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Original Research Article

Anatomical Variations of Facial Nerve Within The Parotid Gland

Sagar Nerpagar[1], Rabiya Amin[2], Bharat Panjabrao Thakre[3], Ujwala Bhanarkar[4]

[1]Associate Professor, Department of Anatomy, Parbhani Medical College RP Hospital and Research Institute, Parbhani, Maharashtra, India

[2]Assistant Professor, Department of Anatomy, Al Falah School of Medical Science and Research Centre, Faridabad, Haryana, India

[3]Associate Professor, Department of Anatomy, N K P S I M S and R C and L M H Nagpur, Maharashtra, India

[4]Associate Professor, Department of Anatomy, All India Institute of Medical Sciences, Kalyani, West Bengal, India

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Corresponding Author: Dr. Bharat Panjabrao Thakre
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Abstract:

Background: The facial nerve exhibits considerable anatomical variability within the parotid gland, posing challenges during parotid and maxillofacial surgeries. Detailed knowledge of its branching patterns is essential to reduce the risk of inadvertent nerve injury and associated functional deficits.

Material and Methods: A descriptive cross-sectional cadaveric study was conducted on 60 hemifaces obtained from 30 embalmed adult cadavers. The facial nerve was identified at its exit from the stylomastoid foramen and traced through the parotid gland. Branching patterns were classified according to the Davis classification. The length of the main facial nerve trunk, patterns of division, interbranch communications, terminal branch variations, and side-wise differences were recorded and analyzed.

Results: Type II Davis branching pattern was the most common, observed in 15 (25.0%) specimens, followed by Type III in 12 (20.0%) and Type V in 11 (18.3%). The mean length of the facial nerve trunk before bifurcation was 16.8 ± 4.2 mm. Classical bifurcation into temporofacial and cervicofacial divisions was present in 49 (81.7%) specimens, while trifurcation and multiple primary divisions were observed in 8 (13.3%) and 3 (5.0%) specimens, respectively. Communicating branches between major divisions were identified in 46 (76.7%) specimens. The typical five-terminal-branch pattern was noted in 38 (63.3%) specimens, whereas accessory buccal branches represented the most frequent variation, occurring in 12 (20.0%) specimens. No statistically significant side-wise differences were observed ($p > 0.05$).

Conclusion: Significant variations exist in the intraparotid branching pattern of the facial nerve. Awareness of these anatomical variations is crucial for surgeons performing procedures in the parotid region to facilitate nerve preservation and minimize postoperative complications.

Keywords: Facial nerve; Parotid gland; Anatomical variation; Davis classification; Cadaveric study; Branching pattern.

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Introduction

The facial nerve is the seventh cranial nerve and is primarily responsible for motor innervation of the muscles of facial expression. After emerging from the stylomastoid foramen, the nerve enters the parotid gland and divides into a complex network of branches that ultimately form the temporal, zygomatic, buccal, marginal mandibular, and cervical branches. The intraparotid course of the facial nerve is characterized by considerable anatomical variability, making it one of the most important structures encountered during surgical procedures involving the parotid region [1,2].

Preservation of the facial nerve remains a major objective during parotidectomy and other surgical interventions in the parotid and maxillofacial regions. Variations in the branching pattern, interbranch communications, and terminal arborization may increase the risk of inadvertent nerve injury, potentially resulting in functional and cosmetic deficits. Consequently, a thorough understanding of the anatomical arrangement of the facial nerve is essential for safe surgical dissection and successful postoperative outcomes [3,4].

Several classification systems have been proposed to describe the branching patterns of the facial nerve within the parotid gland. Studies conducted in different populations have demonstrated substantial differences in the frequency and distribution of these patterns, suggesting the existence of population-specific anatomical variations. Cadaveric investigations continue to provide valuable information regarding these variations and contribute to improved surgical planning and anatomical education [2,5].

Recent studies have reaffirmed that communicating branches between the major divisions of the facial nerve are common findings and that the intraparotid branching architecture often exhibits considerable complexity. Furthermore, systematic analyses of extratemporal facial nerve anatomy have highlighted the wide spectrum of branching arrangements encountered across different populations, emphasizing the need for continued anatomical research [5,6].

Given the clinical significance of facial nerve preservation and the documented variability in its intraparotid branching pattern, the present study was undertaken to evaluate the anatomical variations of the facial nerve within the parotid gland in cadaveric specimens. Particular emphasis was placed on the pattern of division, branching configuration, communicating branches, and terminal distribution of the nerve.

