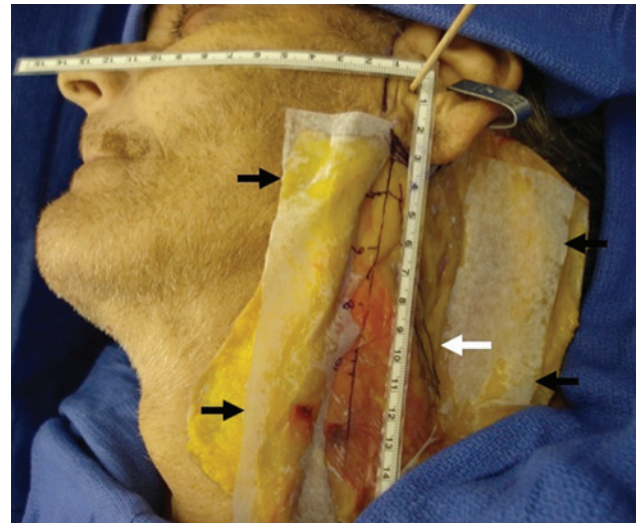


Figure 2. Overlay tracings were obtained using a transparent paper (delineated by black arrows) to record each nerve's course (white arrow) in this 57-year-old male cadaver.

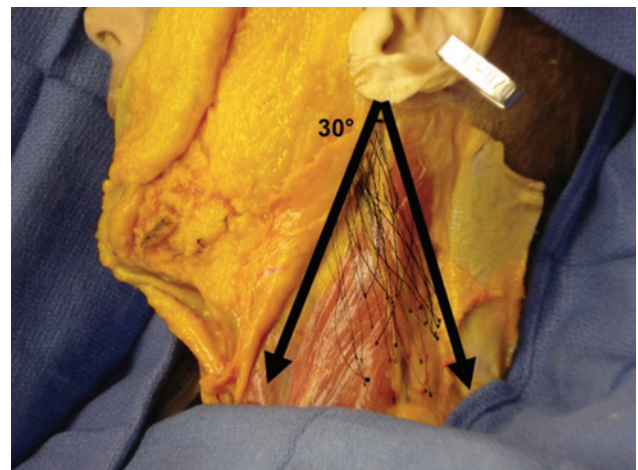


Figure 3. The transparent tracings of each individual cadaver dissection were overlaid to document nerve location, as shown in this 70-year-old female cadaver. All nerves lay within a 30-degree angle (black lines).

(Figure 4). The number of the GAN branches, location of the branching points, and patterns of branching were identified. The relation of the nerve to the EJV was noted and the horizontal distance between the GAN and EJV was measured at the same 3 points described above.

RESULTS

Mean cadaver age was 69.3 years (range, 55-85 years), and the population included 8 males and 5 females. In 100% of dissections, the superior course of the great auricular nerve fell within a 30-degree angle constructed using the vertical limb perpendicular to the Frankfurt horizontal and a second limb drawn posteriorly from the midlobe.

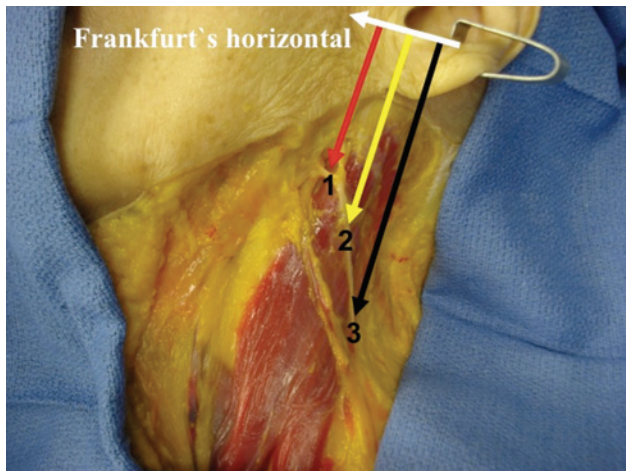


Figure 4. The distance from the bony external auditory canal to the great auricular nerve (GAN) was measured at the anterior muscle border (1, red arrow), at the midbelly of the sternocleidomastoid muscle (2, yellow arrow), and as it emerged from under the sternocleidomastoid muscle (3, black arrow), as shown in this 85-year-old female cadaver. All measurements from external auditory canal to the GAN were made parallel to the reference line described.

