# What Is the Lobular Branch of the Great Auricular Nerve? Anatomical Description and Significance in Rhytidectomy

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**Background:** Current literature suggests that preserving the lobular branch of the great auricular nerve has greater impact on sensory function of the auricle than preservation of the posterior branch during rhytidectomy. However, no methodology exists to efficiently and accurately determine the topographic location of the lobular branch. This study describes the branching characteristics of the lobular branch and algorithmic surface markings to assist surgeons in preservation of the great auricular nerve during rhytidectomy flap elevation.

**Methods:** The lobular branch was dissected in 50 cadaveric necks. Measurements were taken from the lobular branch to conchal cartilage, tragus, and antitragus. The anterior branch was measured to its superficial musculoaponeurotic system insertion, and the posterior branch was measured to the mastoid process. The McKinney point was marked and the great auricular nerve diameter was recorded. Branching pattern and location of branches within the Ozturk 30-degree angle were documented. Basic statistics were performed.

**Results:** The lobular branch was present in all specimens and distributed to three regions. In 85 percent of specimens, the lobular branch resided directly inferior to the antitragus; in the remaining specimens, it was located directly inferior to the tragus. Preoperative markings consisting of two vertical lines from the tragus and antitragus to the McKinney point can be used to outline the predicted location of the lobular branch.

**Conclusions:** This study delineates the location of the lobular branch of the great auricular nerve. The authors translate these findings into a quick and simple intraoperative marking, which can assist surgeons in avoiding lobular branch injury during rhytidectomy dissection. (*Plast. Reconstr. Surg.* 139: 371e, 2017.)

The most common side effect of rhytidectomy is injury to the great auricular nerve, which occurs at an incidence of 6 to 7 percent. Nerve injury results in earlobe pain, paresthesia, and cold hypersensitivity.[1–6] Classically, the McKinney point has been described as a landmark for great auricular nerve identification. The point represents the location of the great auricular nerve trunk, which resides 6.5 cm inferior to the external auditory canal. Ozturk et al. described a 30-degree angle from the Frankfurt horizontal line outlining the region of nerve distribution, and Lefkowitz et al. mapped the most superficial portions of the great auricular nerve.[2,3,7] Various terminal branching patterns of the great auricular nerve have been described; however, data are inconsistent among studies as to which pattern is the most common, how many branches exist, and what function each branch performs.

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The most common branching pattern described in the literature is bifurcation of the great auricular nerve into an anterior branch supplying the skin overlying the parotid gland and a posterior branch supplying the posterior auricular and lobular areas.[2,5,7–9] Traditionally, the posterior branch has been preserved in an attempt to decrease the risk of lower ear paresthesia.[4,8] Recent studies have reported that preserving or severing the posterior branch of the great auricular nerve leads to the same degree of paresthesia.[4,10] These complications are attributable to regeneration of nerve fibers and collateral innervation by the lesser occipital, transverse cervical, auriculotemporal, and trigeminal nerves.[4,5]

Recently, the lobular branch has been identified as a separate branch that supplies sensory innervation to the lobe.[1,4,11] Patients with a preserved lobular branch show faster recovery times and decreased sensory deficits in the lobular area. Severing the lobular branch has been linked directly to side effects because it does not have collateral innervation.[4]

The purpose of this study was to further delineate the course of the lobular branch and other terminal branches. The consistency of the McKinney point and the 30-degree angle in the study by Ozturk et al. is evaluated. A subsequent marking algorithm in relation to known landmarks is developed to assist in rapid identification and preservation of the lobular branch during rhytidectomy procedures.

## MATERIALS AND METHODS

Fifty cadavers, eight fresh and 42 embalmed, were dissected bilaterally with the aid of 2.5× loupes (SurgiTel, Ann Arbor, Mich.) at the Kansas City University of Medicine and Bioscience and the University of Nebraska Medical Center from July 30, 2015, through December 3, 2015. The specimen group consisted of 23 female and 27 male cadavers. Skin markings of the Frankfurt horizontal, Ozturk 30-degree angle, and McKinney point were drawn.