Materials and Methods

Study Design and Setting: A descriptive cross-sectional cadaveric study was conducted in the at a tertiary care teaching institution. All procedures were performed in accordance with institutional guidelines governing the use of human cadaveric specimens for anatomical research.

Study Sample: The study included 60 embalmed adult human hemifaces obtained from 30 formalin-fixed cadavers of both sexes. Cadavers exhibiting evidence of facial trauma, previous surgical intervention in the parotid region, congenital craniofacial anomalies, or significant tissue distortion were excluded from the study.

Dissection Procedure: Each specimen was placed in the supine position with slight extension of the neck. A standard preauricular and cervical incision was made, and the skin and superficial fascia were carefully reflected. The parotid gland was exposed by meticulous dissection, preserving the underlying neurovascular structures.

The main trunk of the facial nerve was identified at its emergence from the stylomastoid foramen using established anatomical landmarks, including the tragal pointer, posterior belly of the digastric muscle, and tympanomastoid suture. The facial nerve was traced distally through the substance of the parotid gland, and all major divisions and interconnecting branches were carefully dissected and documented.

Parameters Studied: The following anatomical characteristics were evaluated-

1. Pattern of division of the facial nerve within the parotid gland.
2. Length of the facial nerve trunk before bifurcation.
3. Type of branching pattern according to Davis classification.
4. Presence and frequency of communicating branches between major divisions.
5. Variations in the origin and course of terminal branches.
6. Side-wise distribution of observed anatomical variations.

Documentation: Digital photographs were obtained for all specimens using a high-resolution camera. Measurements of the facial nerve trunk were recorded using a digital Vernier caliper with an accuracy of 0.01 mm. Each specimen was assigned a unique identification number to ensure systematic data recording.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using SPSS software version 26.0. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Differences between right and left sides were evaluated using the Chi-square test or Fisher's exact test as appropriate. A p-value of less than 0.05 was considered statistically significant.

Results

The branching pattern of the facial nerve was classified according to the Davis classification system. Type II branching pattern was the most frequently encountered variation, observed in 15 specimens (25.0%), followed by Type III in 12 specimens (20.0%) and Type V in 11 specimens (18.3%). Type IV and Type I patterns were identified in 10 (16.7%) and 8 (13.3%) specimens, respectively. Type VI, representing the plexiform arrangement, was the least common pattern and was observed in 4 specimens (6.7%) (Table 1, Figure 1).

Morphometric assessment revealed that the length of the main facial nerve trunk before bifurcation ranged from 9.4 mm to 27.1 mm. The mean trunk length was 16.8 ± 4.2 mm, with a median value of 16.2 mm (Table 2).

Regarding the pattern of division within the parotid gland, the classical bifurcation into temporofacial and cervicofacial divisions was the predominant finding, occurring in 49 specimens (81.7%). Trifurcation of the facial nerve trunk was identified in 8 specimens (13.3%), whereas multiple primary divisions involving more than three major branches were observed in 3 specimens (5.0%) (Figure 2).

Communicating branches between major divisions of the facial nerve were present in 46 specimens (76.7%), while 14 specimens (23.3%) demonstrated no interbranch communication. Thus, anastomotic connections within the intraparotid facial nerve network were found to be a common anatomical feature in the studied population (Table 3).

Analysis of terminal branching patterns demonstrated the typical arrangement of five terminal branches in 38 specimens (63.3%). Variations were identified in the remaining specimens. Accessory buccal branches were observed in 12 specimens (20.0%), representing the most common variation. Double marginal mandibular branches were noted in 6 specimens (10.0%), while accessory zygomatic branches were present in 3 specimens (5.0%). Absence of a distinct cervical branch was observed in 1 specimen (1.7%) (Table 4).

Side-wise comparison of major anatomical variations revealed trifurcation or multiple primary divisions in 6 right-sided specimens (20.0%) and 5 left-sided specimens (16.7%). Communicating branches were present in 24 right-sided specimens (80.0%) and 22 left-sided specimens (73.3%). Accessory terminal branches were identified in 11 right-sided specimens (36.7%) and 10 left-sided specimens (33.3%). Statistical analysis demonstrated no significant differences between the right and left sides for any of the assessed variables ($p > 0.05$) (Table 5).

