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Research Article

STUDY OF FACIAL NERVE COURSE AND ITS VARIATION IN TEMPORAL BONE DISSECTION

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ABSTRACT

Objectives: There are various anatomical variations of the facial nerve in the bony canal making it prone to injury during mastoid surgeries. The objective of the present study is to find the course of the facial nerve and its variation in 40 cases of temporal bone dissection and to evaluate various parameters of the tympanomastoid segments of the facial nerve and its relation with the important middle ear structures.

Methods: The present study was conducted in the Department of Otolaryngology, Uttar Pradesh University of Medical Sciences, Saifai, Etawah, on 40 temporal bones from January 2022 to December 2022. Various parameters of the tympanomastoid segments of the facial nerve and its relations with the important middle ear structures were studied in the present study.

Results: In the present study, out of 40 bones dissected, 34 bones (85%) were well pneumatized whereas 6 bones (15%) were sclerotic in nature. In the present study, tympanic segment length varied from 7.65 to 11.72 mm with a mean of 9.32 mm (±1.02 mm). Vertical segment length varied from 10.2 to 15.9 mm with a mean of 13.48 mm (±1.21 mm). The distance of the second genu from the outer cortex varied from 17.67 to 23.71 mm with a mean of 19.73 mm (±1.44 mm). The distance of chorda tympani from stylomastoid foramen varied from 3.2 to 7.6 mm with a mean of 5.54 mm (±1.41 mm).

Conclusion: Anatomical knowledge of facial nerve in the canal and its relation to surrounding structures is very helpful for ENT surgeons to avoid injury to it during middle ear surgeries.

Keywords: Temporal bone, Facial nerve, Anatomy, Dissection, Knowledge.

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INTRODUCTION

The facial nerve is the longest nerve in a bony canal and has a complex and tortuous course in the canal [1]. There are various anatomical variations of the facial nerve in the bony canal making it prone to injury during mastoid surgeries [2]. Various facial expressions such as joy and sorrow are the result of 7000 motor fibers of facial nerve firing simultaneously. Paralysis of the facial nerve may lead to disfigurement and emotional distress to the affected person resulting in difficulty in social interaction. The facial canal may display anomalies in its usual course, congenital bony dehiscence, and anatomical variations. Anatomical knowledge of the facial nerve in the canal and its relation to surrounding structures is very helpful for ENT surgeons to avoid injury to it during middle ear surgeries. Therefore, the aim of the present study is to find the course of the facial nerve and its variation in 40 cases of temporal bone dissection and to evaluate various parameters of the tympanomastoid segments of the facial nerve and its relation with the important middle ear structures.

METHODS

The present study was conducted in the Department of Otolaryngology, Uttar Pradesh University of Medical Sciences, Saifai, Etawah, on 40 temporal bones from January 2022 to December 2022. Various parameters of the tympanomastoid segments of the facial nerve and its relations with the important middle ear structures were studied in the present study. Procedures used for the present study were modified radical mastoidectomy and facial nerve decompression. Only temporal bones of adult persons were included in the present study whereas diseased temporal bones and cholesteatoma bones were excluded from the study. This study was approved by the Institutional Ethics Committee.

RESULTS

In the present study, out of 40 bones dissected, 34 bones (85%) were well pneumatized whereas 6 bones (15%) were sclerotic in nature. In the present study, tympanic segment length varied from 7.65 to 11.72 mm with a mean of 9.32 mm (±1.02 mm). In maximum cases (42.5% of bones), the length of the tympanic segment was 8.6–9.5 mm followed by 9.6–10.5 cm in 22.5% of bones. In minimum cases (2.5% of bones), tympanic segment length was >11.5 cm.

In the present study, the tympanic segment of the facial nerve of temporal bones turned posterior from the geniculate ganglion. The processus cochleariformis and tensor tympani were anterior to the facial nerve. The facial nerve passed above the promontory and the oval window niche was inferior to the facial nerve in all cases. The facial nerve passed below the horizontal semi-circular canal in all cases.

Vertical segment length varied from 10.2 to 15.9 mm with a mean of 13.48 mm (±1.21 mm). In maximum cases (37.5% of bones), the length of the vertical segment was 13.1–14.0 mm followed by 14.1–15.0 mm in 25.0% of bones. In minimum cases (7.5% of bones), tympanic segment length was <12.0 cm. In all cases, this segment was anterior to the mastoid tip and medial to the tympanomastoid suture.