A skin flap was marked 1.5 cm anterior to the tragus of ear and then a curvilinear line was traced down to the Erb point, followed posteriorly along the mastoid fascia to end 2 cm from the nuchal line. A skin flap was then elevated from anteroposterior, identifying the external jugular vein and the edge of the sternocleidomastoid muscle. The external jugular vein was used as a landmark to identify the great auricular nerve, which lies approximately 1 cm superolateral from the external jugular vein.[2] After the great auricular nerve was located, it was followed cephalically over the sternocleidomastoid muscle to the tail of the parotid gland, tip of the posterior hairline, and

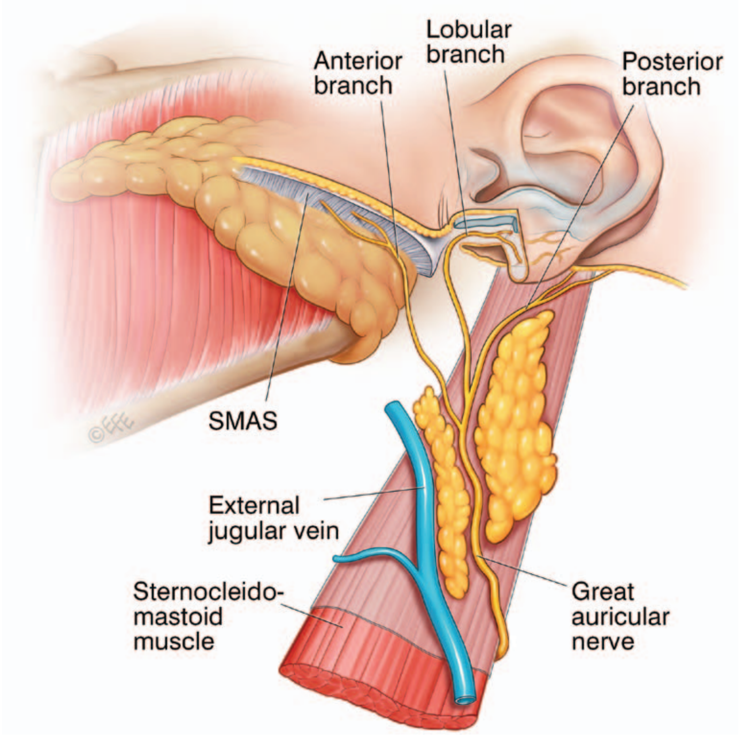



**Fig. 1.** Illustration of anterior, posterior, and lobular branches of the great auricular nerve. (©EFE.)

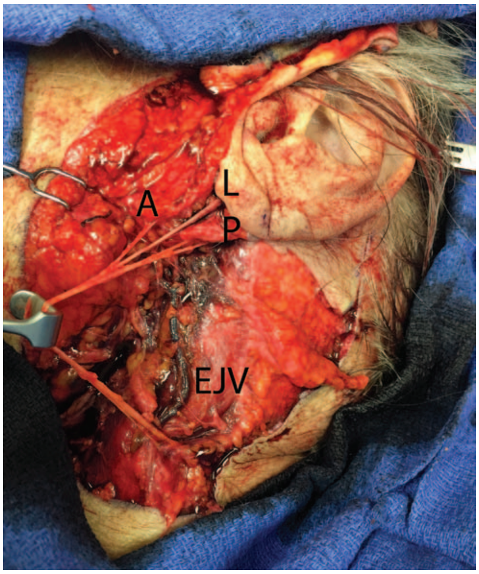



**Fig. 2.** Cadaveric photograph showing the relationship of the great auricular nerve with the external jugular vein and sternocleidomastoid muscle. Anterior (*A*), posterior (*P*), and lobular (*L*) terminal branches are shown entering the SMAS, posterior auricular region, and lobule, respectively.

lobule of the ear to find the anterior, posterior, and lobular branches, respectively (Figs. 1 and 2).

Measurements were taken from the lobular branch to the conchal cartilage, tragus, and antitragus. The anterior branch was measured to its superficial musculoaponeurotic system (SMAS) insertion and the posterior branch was measured to the mastoid process. (**See Video, Supplemental Digital Content 1**, which demonstrates where the lobular branch of the great auricular nerve lies in relation to the caution dissection zone, available in the "Related Videos" section of the full-text article on PRSJournal.com or, for Ovid users, at ***http://links.lww.com/PRS/C3***. The great auricular nerve trunk is found proximally at the posterior aspect of the sternocleidomastoid muscle and 1 cm posterior to the external jugular vein.) The McKinney point was marked and the great auricular nerve diameter was recorded. The branching pattern and location of branches within the Ozturk 30-degree angle were documented. Data were processed using Microsoft Excel (Microsoft Corp., Redmond, Wash.) in a basic statistics format.