Table 1: Distribution of Facial Nerve Branching Patterns According to Davis Classification (n = 60 Hemifaces)

Davis Type	Description	Frequency (n)	Percentage (%)
Type I	Straight pattern without significant anastomosis	8	13.3
Type II	Single communication between branches	15	25.0
Type III	Loop formation between major branches	12	20.0
Type IV	Complex loop pattern	10	16.7
Type V	Multiple communicating branches	11	18.3
Type VI	Plexiform arrangement	4	6.7
Total		**60**	**100.0**

Table 2: Length of Main Facial Nerve Trunk Before Bifurcation (n = 60)

Parameter	Value
Mean ± SD (mm)	16.8 ± 4.2
Minimum (mm)	9.4
Maximum (mm)	27.1
Median (mm)	16.2

Table 3: Presence of Communicating Branches Between Major Divisions (n = 60)

Finding	Frequency (n)	Percentage (%)
Communicating branches present	46	76.7
Communicating branches absent	14	23.3
Total	**60**	**100.0**

Table 4: Variations in Terminal Branching Pattern (n = 60)

Variation Observed	Frequency (n)	Percentage (%)
Typical five terminal branches	38	63.3
Accessory buccal branch	12	20.0
Double marginal mandibular branch	6	10.0
Accessory zygomatic branch	3	5.0
Absence of distinct cervical branch	1	1.7
Total	**60**	**100.0**

Table 5: Side-wise Distribution of Major Anatomical Variations

Variable	Right Side (n=30)	Left Side (n=30)	p-value
Trifurcation or multiple divisions	6 (20.0%)	5 (16.7%)	0.739
Communicating branches present	24 (80.0%)	22 (73.3%)	0.542
Accessory terminal branches	11 (36.7%)	10 (33.3%)	0.787