Figure 3 demonstrates the course of the nerve yielded by overlapping of all 26 overlays.

The distance from the bony external auditory canal to the nerve was 4.9 ± 1.1 cm at anterior muscle border, 7.3 ± 1.0 cm at the midbelly of the SCM, and 9.8 ± 1.2 cm as the GAN emerged from under the SCM.

Four types of branching patterns of the nerve were identified: branching at the superior third of the SCM (type 1), branching at the mid-third of the SCM (type 2), branching at the inferior third of the SCM (type 3), and no branching (type 4) (Figure 5). The most common branching type was type 1 ($n = 14$, 53.8%), followed by type 3 ($n = 7$, 26.9%), type 4 ($n = 4$, 15.4%) and type 2 ($n = 1$, 3.8%).

The average number of nerve branches was 2.0 ± 1.0 . The most common branching pattern was 1 anterior and 1 posterior branch ($n = 15$, 57.7%) (Figure 6). Other types of branching included 2 anterior/1 posterior branch ($n = 4$, 15.4%), no branching ($n = 4$, 15.4%), and 1 anterior/2 posterior branches ($n = 3$, 11.5%).

The relation of EJV to the GAN also varied in the specimens. Most commonly, the vein was seen to be lying anterior and parallel to the course of the GAN ($n = 13$, 50%) (Figure 6). In 6 cadavers, it was located anterior and inferior to the nerve, with an increasing angle in between ($n = 6$, 23%). In 6 specimens, the EJV could not be identified ($n = 6$, 23%). In a single specimen, the vein was posterior to the nerve ($n = 1$, 3.8%). In specimens where the vein was parallel and anterior to the nerve, the horizontal distance between the 2 structures was measured at 3 points. The average distance at the nerve's emergence was 1.6 ± 0.8 cm from under the SCM, 1.4 ± 0.6 cm at the midbelly of the SCM, and 1 ± 0.6 cm at the anterior muscle border.

DISCUSSION

The overall incidence of nerve injury during rhytidectomy is low. The most common nerve injured at the time of facelift surgery is, of course, the GAN, with an estimated incidence from 0% to 2.6%.^{1,10,15-22} While most rhytidectomy patients have transient sensory disturbances due to transection of smaller sensory nerves,²² transection of the GAN can rarely elicit more significant symptoms, including dysesthesias, painful nodules, and discomfort with cold exposure.^{1-10,23}

The anatomy of the GAN has previously been described in detail. It is a pure sensory nerve that supplies the earlobe, antitragus, scapha, helical crus, and lower posterior auricle.^{12,24-27} It arises from the cervical plexus (C2-C3) and emerges from behind the posterior border of the SCM.^{4,6,12,28,29} The nerve ascends on the lateral SCM surface and gives terminal branches anteriorly and posteriorly in the vicinity of the earlobe.^{3,27,30-32} The anterior branch passes into a deeper plane under the parotid gland, while the posterior branch has a more superficial course.^{30,31} Along its course, the nerve is deep to both the superficial musculoaponeurotic system (SMAS)-platysma layer and the SCM's investing fascia.^{3,31} We have confirmed these anatomical findings in our dissections. Corroborating previous reports, the most common branching point of the nerve was just inferior to the parotid gland, where it gives off anterior and posterior branches. As for the relation of the GAN and the EJV, again our findings were consistent with previous descriptions. The EJV lies most commonly anterior and parallel to the GAN, but not always.^{4,27,33}

The report by McKinney and Gottlieb³ is the most frequently cited means of locating the GAN. They defined a point 6.5 cm inferior to the external auditory canal as it crossed the midbelly of the SCM, where the nerve was particularly vulnerable. Following their cadaver study, the same authors published a case series of 75 patients and reported that the GAN fell within 2 to 3 mm of this point.⁴ They also concluded that the measurement was accurate regardless of patient height. Izquierdo et al,³⁰ however, found that McKinney's point has a greater variation, being within 2 to 4 cm of the actual GAN location. This variability was corroborated by a recent publication describing the location of the GAN in relation to the SCM muscle length.³¹ This latter report also noted that the nerve was most superficial in the superior third of its course along the muscle.³¹ This distance was reported to be 6.5 ± 0.9 cm from the external auditory canal.

