

# Morpho-metric study of the facial nerve in the Andaman and Nicobar islands population: A cadaveric study



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## ABSTRACT

**Background:** Facial nerve (FN) is the seventh cranial nerve. It is the only cranial nerve which has a long course in a bony canal. From the brain stem, to its terminal branches, it changes its direction 5 times, to innervate, muscles of the second pharyngeal arch. Hence, it is morphometric study and has great clinical importance. **Aims and Objectives:** This study was conducted to ascertain the variations of the length of facial Nerve at different parts of the crania so that this study could be helpful for neurosurgeon, radiologist, and clinician, to deal with various diseases of FN. **Materials and Methods:** Thirty-five (35) male cadaveric temporal bones, were taken out, by removing soft parts attached to it. The FN was exposed. The length of the FN was measured, by digital vernier calliper, in different regions, of the temporal bone. **Results:** 7.90 (SD ± 1.24) in petrous part, 3.7 (SD ± 0.40) in labyrinthine part, 12.13 (SD ± 0.36) in tympanic, 12.24 (SD ± 1.86) mastoid part, 15.76 (SD ± 0.54) length of nerve to stapedius, and 19.06 (SD ± 0.66) length of branches of chorda-tympani. **Conclusion:** The present cadaveric study has clinical importance, for the ENT surgeon, neurosurgeon, neurophysician, and the radiologist.

**Key words:** Facial nerve; Digital vernier calliper; Cadavers; Temporal bone

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## INTRODUCTION

The facial nerve (FN) gains its importance clinically, in facial palsy, which is of great concern to the clinician and his or her patients.<sup>1</sup> Iatrogenic injury to the FN is most often seen, after cervicofacial rhytidectomies, surgery of parotid gland, acoustic neuroma resection, or tumor resection at any point, along the passage of the FN.<sup>2</sup>

FN emerges from the stylomastoid foramen (SMF) and enters into the parotid gland, through its posteromedial surface. It further furcates into an upper division (temporofacial) which further gives the five terminal

branches.<sup>3,4</sup> The lesions of intracranial course of FN, also impairs the normal function of FN. During intrauterine life, there may be variations in the position of fetus or the fetus itself may accommodate with the uterine space; hence, there will be variation in the length of neural tube which results into variations in morphology of brain and cranial nerves including FN. However, least data are available about FN in Indian literature. These variations in different parts of the head and neck may result into morbidity of the patient by in experienced surgeon. Hence, an attempt is made, to measure the length of various segments of the temporal bone which assumes greater importance for the radiologist, neurosurgeon, neurophysician, and the ENT surgeon as well.

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### Aims and objectives

As Facial Nerve is motor nerve to face and structures like Eye ball, parotid gland, salivary gland present in face the variations of Facial Nerve may get injured if prone to any pathology may cause many hazards to facial muscles and associated structures of the face. Hence variations in length of Facial Nerve have surgical and clinical importance.

### MATERIALS AND METHODS

35 male cadavers (temporal bones) present in the dissection theater of the Anatomy Department, Andaman and Nicobar Islands Institute of Medical Sciences Port Blair-744104. The descriptive morphometric study of FN was carried out.

#### Inclusive criteria

Non-pathological, intact temporal bones of cadavers were selected for the study.

#### Exclusion criteria

Pathological, cut or torn FN, in any part or segment of the temporal bone, was excluded from the study.

#### Methods

Temporal bones were taken out, by removing the soft parts attached to it. The FN was exposed as per the method, given in Cunningham manual Vol. III<sup>rd</sup>. The length of the FN was measured by digital vernier calliper (mm).

- Length of FN at petrosal segment of temporal bone was measured at the entry into internal auditory meatus to the superior semicircular canal
- Length was measured from the superior semi-circular canal to geniculate ganglion
- Length was measured from the geniculate ganglion to processus cochleariformis
- Length was measured from the medial wall of tympanic cavity to SMF
- Length of nerve to stapedius (distance was measured from geniculate ganglion)
- Length of nerve, at the level of branching of chorda tympani
- Duration of the study was from, February 2021 to February 2022.

#### Statistical analysis

Mean values of various segments were calculated, to get the mean value. The statistical data were carried out, with SPSS software.