The distance of the second genu from the outer cortex varied from 17.67 to 23.71 mm with a mean of 19.73 mm (±1.44 mm). In maximum cases (30.0% of bones), the distance of the second genu from the outer cortex was 18.6–19.5 mm followed by 19.6–20.5 mm in 27.5% of bones. In minimum cases (2.5% of bones), distance of the second genu from the outer cortex was 22.6–23.5 mm and >23.5 mm.

Table 1: Details of tympanic bones in the present study

Details	Number of bones (%)
Type of bones	
Pneumatized	34 (85)
Sclerotic	6 (15)
Length of tympanic segment	
7.5 cm–8.5 mm	7 (17.5)
8.6 cm–9.5 mm	17 (42.5)
9.6 cm–10.5 mm	9 (22.5)
10.6 cm–11.5 mm	6 (15.0)
>11.5 mm	1 (2.5)
Length of vertical segment	
<12 mm	3 (7.5)
12.1 cm–13.0 mm	7 (17.5)
13.1 cm–14.0 mm	15 (37.5)
14.1 cm–15.0 mm	10 (25.0)
15.1 cm–16.0 mm	5 (12.5)
Distance of the second genu from the outer cortex	
17.5 cm–18.5 mm	7 (17.5)
18.6 cm–19.5 mm	12 (30.0)
19.6 cm–20.5 mm	11 (27.5)
20.6 cm–21.5 mm	5 (12.5)
21.6 cm–22.5 mm	3 (7.5)
22.6 cm–23.5 mm	1 (2.5)
>23.5 mm	1 (2.5)
Distance of chorda tympani from stylomastoid foramen	
3.1 cm–4.0 mm	6 (15.0)
4.1 cm–5.0 mm	11 (27.5
5.1 cm–6.0 mm	7 (17.5)
6.1 cm–7.0 mm	7 (17.5)
7.1 cm–8.0 mm	9 (22.5)

The distance of chorda tympani from stylomastoid foramen varied from 3.2 to 7.6 mm with a mean of 5.54 mm (±1.41 mm). In maximum cases (27.5% of bones), the distance of chorda tympani from stylomastoid foramen was 4.1–5.0 mm followed by 7.1–8.0 mm in 22.5% of bones. In minimum cases (15.0% of bones), distance of chorda tympani was 3.1–4.0 mm.

In Table 2, the length of the facial nerve segment of the present study was compared with the Japanese and American population. In the present study, the mean length of the tympanic and mastoid segments was found to be 9.32±1.02 mm (range 7.65–11.72 mm) and 13.48 mm±1.21 (range 10.2–15.9 mm), respectively, which is considerably at variance to Japanese and American studies.

DISCUSSION

Facial expressions are a very important means of social communication among people which is controlled by the facial nerves. The facial nerve has more length and tortuosity in its intraosseous course through the temporal bone in comparison to other nerves. Middle ear diseases (congenital, pathological, etc.) may lead to paralysis of the facial nerve. Due to the advancement in technology, interest among ENT surgeons regarding the study of middle ear anatomy with the help of a microscope has evolved. Bibas *et al*. [3] observed that knowledge of the developmental anatomy of the middle ear helps in understanding unaware aspects of adult structures of the human ear and temporal bone. The bony architecture of temporal bone and neurovascular structures such as facial nerve in and around it make it challenging for ENT surgeons to perform successful surgery. This difficulty partly may be reduced by pre-operative radiological evaluation of the middle ear and partly by the knowledge of temporal bone relations with in and around neurovascular structures. With this knowledge, iatrogenic injury to the facial nerve can be prevented.

In the present study, the majority of bones (85%) were pneumatized whereas only 15% were sclerotic in nature. Jatale *et al*. [4] also showed similar results to the present study. A high degree of pneumatization makes dissection easier but may develop pneumatocele due to the thinness of bones whereas poor pneumatization makes the dissection slower resulting in less injury to underlying structures.