## RESULTS

The anterior, posterior, and lobular branches were found in all 50 specimens (Fig. 1). The descriptive statistics for pooled data and comparisons for gender and side were calculated (Table 1). The McKinney point was reconfirmed at an average of 6.44 cm. The lobular branch fell within the Ozturk 30-degree angle in all specimens. The length of the lobular branch from origin to insertion into the conchal cartilage was 3.32 cm. The lobular branch originated from four different points (Table 2). The most frequent origin was from a common trifurcation with the anterior and posterior branches. However, the


**Video.** Supplemental Digital Content 1, demonstrating where the lobular branch of the great auricular nerve lies in relation to the caution dissection zone, is available in the "Related Videos" section of the full-text article on PRSJournal.com or, for Ovid users, at ***http://links.lww.com/PRS/C3***. The great auricular nerve trunk is found proximally at the posterior aspect of the sternocleidomastoid muscle and 1 cm posterior to the external jugular vein.

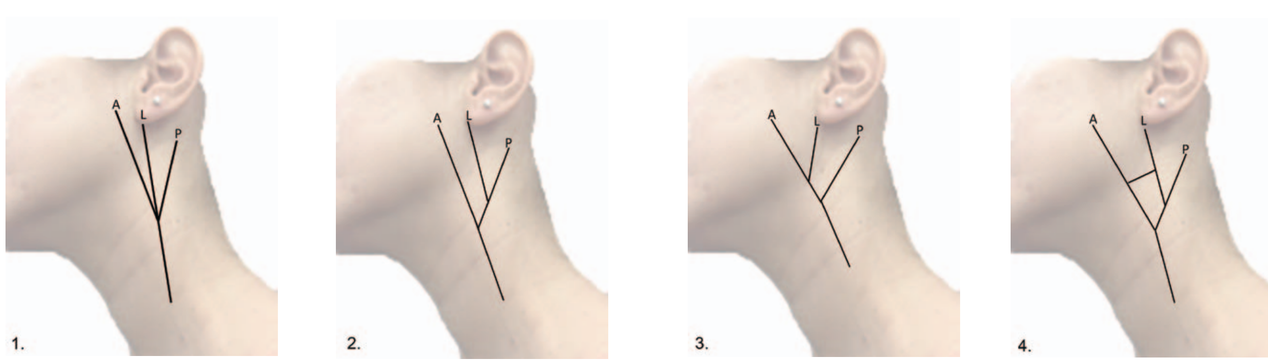
**Table 1. Pooled Data of All Measurements and Comparisons for Gender and Sides**

| | All Specimens | | Gender | | | | Side | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Male | | Female | | Left | | Right | |
| | Average (cm) | Range (cm) | Average (cm) | Range (cm) | Average (cm) | Range (cm) | Average (cm) | Range (cm) | Average (cm) | Range (cm) |
| Neck circumference | 42.88 | 33.2–52.8 | 44.6 | 36.1–52.8 | 40.87 | 33.2–50.5 | 42.88 | 33.2–52.8 | 42.88 | 33.2–52.8 |
| McKinney point | 6.44 | 5.5–7.2 | 6.47 | 5.5–7.2 | 6.39 | 5.7–6.9 | 6.42 | 5.5–7.2 | 6.45 | 5.8–7.1 |
| Diameter of GAN at the McKinney point | 0.26 | 0.2–0.4 | 0.28 | 0.2–0.4 | 0.24 | 0.2–0.4 | 0.26 | 0.2–0.4 | 0.26 | 0.2–0.4 |
| Length of lobular branch to cartilage | 3.32 | 1.3–5.8 | 3.29 | 1.7–1.9 | 3.34 | 1.3–4.6 | 3.42 | 1.9–5.8 | 3.22 | 1.3–4.5 |
| Length of anterior branch to SMAS | 1.67 | 0.8–5.8 | 1.78 | 0.9–5.8 | 1.55 | 0.8–2.4 | 1.69 | 0.8–5.8 | 1.66 | 1.1–4.8 |
| Length of posterior branch to mastoid | 3.91 | 3.0–6.0 | 3.9 | 3–4.7 | 3.92 | 3.1–6.0 | 3.97 | 3.1–6.0 | 3.85 | 3.0–4.7 |

GAN, great auricular nerve.