Although these preceding authors' findings are both accurate and helpful in estimating the location of the nerve as it crosses the SCM, we suggest that the nerve is at greater risk closer to the earlobe and at a more superior location during the facelift dissection. Our description of the 30-degree angle with its apex at the lobule defines a danger zone rather than a single point. Both the more proximal location and the zonal configuration, we believe, make our description more clinically useful. The senior author (JEZ) routinely marks this angle during surgery as the dissection proceeds toward the neck, clearly

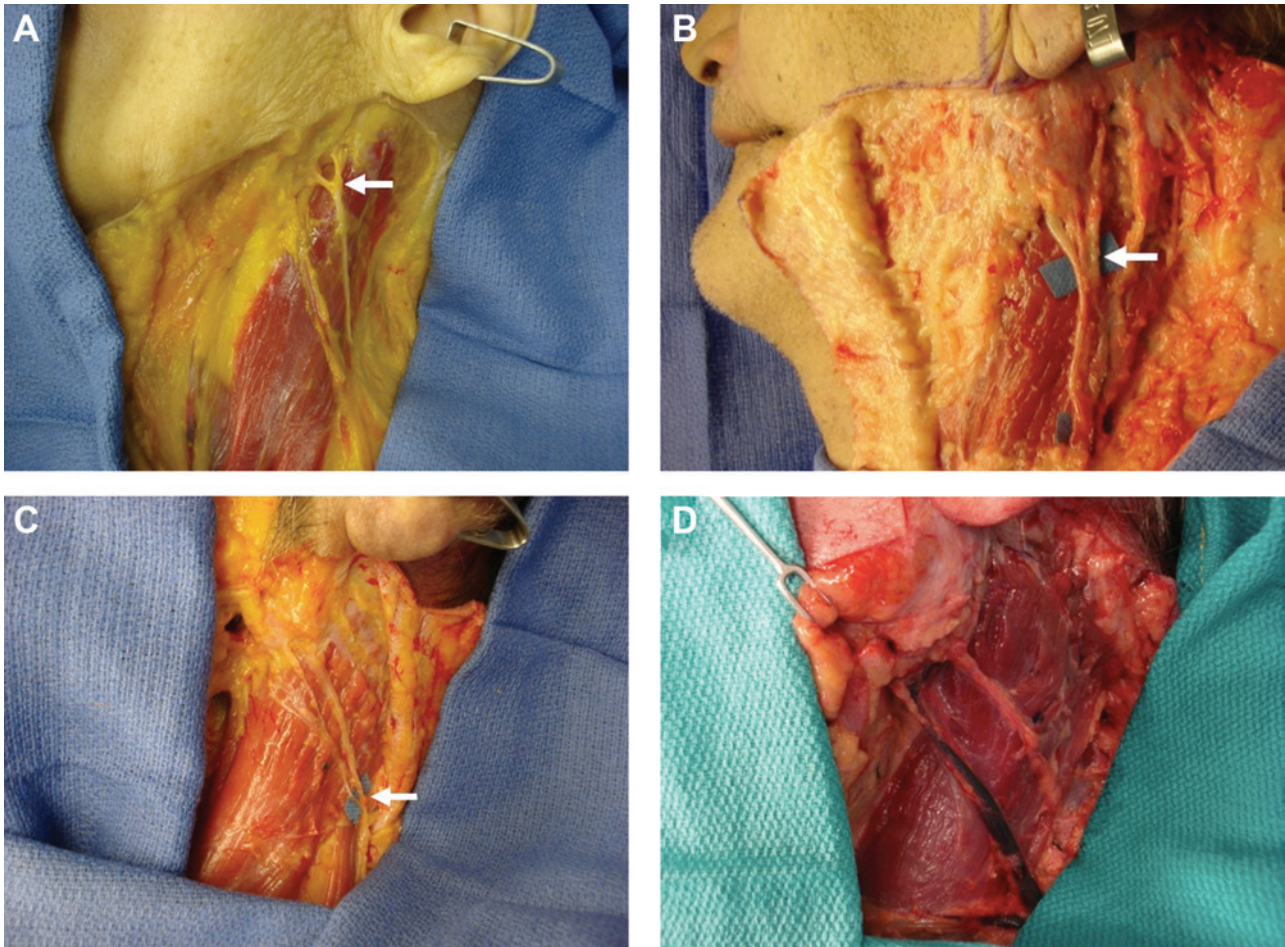


Figure 5. Four types of branching patterns were identified (white arrows). (A) Branching at the superior one-third of the sternocleidomastoid muscle (SCM), as shown in this 85-year-old female cadaver; (B) branching at the mid-third of the SCM, as shown in this 57-year-old male cadaver; (C) branching at the inferior one-third of the SCM, as shown in this 56-year-old male cadaver; and (D) no branching, as shown in this 55-year-old male cadaver.

orienting residents and junior staff to the nerve location. A video of this technique is available at www.aestheticsurgeryjournal.com. You may also scan the code on the first page of this article with any smartphone to be taken directly to the video on www.YouTube.com.

To minimize great auricular nerve injury, it is suggested that the facelift flap elevation should begin superficially in the cheek, extending in this superficial plane over the sternocleidomastoid fascia in the neck.^{1,3,4,31,34-36} The 30-degree angle is drawn early in the neck dissection, with particular care taken to remain superficial over this danger zone.

The GAN may also be injured when sutures are used to anchor the posterior platysma to the mastoid or SCM fascia.^{27,30} This maneuver is often performed without visualizing the nerve and has the potential of including the nerve in these sutures.³⁰ In their anatomic study, Izquierdo et al³⁰ suggested placement of these sutures posterior to a line drawn from McKinney's point to another point 1.5 cm

