Morphometry of stylomastoid foramen and its clinical application in facial nerve block

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ABSTRACT

Background: Stylomastoid foramen is an important site for Nadbath facial nerve block. Exact localization of foramen holds the key to success, thus decreasing the complications. Wide racial variation exists in position of stylomastoid foramen in different population groups. Aim: The aim was to study the morphometry of stylomastoid foramen and its location with respect to nearby anatomical landmarks. Materials and Methods: A total of 100 dry skulls (60 male and 40 female) were studied to locate the position of center of stylomastoid foramen (CSMF) with respect to tip and anterior border of the mastoid process and jugular foramen (JF). Along with this angle between antero-posterior line passing through the tip of the mastoid process and line joining the tip with stylomastoid foramen was also measured. Result: In 83.51% sides of skulls, the most common position of foramen was found to be anterior to the line passing through anterior border of the mastoid process. The mean distance of center of foramen from the tip of the mastoid process was 15.26 ± 1.4 mm on right and 14.32 ± 1.8 on the left side (P < 0.001) and from JF was 12.28 ± 1.9 mm and 12.96 ± 2.1 mm on the right and left sides, respectively (P < 0.01). The position of CSMF was found at an angle of 66.57° ± 2.6° and 65.96° ± 1.8° on the right and left sides, respectively from the tip of the mastoid process. Conclusion: This study makes possible the identification of the exact position of stylomastoid foramen and its application in facial nerve block.

Key words: Facial nerve, morphometry, Nadbath block, stylomastoid foramen

INTRODUCTION

Good anesthesia is vital for the performance of safe intraocular surgery. Orbicularis oculi muscle is a sphincter muscle around the eye which is innervated by zygomatic and frontal branches of the facial nerve.[4] To prevent an ascend in the intraocular pressure due to the squeezing action of the eyelids during cataract extraction, a temporary paralysis of the orbicularis muscle is necessary. Hence, retrobulbar anesthesia combined with a facial nerve block, is the most frequently employed method of anesthesia in cataract surgery.[4] There are four types of facial block: van Lint’s block, Atkinson block, O’Brien block and Nadbath block.[2]

• van Lint’s block: In van Lint’s block, the peripheral branches of the facial nerve are blocked. 2.5 ml of anesthetic solution is injected just above the eyebrow and below the inferior orbital margin, through a point about 2 cm behind the lateral orbital margin in level with the outer canthus of the eye.
• O’Brien’s block: It is also known as facial nerve trunk block. The block is done at the level of the neck of the mandible near the condylar process.
• Atkinson’s block: The superior branch of the facial nerve is blocked by injecting the anesthetic solution at the inferior margin of the zygomatic bone.
• Nadbath block: Furthermore, called as modified O’Brien’s method. In this technique, the facial nerve is blocked at the stylomastoid foramen.

Recent study[3] suggests that the modified O’Brien block decreases the force of lid closure and lid movements far more effectively than the Atkinson and van Lint blocks. Also this technique avoids ecchymosis of the face and is less painful.[4] The facial nerve passes from the stylomastoid foramen into the substance of the parotid gland, and 5-7 mm behind the ramus of the mandible it divides into two divisions: temporofacial and cervicofacial. The temporofacial division supplies orbicularis oculi muscle. However, block of the facial nerve trunk at stylomastoid
foramen is preferred technique but involve the risks of nerve injury and serious neurological complications. Respiratory and vocal cord paralysis have been reported with inadvertent injections. Such hazards can be avoided by studying the morphometry of stylomastoid foramen and its relation with other anatomical landmarks.

**MATERIALS AND METHODS**

A total of 100 dry skulls (60 male and 40 female) collected from medical and dental colleges of Teerthanker Mahaveer University, India, were studied bilaterally. We excluded skulls of children and skulls with damaged mastoid process. Two imaginary lines were drawn [Figures 1 and 2]:

1. Transverse line passing through the upper end of the anterior border of both mastoid processes (XY).
2. Antero-posterior line passing through the tip of the mastoid process (AB) which is perpendicular to the line joining the tips of mastoid processes of both sides.

Following parameters were measured on both sides of the skull.

a. Shortest distance from the tip of the mastoid process to center of stylomastoid foramen (CSMF).

b. Shortest distance from the upper end of the anterior border of the mastoid process (UAMP) to CSMF.

c. Position of CSMF in relation to XY [Figure 2].

d. Angle ($\alpha$) between AB and shortest distance between the tip of the mastoid process to CSMF [Figure 1].

e. Distance from CSMF to centre of jugular foramens (JF).

The measurements related to stylomastoid foramen were taken with the help of scale and double-tipped compass and then transferred to calipers (least count 0.01 mm) to measure the distances. The dimensions were taken 3 times by the same person and the mean was taken, thus increasing the accuracy of the data.