**Table 2. Lobular Branch Origin Patterns and Corresponding Percentages**

| Branching Origin Patterns | % of Lobular Branch Origin |
|---|---|
| The lobular branch comes off at a common origin with the posterior and anterior branches. | 50 |
| The lobular branch comes off the posterior branch after the bifurcation of anterior and posterior branches. | 38 |
| The lobular branch comes off the anterior branch after the bifurcation of the anterior and posterior branches. | 10 |
| After the bifurcation into anterior and posterior branches, branches from both the anterior and posterior branches fuse together to form the lobular branch. | 2 |




lobular branch also found to originate from the posterior branch, anterior branch, and from contributions of both branches in select specimens.

The lobular branch demonstrated variation in the number of accessory branches and its area of distribution. In 44 percent, the lobular branch remained as a single branch. The remaining specimens provided accessory branches, as the nerve traveled superiorly toward the lobule (Table 3 and Fig. 3). In this study, the lobular branch always terminated in the lobule (zone 1), but it may send branches to the preauricular area (62 percent, zone 2) and to the posterior inferior auricle (6 percent, zone 3) (Fig. 4).

In 85 percent of specimens, the lobular branch was located directly inferior to the center of the antitragus. In the remaining 15 percent of specimens, the lobular branch was located directly inferior to the caudal edge of the tragus (Fig. 5).

**Table 3. Lobular Branch Patterns and Corresponding Percentages**

| Branching Patterns | % of Lobular Branch Pattern |
|---|---|
| Lobular branch continues as a single branch | 44 |
| Lobular branch bifurcates | 38 |
| Lobular branch trifurcates | 15 |
| Lobular branch splits into four branches | 3 |

