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The depth of the facial nerve in the mastoid bone

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ABSTRACT

Background: The hallmark of the temporal bone is variation. Various important structures like the facial nerve run in the temporal bone at various depths which can be injured during mastoidectomy.
Methods: Twenty wet cadaveric temporal bones were dissected. A cortical mastoidectomy was performed followed by a canal wall down mastoidectomy and the depth of the vertical segment of the facial nerve in the mastoid was determined.
Results: The mean depth of the second genu was 13.82 mm. The mean depth of the stylomastoid foramen was 12.75 mm and the mean distance from the annulus at 6'0 clock to the stylomastoid foramen was 10.22 mm.
Conclusions: There is significant variation in the average depth of the facial nerve in the mastoid.

Keywords: Temporal bone, Facial nerve, Depth

INTRODUCTION

The anatomy of the temporal bone is intricate, complex and highly variable.[1] It is important for an ear surgeon to study the three dimensional anatomy of this bone. Understanding the interrelationships of the structures contained within the temporal bone is an intellectually demanding task. This is important for the otologist in order to operate safely and effectively to achieve good results in ear surgery.[2] Various important neurovascular structures run within or adjacent to the temporal bone. Of these, the facial nerve is the most important. The course and depth of the facial nerve in the mastoid is subject to variation and hence liable for iatrogenic injury during tympanomastoid surgery. Iatrogenic injury resulting in facial paralysis is a difficult complication for the surgeon, patient and for people who interact with the affected patient. A poll in the early 1990s' in the United States revealed a high level of discomfort for both patients and their attendants.[3] Very few studies have been performed regarding the depth of the facial nerve from fixed reference points in the temporal bone. Hence this study attempts to determine the mean depth of the facial nerve in the mastoid and hence address these deficiencies.

METHODS

This cadaveric anatomical study was conducted at the Department of ENT, Mysore Medical College and Research Institute, Mysore, between 1/12/2017 to 31/01/2018. Institutional Ethical Committee Clearance was obtained for this study.

Twenty adult wet temporal bones from both sides were harvested for this study. The temporal bone was mounted on a temporal bone holder in the surgical position. Using a drill, the first bone cut was made along the linea temporalis. The second cut was made along the postero-superior canal wall upto the mastoid tip. These two cuts were joined together forming a triangle of attack. Cortical

bone was progressively removed to reach mastoid antrum. Once the mastoid antrum was reached, the dome of the lateral semicircular canal and short process of incus were identified (Figure 1).

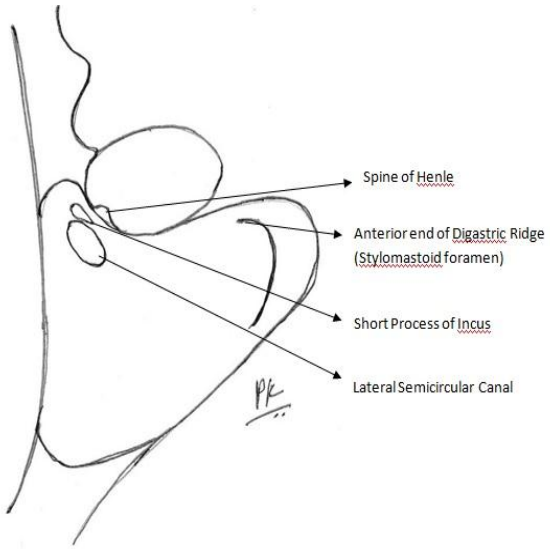

Figure 1: Schematic diagram of cortical mastoidectomy.

All air cells were systematically exenterated. The Digastric ridge was identified medial to the mastoid tip and followed anteriorly to the stylomastoid foramen (Figure 1). A cortical mastoidectomy was completed.

Next using a measuring probe, the distance between the spine of Henle and the tip of short process of incus was measured (Figure 2).

Figure 2: Photograph demonstrating measurement of the distance between spine of Henle and short process of incus.

The distance between the posterior canal wall (at the level of the floor of bony ear canal) and the anterior end of the digastric ridge was measured (Figure 3).

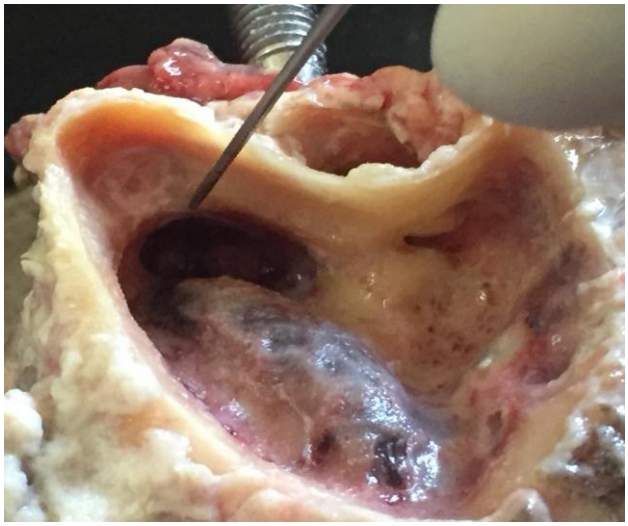

Figure 3: Photograph demonstrating measurement of the distance between the posterior canal wall (at the level of floor of bony ear canal) and anterior end of digastric ridge.

