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Anatomy

# 'PINNING' THE STYLOMASTOID FORAMEN

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**ABSTRACT** Knowing the exact location of the foramen is of great importance to surgeons and anaesthetists in locating the trunk of the facial nerve in various procedures. The aim of the study was to study the position of the stylomastoid foramen (SMF) and find the mean distance of the foramen from the upper end of the anterior border and tip of the mastoid process and also the outer anterior angulation of a line drawn from the anterior border of the mastoid process to the stylomastoid foramen. The parameters considered were the distance from the upper end of anterior border of the mastoid process to the stylomastoid foramen, and the distance from the tip of the mastoid process to the stylomastoid foramen. The parameters used in the present study are of importance to surgeons and anaesthetists to accurately locate the facial nerve as it exits the stylomastoid foramen.

**KEYWORDS :** Stylomastoid foramen, anterior border of the mastoid process, facial nerve, outer anterior angulation

## AIMS AND OBJECTIVES

To study the position of the stylomastoid foramen and find the mean distance of the foramen from the upper end of the anterior border and tip of the mastoid process and also the outer anterior angulation of a line drawn from the anterior border of the mastoid process to the stylomastoid foramen.

## INTRODUCTION

The stylomastoid foramen is a round opening on the inferior surface of the petrous part of the temporal bone. It lies between the base of the styloid process and the mastoid process [1].

It has been named based on its location and is derived from the Latin name "Foramen Stylomastoideum" Styloid comes from the Greek word stylos meaning pillar, and mastoid from mastos meaning breast. Galen used this name to describe the process of the temporal bone because he thought it resembled the breast in appearance. Foramen comes from the Latin term forare meaning to bore or perforate, designating a hole-like opening.

This foramen is the termination of the facial canal which connects the internal auditory meatus of the posterior cranial fossa to the base of skull. It transmits the facial nerve and the stylomastoid artery. It is the main motor portion of the facial nerve that passes through the stylomastoid foramen [1].

The structures present in the vicinity of the stylomastoid foramen are styloid process, mastoid process, jugular fossa and the stylopharyngeus muscle.

The facial nerve after leaving the skull through the stylomastoid foramen (SMF), passes through the substance of the parotid gland where it divides into two divisions, temporofacial and cervicofacial [2].

**Knowledge of the exact location of the stylomastoid foramen (SMF) has many clinical applications. These include: -**

- Diagnostics like Electroneurography (EnoG) and electromyography (EMG) [3].
- To identify the facial nerve by intraoperative nerve stimulation in parotid surgery and other base of skull surgeries.
- To induce a temporary paralysis of the orbicularis oculi muscle in ocular surgeries requiring regional anaesthesia in addition to topical anaesthesia.
- To decompress facial nerve in Bell's palsy when inflammation is at the stylomastoid foramen.
- Facial nerve repair in traumatic facial paralysis resulting from penetrating or intraoperative iatrogenic facial nerve injury [3].

Locating the SMF is difficult.

This study has been directed at identifying the facial nerve as it exits the foramen. Most of the studies have focussed on finding the distance of the facial nerve from various reference points, than the SMF itself. These studies measured the distance of the facial nerve from the skin surface. Inaccuracy of results was mainly because of the absence of fixed reference points on the skin [7]. Hence, bony processes like the mastoid process [8], mastoid notch, styloid process [9], transverse process of axis, and angle of mandible [10] have formed the basis of evaluation in later studies.