**Statistical analysis**

From the above measurements, mean and standard deviation (mean ± SD), median (range), and mode were calculated. Data analysis was performed by using “IBM SPSS Statistics for Windows, Version 19.0. Armonk, NY: IBM Corp”, and $P < 0.05$ was considered as statistically significant. The angle was measured and calculated on digital photographs using the Vista Metrix software (Skill Crest, LLC, version 1.38, 2012).

**RESULTS**

Total skulls examined: 100
Male skulls: 60
Female skulls: 40
No. of sides not examined due to destruction: Right-2, Left-4
Total no. of sides examined: 194.

The position of CSMF was studied in relation to XY axis [Table 1]. The most common position observed was anterior to the XY axis in 83.51% sides whereas only in 13.4% sides it was along the XY axis. The least common position observed was posterior to XY axis in 3.09% sides.

The mean, median and range of distances from the CSMF to various important anatomical landmarks were tabulated [Table 2].

| Table 1: Position of CSMF in relation to axis XY |
|-----------------|-----------------|-----------------|-----------------|
| Position of CSMF | Right (%) (n = 98) | Left (%) (n = 96) | Total (%) (n = 194) |
|-----------------|-----------------|-----------------|-----------------|
| Anterior to XY axis | 82 (83.67) | 80 (83.33) | 162 (83.51) |
| Along XY axis | 14 (14.29) | 12 (12.5) | 26 (13.4) |
| Posterior to XY axis | 2 (2.04) | 4 (4.12) | 6 (3.09) |

CSMF: Centre of stylomastoid foramen

- **Figure 1:** Imaginary line AB passing through the tip of the mastoid process

- **Figure 2:** Imaginary line XY passing through the upper end of the anterior border of the mastoid process
The mean distance from CSMF to MP (Tip of Mastoid process) was 15.26 ± 1.4 mm on the right side and 14.32 ± 1.8 mm on the left side, (P = 0.001) [Table 2]. Along with that, statistical significance was also seen among the mean distance from CSMF to JF on right and left side (12.28 ± 1.9 and 12.96 ± 2.1) mm (P = 0.01) [Table 2]. Besides this, the mean distance from CSMF to UAMP was statistically insignificant [Table 2]. The minimum and maximum distances observed from CSMF to MP were 12.62 mm and 16.56 mm respectively. The values of distance CSMF-UAMP, which is most frequently present, are 10.25 mm and 10.4 mm respectively.

The angle between AB and CSMF-MP was statistically insignificant between both sides (66.57 ± 2.6 on the right side and 65.96 ± 1.8 on the left side) with the maximum value of 69.73 and minimum value of 52.95 [Table 2].

**DISCUSSION**

Different studies [2,3,5,6] give different methods of Nadbath facial nerve block. According to some studies [7], injection is made into the cavity between mastoid process and posterior border of the mandibular ramus. Some studies [3,5] advocate region inferior to earlobe or tip of the mastoid process as best landmark for this technique. No literature describes exact anatomical landmarks for location of stylomastoid foramen. The aim of our study is to determine the precise location of this foramen in relation to various anatomical structures, thereby decreasing the possibilities of failures as well as complications.

In 83.51% skulls the position of stylomastoid foramen was anterior to the axis passing through anterior border of the mastoid process. Hence, the needle when introduced along the anterior border of the mastoid process should be directed forward and medially and if the needle is entered from tip of the mastoid process than the direction should be upward, forward and medially.

In our study, we measured the shortest distance between the CSMF-MP, which was found to be 15.26 ± 1.4 and 14.32 ± 1.8 mm on right and left sides (P = 0.001), respectively. Wide variations have been observed between the distance from CSMF to MP in several studies [7-9] again justifying the racial possibility behind it. The most repeated value for distance between CSMF-UAMP was found to be 10.25 on right and 10.4 cm on the left side. We additionally analyzed our observations using statistical parameters (mean ± SD, median [range], mode) to improve the accuracy for the location of stylomastoid foramen. The mean distance indicates the location of foramen while SD provides the variability in its position. The range also provides an indication for the location but depends upon sample size and the dispersion of values. Such parameters prove to be very informative in locating the position of stylomastoid foramen during anesthetic block and surgical interventions. The mode is the dimension which helps us to know the value which is found in most of the subjects of same racial group.

The most drastic complication related to Nadbath facial nerve block is the IX, X, XI cranial nerve injury, which occurs due to deeper penetration of the needle reaching the JF. Thus we measured the distance between CSFN and JF and also give the range. The measurement of such a dimension makes our study distinctive from other available literature [10] as during Nadbath block, vigilance is required for an anesthetist regarding appropriate depth while approaching the foramen.

Besides these linear parameters, in this study we additionally studied the angle (α) which will prove to be very helpful for anesthetist to decide the direction of needle thus decreasing the possibilities of penetrating the surrounding structures and failure rate.

**CONCLUSION**

This study helps to determine the precise location of the stylomastoid foramen in relation to various anatomical structures in Indian population. The landmarks described could be identified and effectively applied with success in Nadbath facial nerve block, thereby decreasing the risk of failures and complications.
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