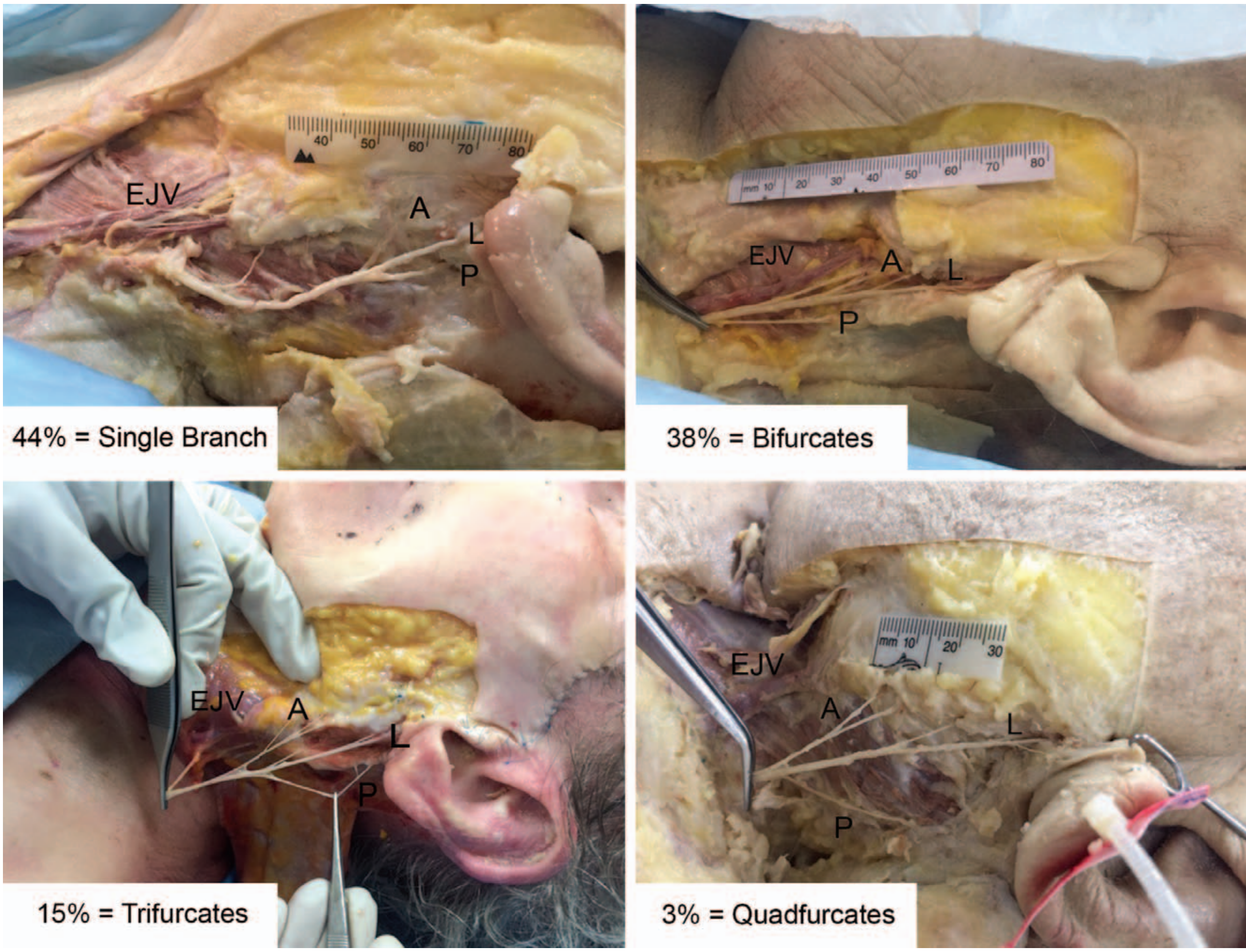



**Fig. 3.** Cadaveric photographs showing accessory branches of the lobular branch. (*Above*, *left*) Lobular branch courses superiorly as a single branch before entering the lobule. (*Above*, *right*) Lobular branch bifurcating before entering the lobule. (*Below*, *left*) Lobular branch trifurcating before entering the lobule. (*Below*, *right*) Lobular branch quadfurcating before entering the lobule. *EJV*, external jugular vein; *A*, anterior; *L*, lobular; *P*, posterior.

Based on the above data, a topographic intraoperative marking was created. The marking consists of two vertical lines drawn from the tragus and antitragus terminating in the lower neck with a horizontal line representing the McKinney point (Fig. 6). The area within these lines is considered to be the regional location of the lobular branch.

## DISCUSSION

The literature is inconsistent as to which great auricular nerve branching pattern is the most common, how many branches exist, and what function each branch performs. Some authors describe the great auricular nerve most commonly splitting into one anterior and one posterior branch,[2,7] although others describe the most common pattern as three branches arising from a common origin.[1,4] It is clearly understood that the anterior branch distributes to the skin overlying the parotid gland and the anteroinferior aspect of the auricle. The inconsistency lies in the remaining branches. Lefkowitz et al. describe a posterior branch that provides sensory innervation to the posteroinferior aspect of the auricle. Yang et al. describe a posterior branch that supplies sensory innervation to the anterior aspect of the ear and a third branch titled the "deep" branch that distributes to the posterior aspect of the auricle.[1] Hu et al. also describe a third branch to the inferior aspect of the lobule, in this study this branch is called the "lobular" branch.[4]

We sought to clarify the existence and relevance of the previously described lobular branch. We have found that in all 50 specimens there was a distinct lobular branch. Traditional teaching states that preservation of the posterior branch of

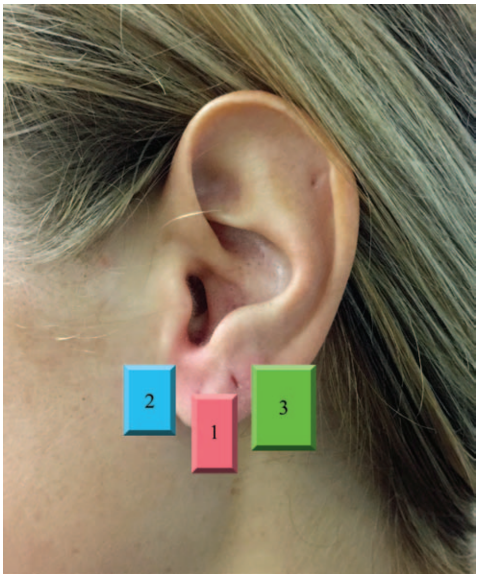



**Fig. 4.** Areas of distribution in which accessory branches of the lobular branch terminate. This figure illustrates potential zones of paresthesias after lobular branch injury.