The facial bridge and ridge was taken down completely upto the vertical segment of the facial nerve. The posterior buttress was completely removed so that the floor of the ear canal was confluent with the mastoid tip to complete a canal wall down mastoidectomy (Figure 4).

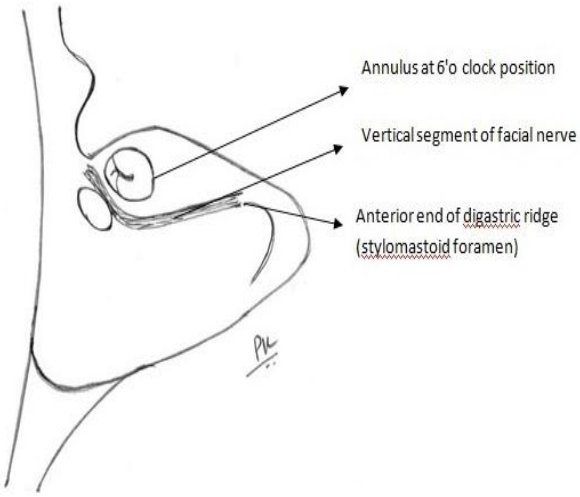

Figure 4: Schematic diagram of a canal wall down mastoidectomy.

The third measurement from the annulus at 6’0 clock position upto the anterior end of the digastric ridge was taken (Figure 5).

All the measurements were entered into a proforma sheet.

Figure 5: Measuring the distance between the annulus at 6'o clock and anterior end of digastric ridge.

RESULTS

Twenty wet adult temporal bones were dissected. There were eleven right and nine left temporal bones in our study.

The distance between the spine of Henle and short process of incus ranged from 11 to 16.5 mm with a mean of 13.82 mm (±1.53 mm)

The distance between the posterior canal wall (at the level of the floor of the bony ear canal laterally) and the anterior end of the digastric ridge varied from 10 to 16.5 mm with a mean of 12.75 mm (±1.63 mm).

The distance from the annulus at 6'0clock position upto the anterior end of the digastric ridge varied between 7 to 16.5 mms with a mean of 10.22 mm (±2.38 mm).

The results of our study are as follows (Table 1):

Table 1: Results of distances measured with standard deviation.

Temporal bone	Distance between spine of Henle and short process of incus (in mm)	Distance between posterior canal wall and anterior end of digastric ridge (in mm)	Distance between annulus at 6'o clock and anterior end of digastric ridge (in mm)
Mean in mm	13.82	12.75	10.22
SD	1.53	1.63	2.38

DISCUSSION

The facial nerve is a nerve which has the longest course in a bony canal in the temporal bone. Besides this, it exhibits a lot of variations and anomalies in its course, which can lead to iatrogenic injury during temporal bone surgery.[4] Facial paralysis due to facial nerve injury can cause lot of emotional trauma to the patient besides difficulties in activities which requires the use of facial muscles such as speech and blinking.

The incidence of iatrogenic facial nerve trauma ranges from 0.6–3.6% in otologic surgeries and increases to 4-10% in revision surgery.[5] The most common site of iatrogenic injury during mastoidectomy is the second genu.[6] Iatrogenic injury may result from a lack of surgical skills or poor knowledge of anatomy.

Various landmarks in the middle ear and mastoid helps in identification of the facial nerve and hence prevents its injury. The short process of incus is a good landmark for the second genu of the facial nerve.[7] The beginning of the vertical segment of the facial nerve is located just below the short process of incus. The anterior end of the digastric ridge (anterior end of posterior belly of digastric muscle) leads to the stylomastoid foramen which indicates the terminal point of the vertical segment of the facial nerve.[7]

A few studies have been performed measuring the depth of the facial nerve in the temporal bone.

Kharat, found the mean depth of the second genu from the cortex to be 19.72 mm, whereas in our study it was 13.82 mm.[8] Hence this finding is not in concordance with our study. Kharats' study does not mention the exact point in the mastoid cortex from where the measurement was taken. Whereas in our study we used a fixed bony reference point (spine of Henle) for this measurement. This bias could be the source of discordance.

Yadav found the mean depth of the second genu from the outer cortex to be 21.6 mm.[9] In our study it is 13.82 mm, which is not in agreement. The mean depth of the stylomastoid foramen from the cortex was 12.8 mm. In our study it is 12.75 mm. The results of this measurement are hence similar in Yadavs' and our study.

Boemo performed a study in 2007. The results of his study are similar to our study.[10] The mean distance of the short process of incus from the external mastoid surface was 11.86 mm. In our study, this depth was 13.82 mm. The depth of the stylomastoid foramen from the external mastoid surface was 10.78 mm, which is similar to results in our study- 12.75 mm.

These findings show that a few results were similar to our study and a few were not in concordance. We have

measured another parameter in our study which has not been done in earlier studies. We have measured the distance from the annulus at 6'o clock and anterior end of the digastric ridge which was found to be 10.22 mm (±2.38 mm).

Future research evaluations are required to determine the variations in the depth of the facial nerve which could be due to differences in pneumatization of the mastoid, sex, race, genetic and environmental factors.

CONCLUSION

This study proves the many variations in the depth of the facial nerve in the mastoid and hence the importance for surgical discipline and knowledge of temporal bone anatomy for the ear surgeon.

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