## MATERIALS AND METHODS

A total of 100 adult dry skulls of unknown sex from the bone bank in the Department of Anatomy were selected. Skulls with damaged mastoid processes were excluded from the study. The parameters which were measured on left and right sides of each skull are given in fig.1

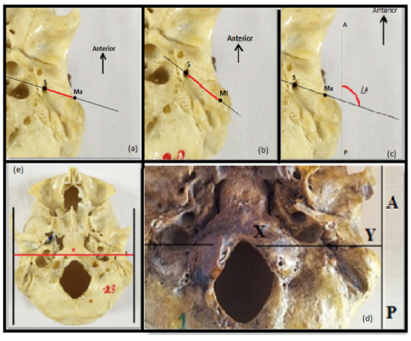


**Fig 1**: Parameters **(a)** Distance from the upper end of anterior border of the mastoid process (Ma) to the stylomastoid foramen (S) (Line S-Ma). **(b)** Distance from the tip of the mastoid process (Mt) to the stylomastoid foramen (S) (Line S-Mt). **(c)** Angle 'A' formed between a line drawn from the upper end of the anterior border of the mastoid process to the stylomastoid foramen (line S-Ma) with a line drawn antero- posteriorly along the lateral border of mastoid process (line AP). This was measured on digital photographs of the base of each skull using Microsoft Paint tools. **(d)** The position of the SMF was also found in relation to a line drawn along the upper end of the anterior border of the mastoid process (line XY) and perpendicular to a line AP. **(e)** The inter mastoid distance was also calculated

The measurements related to the stylomastoid foramen were taken with the help of a digital Vernier Calliper and the angle was measured using a protractor. Both were carried out by a single person to obliterate observer bias.

The observations were tabulated and analysed statistically.

The mean and standard deviations, mode and median of the data were calculated. Data analysis was performed using SPSS version 20.

Variations from similar studies were observed and results were charted and compared with similar studies obtained on review of literature.

## RESULTS

**Table 1: Description of skulls. Total skulls examined: 100**

| Description | Right | Left |
|---|---|---|
| SMF - mastoid anterior border | 96 | 98 |
| SMF- mastoid tip | 94 | 96 |

**Table 2: The position of the SMF as studied in relation to a line XY is tabulated below.**

| Side | Total skulls | No of foramina anterior to XY | No of foramina posterior to XY | No of foramina on the line XY |
|---|---|---|---|---|
| Right | 96 | 25 | 32 | 39 |
| Left | 98 | 20 | 22 | 56 |

On the right side 40.62% of the foramina are on the line XY, 33.33% are anterior to XY and 26.04% are posterior to it. On the left side 57.14% of the skulls are on the line XY, 20.40% are anterior to XY and 22.44% are posterior to the line XY.

The mean, standard deviation, maximum and minimum values from the SMF to the mastoid are tabulated below

**Table 3: Descriptive Statistics**

| Parameters measured | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| S to Ma: RIGHT | 96 | 7 | 17 | 11.61 | 2.464 |
| S to Ma: LEFT | 99 | 7 | 16 | 11.73 | 2.053 |
| S to Mt: RIGHT | 94 | 13 | 25 | 17.50 | 2.530 |
| S to Mt: LEFT | 96 | 12 | 25 | 17.45 | 2.522 |
| ANGLE [A]: RIGHT | 96 | 46 | 114 | 88.96 | 10.874 |
| ANGLE [A]: LEFT | 98 | 28 | 119 | 88.47 | 10.461 |
| Valid N (list wise) | 91 | | | | |

A positive correlation between the inter-mastoid distance and the angle 'A' bilaterally was established.

## DISCUSSION

The stylomastoid foramen is situated posterior to the root of the styloid process at the anterior end of the mastoid notch [1]. Though there are descriptions of its anatomy, there is little description of its exact position or surface anatomy.

The facial nerve leaves the skull through the stylomastoid foramen. Here it lies medial and slightly anterior to the base of the mastoid process at the medial end of the tympano-mastoid fissure on the base of skull. It then runs obliquely inferiorly and laterally and passes into the substance of the parotid gland where it divides into the temporo-facial and cervico-facial divisions at a point vertically below the lowest part of the bony external auditory meatus [2].

Most studies have focused on finding the distance of the facial nerve from various reference points, than the SMF itself.

While dissecting to locate the facial nerve a common error made was to go deep to locate the nerve [11].