**Fig. 5.** The lobular branch has been found to be directly inferior to the tragus (*pink*) and antitragus (*green*).

the great auricular nerve was necessary to avoid postoperative auricular paresthesia. Anecdotally, this has shown promise, likely because the lobular branch arises from the posterior branch in 38 percent of the specimens. However, recent data demonstrate that simply preserving the posterior branch does not always translate into prevention of paresthesia.[4,5] We believe this is linked to the anatomical branching of the lobular branch from the common trunk or anterior branch in the remaining 62 percent of specimens in this study.

Studies comparing preservation or severing the posterior branch found significant differences in thermal and tactile sensitivity in the lobular area, followed by the infraauricular area, and then the posterior auricular area. Hu et al. demonstrated that preservation of the posterior branch did not help impact recovery of the posterior auricular region.[4] This result was attributable to several factors, including regeneration of nerve fibers, and collateral innervation by the lesser occipital, auriculotemporal, and trigeminal nerves. However, the lobular area is not innervated by these nerves and therefore fails to reinnervate. This explains why select studies have shown that preservation of the posterior branch did not improve recovery, thereby postulating that preservation is unnecessary.[5,6,9] In contrast, patients with a preserved lobular branch show faster recovery times and decreased sensory deficits in the lobular area.[4]

In a rhytidectomy operation, compromising the great auricular nerve is at significant risk during elevation of the postauricular skin from the mastoid fascia and sternocleidomastoid muscle. Various techniques exist for elevation of this flap ranging from no. 10 scalpel elevation to direct vision cautery or scissor dissection. Some surgeons advocate leaving an adipofascial tissue layer on top of the sternocleidomastoid muscle and make no attempt to visualize the nerve. Others identify and protect the nerve before proceeding to lateral neck and platysma flap dissection. Defined anatomical landmarks include the external jugular vein and muscle borders of the sternocleidomastoid muscle. Identification of these structures can guide the surgeon into the proper tissue plane.

In this study, we performed a caudocranial dissection to trace the terminal branches of the nerve. Dissection of the nerve from the posterolateral approach facilitates isolation of the main trunk, whereas a retrograde dissection from a preauricular superoanterior position requires identification of smaller terminal branches, ultimately a more challenging dissection. In the rare operative cases that surgeons must identify this nerve in retrograde fashion, the mapping patterns in this study may serve as a valuable resource. We propose a preoperative topographic marking to isolate the predicted locations of the lobular branch. Standard SMAS plication and vertically vectored SMAS maneuvers are performed anterior to the lobular branches; therefore, these nerves are not at risk for entrapment during that portion of the operation. The anterior branches of the great auricular nerve, both superficial and

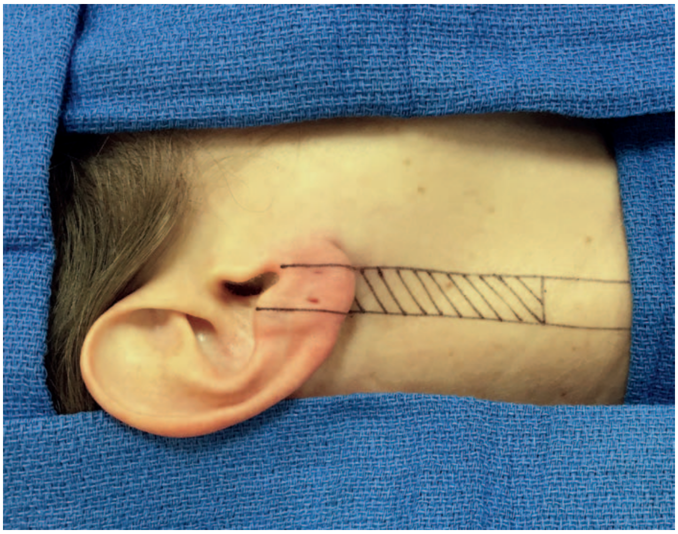


**Fig. 6.** Intraoperative marking of surgical caution zone of lobular branch location represented by two vertical lines from the tragus and the antitragus to the McKinney point.

deep, terminate in the preauricular SMAS. These branches are at risk of entrapment or damage; however, the clinical sequelae of injury to these nerves appears to be insignificant.