Table 2: Length of facial nerve segment of Japanese, American, and Indian subjects

Race	Tympanic segment (mm)		Mastoid segment (mm)	
	Maximum	Minimum	Maximum	Minimum
Japanese (Kudo and Novi, 1970)	15.6	8.67	15.7	11.8
American (Rulon and Hallberg, 1962)	11	8.0	14.0	9.0
Indian (present study)	11.72	7.65	15.9	10.2

Tympanic segment length varied from 7.65 to 11.72 mm with a mean of 9.32 mm (±1.02 mm). In maximum cases (42.5% of bones), the length of the tympanic segment was 8.6–9.5 mm followed by 9.6–10.5 cm in 22.5% of bones. The minimum length of the tympanic segment (7.5–8.5 cm) was noted in 17.5% of cases. Similar observations were also seen in studies done by Kharat *et al*. [1] and Proctor [5]. The tympanic segment of the facial nerve lies above the oval window and is turned posterior from the geniculate ganglion in all cases in the present study. Similar results were observed by various authors such as Kharat *et al*. [1], Proctor [5], and Jatale *et al*. [4].

The length of the mastoid segment varied from 10.2 mm to 15.9 mm with a mean length of 13.48 mm (±1.21 mm). In maximum cases (37.5% of bones), the length of the vertical segment was 13.1–14.0 mm followed by 14.1–15.0 mm in 25.0% of bones. In minimum cases (7.5% of bones), tympanic segment length was <12.0 cm. A study done by Kharat *et al*. [1] and Proctor [5] observed results similar to the present study.

In all cases, the degree of descent was noted as 30° which is similar to a study done by Yadav *et al*., [6] and Bibas *et al*. [3] while the result of the present study is in contrast with the study done by Proctor where degree of descent was noted 37° in cases.

Out of 40 temporal bone dissections in the present study, dehiscence was found in 5% of bones in the tympanic segment. The incidence of dehiscence in the present study is low as compared to studies done by Beddard and Saunders [7], Hough [8], and Guild [9] where dehiscence was reported in the range of 8–70% but similar to studies done by Kharat *et al*. [1] and Yadav *et al*. [6] During middle ear surgery, dehiscence of the bony facial canal in the tympanic segment poses a risk of immediate or delayed facial paralysis. A low incidence of dehiscence reduces the chances of facial paralysis during middle ear surgery.

The distance of the second genu from the outer cortex varied from 17.67 to 23.71 mm with a mean of 19.73 mm (±1.44 mm). In maximum cases (30.0% of bones), the distance of the second genu from the outer cortex was 18.6–19.5 mm followed by 19.6–20.5 mm in 27.5% of bones. In minimum cases (2.5% of bones), the distance of the second genu from the outer cortex was 22.6–23.5 mm and >23.5 mm. The results of the present study coincide with the studies done by Jatale *et al*. [4] and Yadav *et al*. [6]

The distance of chorda tympani from stylomastoid foramen varied from 3.2 to 7.6 mm with a mean of 5.54 mm (±1.41 mm). In maximum cases (27.5% of bones), the distance of chorda tympani from stylomastoid foramen was 4.1–5.0 mm followed by 7.1–8.0 mm in 22.5% of bones. In minimum cases (15.0% of bones), distance of chorda tympani was 3.1–4.0 mm. Similar results were observed by Nager and Proctor [10].

Chorda tympani is used as a landmark for the identification of facial nerve in the mastoid. The facial nerve can be traced by tracing chorda tympani inferiorly to its origin.

Wetmore [11] and Hohman *et al*. [12] observed that chorda tympani can be used as a landmark to identify the facial nerve during middle ear surgery in the mastoid by tracing it inferiorly to its origin. Fowler [13] and Măru *et al*. [14] observed that the facial nerve was in a more lateral position than usual in their study. Therefore, ENT surgeons should be aware of it to avoid facial nerve injury during middle ear surgery.

CONCLUSION

The facial nerve has various anatomical variations of the facial nerve in the bony canal making it prone to injury during mastoid surgeries. Anatomical knowledge of the facial nerve in the canal and its relation to surrounding structures is very helpful for ENT surgeons to avoid injury to it during middle ear surgeries.

AUTHOR'S CONTRIBUTION

All four authors contributed equally to conceptualizing the research proposal, literature review, data collection and analysis, and manuscript writing.

CONFLICTS OF INTEREST

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