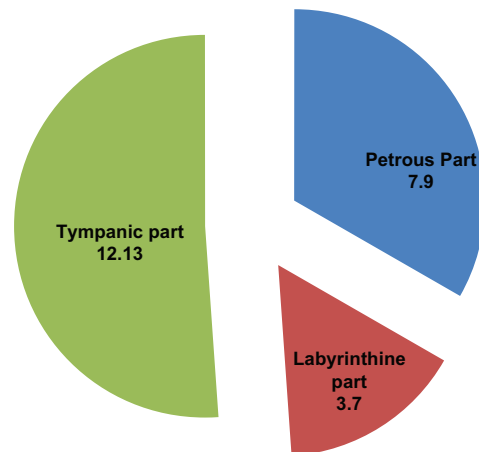
### RESULTS

Table 1: Mean values of Facial Nerve, in various segments, of temporal bone:

**Table 1: Mean values of facial nerve in various segmental of temporal bone**

Segments	Mean value (mm)±SD
Petrous part	7.90±1.24
Labyrinthine part	3.7±0.40
Tympanic part	12.13±0.36

SD: Standard deviation



7.90 (SD±1.24) petrous parts, 3.7 (SD±0.40) at labyrinthine part, 12.13 (SD±0.36) tympanic part, 12.24 (SD±1.86) at mastoid part, 15.76 (SD±0.54) nerve to stapedius, 19.06 (SD±0.66) length of branches of chorda-tympani.

Table 2: Present findings were compared with previous studies.

The radiologist, neurosurgeon, and ENT surgeon must be aware of these variations.

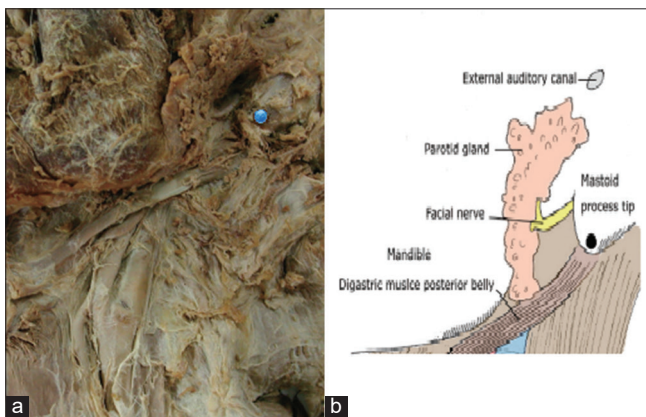
### DISCUSSION

The present study of FN of cadavers, in Andaman and Nicobar Islands population 7.90 (SD±1.24) petrous part, 3.7 (SD±0.40) labyrinthine part, 12.13 (SD±0.36) tympanic part, 12.24 (SD±1.86) mastoid part, 15.76 (SD±0.54) nerve to stapedius, and 19.06 (SD±0.66) length of branches of chorda tympani branch (Table 1) (Figures 1 and 2). Our findings are more or less in agreement with previous studies.<sup>5-7</sup>

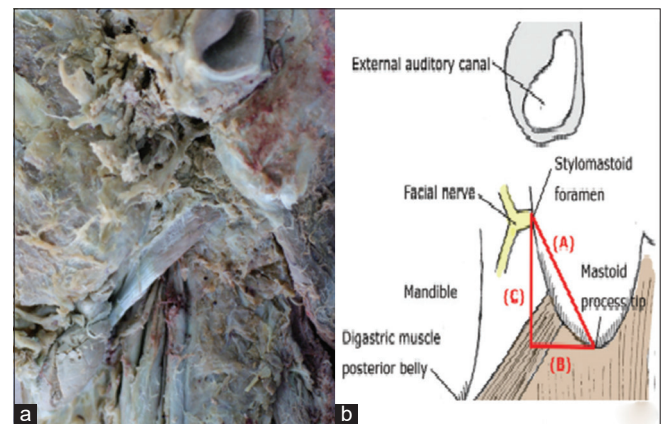
The probable reason for these variations in FN could be different morphological elements of temporal bone, namely, petromastoid, tympanic, squamous, and styloid process. FN being the nerve of the II<sup>nd</sup> pharyngeal arch, runs behind the cartilaginous bars of I<sup>st</sup> and II<sup>nd</sup> arch (which are typically arranged) to innervate muscles

**Table 2: Comparison of present study with previous studies, at different places**

Name of the worker with year	Place of study	Mean length in Petrous part (mm)	Mean length in Labyrinthine part (mm)	Mean length in Tympanic part (mm)	Mean length in Mastoid part (mm)
Ehud Fliss Et al <sup>16</sup> 2022	Tel-Aviv, Israel	--	3-4	8-11	10-14
Yadhav SP, Rangan R 2006	North India	--	--	11-1 (SD±0.8)	15.4 (SD±2.34)
Boehme RL, <sup>12</sup> Novelette 2007	Spain	--	--	--	13.3 (SD±1.43)
Waheed E Et al <sup>13</sup> 2009	Iraq	5-10	3.5-4	12.4 (SD±0.45)	--
Kharat RD, Golhar et al <sup>14</sup> 2009	Maharashtra	--	--	9.28	13.7
Nicoleta More et al. 2010	Roman	--	3.74 - 5.27	9.15-12.03	11.23- 15.07
Makandar UK, Kulkarni PR 2011	South India	7.82 (SD±0.27)	3.4 (SD±0.9)	12.3 (SD±0.7)	12.24 (SD±0.38)
Nicoleta Maru et al. <sup>15</sup> 2010	Bucharest, Romania	7.92 (SD±1.22)	3.5 (SD±0.42)	12.14 (SD±0.38)	12.26 (SD±1.88)
Present study 2023	Andaman and Nicobar	7.90 (SD±1.24)	3.7 (SD±0.40)	12.13 (SD±0.36)	12.24 (SD±1.86)