from the insertion of the lobule. We suggest that placing the sutures posterior to our already marked 30-degree angle provides a similarly accurate and rapidly identified landmark. Finally, iatrogenic injury to the nerve can also occur during development of SMAS-platysma flaps. Drawing the anterior limb of our 30-degree angle perpendicular to the Frankfurt horizontal also rapidly and accurately identifies the posterior border of the platysma, again obviating GAN injury.

Outcomes after accidental injury or sacrifice of the nerve during parotidectomy have been described in detail.^{29,37-39} Even when the nerve is purposely sacrificed during parotidectomy, recovery without significant sequelae is usually the rule. Rarely do dysesthesias or painful neuromas develop necessitating intervention.^{2,5-7,9-11,22} Despite this, should nerve injury occur at the time of the facelift, repair should be performed to prevent these rare incidents of symptomatic nerve injury.^{1,2,5,8,22}

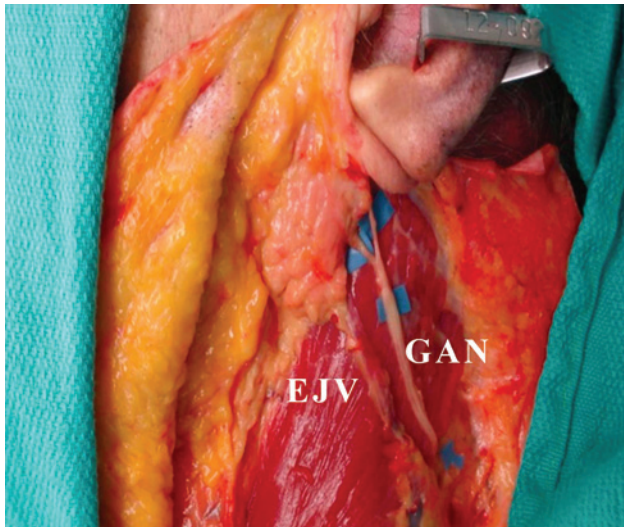


Figure 6. The most common branching pattern was 1 anterior and 1 posterior branch. The external jugular vein (EJV) is seen lying anterior and parallel to the course of the great auricular nerve (GAN) in this 85-year-old male cadaver.

CONCLUSIONS

While long-term painful sequelae following GAN injury are rare, they can occur. The 30-degree angle marking described in this article rapidly and accurately identifies the nerve's superior course and defines a danger zone in the vicinity of the earlobe. Injury to the great auricular nerve can be minimized by superficial dissection of the skin flap in this triangle and by placement of suspension sutures posterior to the angle described.

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