Methods for accurate nerve identification have been described. Ozturk et al. found that the great auricular nerve was always present within a 30-degree angle using a perpendicular line from the Frankfurt horizontal and a line drawn down posteriorly from the mid lobule.[7] Iwai et al. described the great auricular nerve passing through a median point between the tip of the mandibular angle and mastoid process.[12] From the median point, a line could be drawn for rapid identification of the great auricular nerve trunk, which could then be dissected simultaneously with skin flap elevation to the parotid capsule.

We propose two vertical lines drawn from the tragus and antitragus terminating in the lower neck with a horizontal line representing the McKinney point (Fig. 6). The area within these lines we consider to be the regional location of the lobular branch, providing surgeons with a landmark for careful dissection in rhytidectomy procedures. This simple topographic marking can be used in addition to or in place of the aforementioned published markings to aid in anatomically accurate preoperative planning.

The main limitation of this study is that it is a cadaveric study. Clinical correlation using this marking system and assessment of postoperative paresthesia is needed to confirm the significant of lobular branch preservation in rhytidectomy.

## CONCLUSIONS

This study delineates the course of the deep/lobular branch and terminal branches in the infraauricular region. A subsequent topographic marking in relation to known landmarks has been developed to assist in rapid identification and preservation of this nerve during rhytidectomy procedures.

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### REFERENCES

1. Yang HM, Kim HJ, Hu KS. Anatomic and histological study of great auricular nerve and its clinical implication. *J Plast Reconstr Aesthet Surg.* 2015;68:230–236.
2. Lefkowitz T, Hazani R, Chowdhry S, Elston J, Yaremchuk MJ, Wilhelmi BJ. Anatomical landmarks to avoid injury to the great auricular nerve during rhytidectomy. *Aesthet Surg J.* 2013;33:19–23.
3. McKinney P, Gottlieb J. The relationship of the great auricular nerve to the superficial musculoaponeurotic system. *Ann Plast Surg.* 1985;14:310–314.

4. Hu J, Ye W, Zheng J, Zhu H, Zhang Z. The feasibility and significance of preservation of the lobular branch of the great auricular nerve in parotidectomy. *Int J Oral Maxillofac Surg.* 2010;39:684–689.
5. Min HJ, Lee HS, Lee YS, et al. Is it necessary to preserve the posterior branch of the great auricular nerve in parotidectomy? *Otolaryngol Head Neck Surg.* 2007;137:636–641.
6. Ryan WR, Fee WE. Long-term great auricular nerve morbidity after sacrifice during parotidectomy. *Laryngoscope* 2009;119:1140–1146.
7. Ozturk CN, Ozturk C, Huettner F, Drake RL, Zins JE. A failsafe method to avoid injury to the great auricular nerve. *Aesthet Surg J.* 2014;34:16–21.
8. Brennan PA, Webb R, Kemidi F, Spratt J, Standring S. Great auricular communication with the marginal mandibular nerve: A previously unreported anatomical variant. *Br J Oral Maxillofac Surg.* 2008;46:492–493.
9. Patel N, Har-El G, Rosenfeld R. Quality of life after great auricular nerve sacrifice during parotidectomy. *Arch Otolaryngol Head Neck Surg.* 2001;127:884–888.
10. Porter MJ, Wood SJ. Preservation of the great auricular nerve during parotidectomy. *Clin Otolaryngol Allied Sci.* 1997;22:251–253.
11. Zumeng Y, Zhi G, Gang Z, Jianhua W, Yinghui T. Modified superficial parotidectomy: Preserving both the great auricular nerve and the parotid gland fascia. *Otolaryngol Head Neck Surg.* 2006;135:458–462.
12. Iwai H, Masaya K. Parotidectomy combined with identification and preservation procedures of the great auricular nerve. *Acta Otolaryngol.* 2015;135:937–941.