**Figure 1:** Neurovascular structures of the submandibular area. (a) Photograph showing cadaveric dissection of the submandibular region. Most of the facial nerve (FN) trunk are found in the ventral portion of the mastoid process tip. (b) Dissection of the FN proximally in the posterior parotid gland exposed the distal FN trunk



**Figure 2:** Measurements of the distance from the mastoid process tip (MPT) to the stylomastoid foramen (SMF). (A) Photograph showing cadaveric dissection of the submandibular region. (B) Schematic representation. (a) The shortest distance between the two points. (b) Horizontal distance between the MPT and the SMF. (c) Vertical distance between the SMF and the MPT

of facial expression.<sup>8</sup> Moreover, during development, motor axons of the arches undergo an intricate feat of path findings, to reach their target muscles. These pathways are regulated by some chemoattractants and chemorepulsants, produced by mesenchyme. If there is any altered expression of these agents, it may lead to variations in the length of FN.<sup>9</sup>

Developmentally, chondrified otic capsule stops its ossification and forms a canal, to give space for FN and vestibulo-cochlear nerve, which will later, ossify into petrosal part on temporal bone. Vestibulocochlear nerve has limited distribution, but FN has to innervate, muscles of facial expression, through a tortuous journey. Moreover, the variation of FN in temporal bone is due to, dual ossification of temporal bone, i.e., partly cartilaginous and partly membranous. Rate of bone growth and maturation is influenced, not only by age and sex, but also from socioeconomic status and individual body weight, as they play a vital role in the maturation of bone growth by, altering its length. Regional and racial factors also play a contributory role in the maturation of bony elements. Hence, morphometric values of

mesodermal derivatives are uncertain. This uncertainty leads to, variations in the length of FN in gorilla and man. In gorilla, it is rudimentary and medially placed, but in human, it is shifted laterally, a prominent process which is filled with more amount of pneumatization to act against antigravity movements of skull and to adopt erect posture, by displacing the course of FN,<sup>10</sup> which resulted into variations in length. Hence, these values of variations of FN in the different regions of India and abroad might be rooted back to their ancestors.<sup>11</sup> However, these variations in the length of FN have surgical, anatomical, and anthropological importance. The identification of FN trunk during parotidectomy is essential to avoid this complication. Some authors have reported soft tissue and bony landmarks to assist the surgeon for the early identification of the nerve. There has been much debate regarding FN in literature defining the safest and most reliable landmark. Since the FN paralysis remains an issue in maxillofacial surgery. It is necessary to understand the morphometry of the FN for performing any surgical intervention in the parotid area of the face.

In conclusion, the variations in the length of FN will be useful for maxillofacial, ENT, and neurosurgeons, radiologists, clinicians, anatomists, and anthropologists, because these variations indicate the regional significance, apart from surgical importance. However, this study demands, further embryological, genetic, nutritional, and environmental studies, because the exact mechanism and factors, which cause variations in the length of FN is still unclear.

### Limitations of the study

Owing to tertiary location of the research center and small number of cadavers with a lack of latest techniques, we have limited findings and results.

## CONCLUSION

In conclusion, the study has provided knowledge of anatomy of temporal bone and its pneumatization pattern, the anatomy of the facial nerve, its variations and their incidence, relation of various middle ear landmarks with the facial nerve and proficiency in dissection. The variations occur with sufficient frequency as described in available literature, showing not much racial and geographical variance and the otologic surgeon must be aware of them, to avoid the disasters and alleviate the fear regarding facial nerve. “The surgeon learned in anatomy, with the knowledge and skill learned in the dead house may safely traverse the perilous narrow ocean of the operation in the fallopian aqueduct.”

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## ETHICAL APPROVAL

This research paper is approved by the Ethical committee of Andaman and Nicobar Islands Institute of Medical Sciences, Port Blair-744104. As it is cadaveric, study no written permission is given.

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**Authors Contribution:**

**SJF**- Definition of intellectual content, literature survey, prepared first draft of manuscript, implementation of study protocol, data collection, data analysis, manuscript preparation and submission of article; **CAK**- Concept, design, clinical protocol, manuscript preparation, editing, and manuscript revision, figures; **ASL**- Design of study, statistical analysis and interpretation, coordination and manuscript revision.


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