Nadbath RP and Rehman I in 1963 while describing their facial nerve block had reported that the depth of the facial nerve was 15 mm by the lateral cervical approach just anterior to the antero-superior aspect of the mastoid process. [6] Studies of the facial nerve trunk by Kwak HH et al [12] & Li X et al [13] have also reported similar values for the distance of the facial nerve trunk at its exit.

Kwak HH et al [12] found the average depth of the stylomastoid foramen from the skin surface to be 21.0±3.1 mm and Li X et al [13] found that the mean minimal distance of the facial nerve trunk from the skin surface in this area was 22.62 +/- 2.88 mm. This variation in its location is due to the different anatomical landmarks that have been used to relate the position of the main trunk of the facial nerve. Alternately bony structures are more suitable as reference points because of their rigidity and reliability [7].

The mastoid process as it is a relatively large structure located superficially; specific marks on the upper end of the anterior border and the tip of the mastoid process were used as landmarks in the present study.

In 2006 Li X et al [13] while studying the microsurgical anatomy of the facial nerve trunk found that the distance of the SMF from the mastoid process was 17.91± 2.68 mm whereas Greyling et al found the distance to be less. [14] The results on both sides were 9.18 ± 2.05 mm on the left side and 9.35 ± 1.67mm on the right. Both these studies did not specify the exact location on the mastoid process from where the measurement was taken.

Sawamura et al described a method, which involved exposure of the tip of the mastoid process of cadavers to search for the facial nerve [15]. Asaoka et al, in his study on the surgical anatomy of the facial nerve [16] reported that the facial nerve usually appeared on the ventral portion of the tip of the mastoid process.

Using the upper end of the anterior border and the tip of the mastoid process as landmarks Shin DS et al, measured the distance of the stylomastoid foramen from the mastoid tip, and compared the values on both sides and found a mean value of 8.6 ± 2.8 mm. [17] In the present study, the mean distance of the stylomastoid foramen from the tip of the mastoid process was found to be 17.50 $\pm$ 2.53mm on the right side and 17.45 $\pm$ 2.52mm on the left side. Whereas, the mean distance of the stylomastoid foramen from the upper end of the anterior border of the mastoid process was 11.61 + 2.46 mm on the right side and 11.73 $\pm$ 2.05 mm on the left side. This result showed wide variation from the study by Shin DS.

Sharma et al found the average distance of the SMF from the tip of the mastoid process was found to be 15.26 ± 1.4 mm on the right side and 14.32 ± 1.8 mm on the left. They also measured the mean angle between an antero-posterior line passing through the tip of the mastoid process and a line joining the tip of the stylomastoid foramen. The mean values obtained were 66.57 ± 2.6 degrees and 65.96 ± 1.8 degrees on the right and left sides respectively. [18] This was significantly different from the results obtained in the present study.

Use of the parameters of the present study is of importance to surgeons and anaesthetists who need to accurately locate the facial nerve as it exits the stylomastoid foramen. This information is particularly useful for facial nerve trunk surgeries and for identifying the facial nerve to prevent injury to it.

Similarly, common ocular surgeries like cataract and glaucoma surgeries require regional anesthesia to achieve lid akinesia by a temporary paralysis of the orbicularis oculi muscle. This paralysis is produced by blocking the facial nerve trunk or its branches. [4]

A number of techniques have been described to block the facial nerve. [5] These techniques depend on the position where the block is given along the course of the nerve. Nadbath et al described their technique of the facial nerve trunk block at the stylomastoid foramen.[6]

Though the efficacy of the Nadbath block is superior in terms of extent of lid akinesia, it is associated with risk of complications like respiratory and neurological complications due the facial nerve close proximity to the vagus, glossopharyngeal and accessory nerves [5,18,19]. In order to prevent these complications, the block needs to be administered with utmost care and with a thorough understanding of the logistics of the stylomastoid foramen.

## CONCLUSION

Information obtained from the present study regarding the morphometric anatomy of the location, of the stylomastoid foramen and thereby facial nerve trunk with respect to the mastoid process will aid in reducing the risk of facial nerve injury.

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