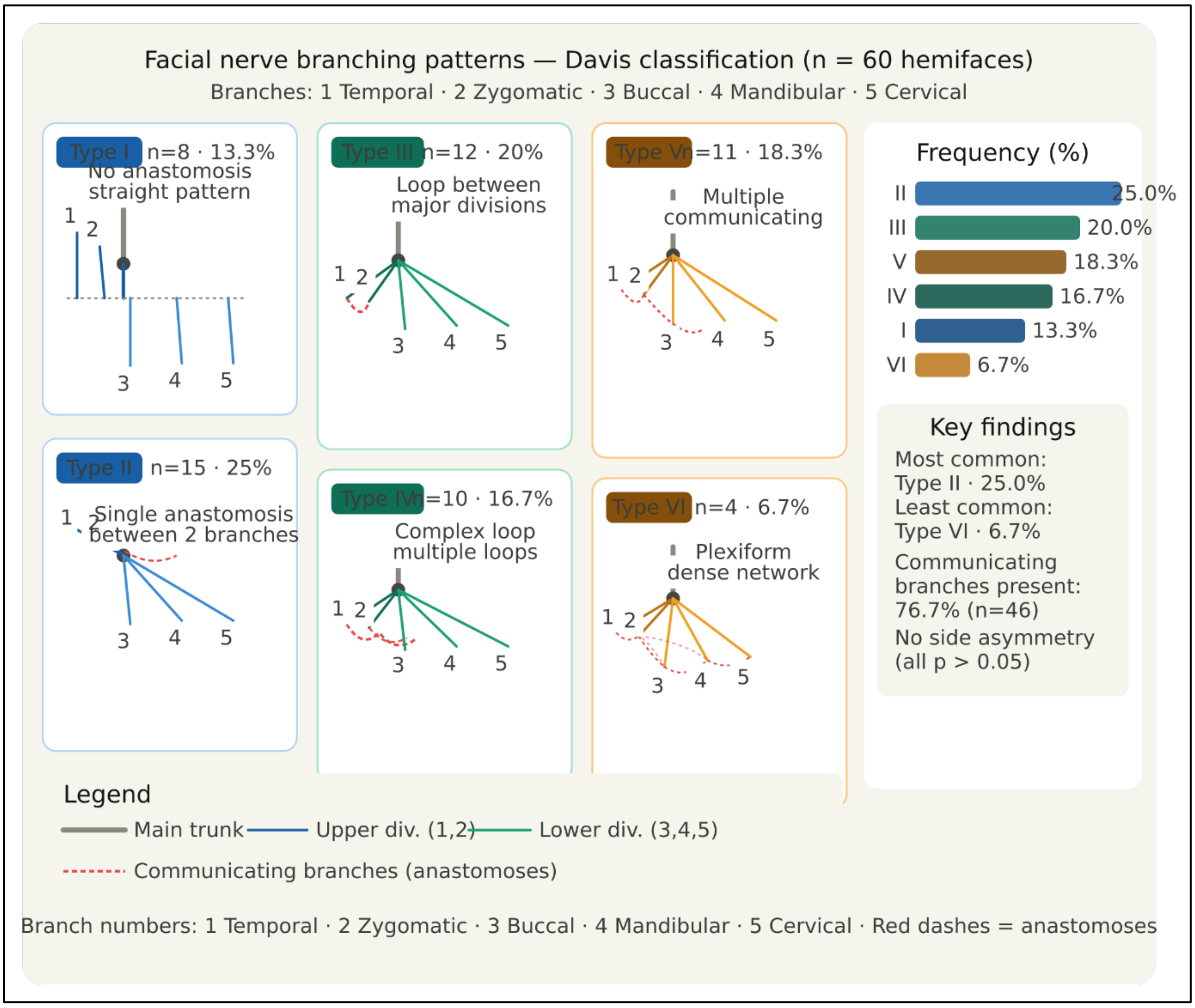

Figure 1: Facial Nerve Branching Patterns observed in our study

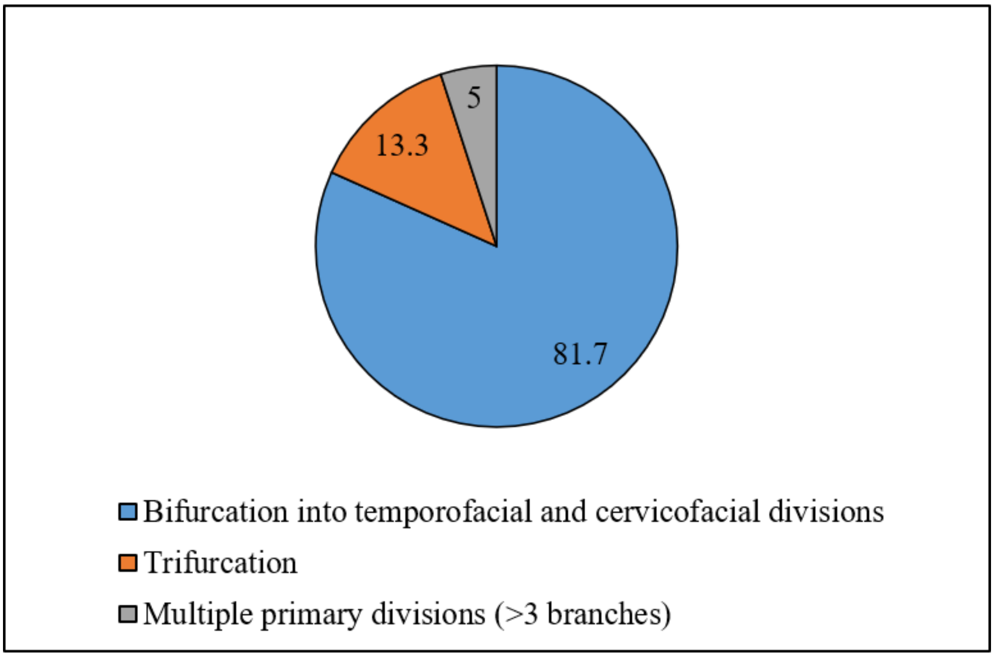

Figure 1: Pattern of Division of Facial Nerve Within the Parotid Gland (n = 60)

Discussion

The present cadaveric study demonstrated considerable variability in the intraparotid branching pattern of the facial nerve. Although the classical bifurcation into temporofacial and cervicofacial divisions was the predominant arrangement, trifurcation, multiple primary divisions, and extensive communicating branches were also observed. These findings reinforce the concept that the facial nerve within the parotid gland possesses a highly variable architecture that must be carefully anticipated during surgical dissection.

In our study, Type II Davis branching pattern was the most common configuration, followed by Types III and V. Similar observations have been reported in recent cadaveric investigations, where Type II and Type III patterns frequently predominated among intraparotid facial nerve arrangements [7,8]. The relatively lower frequency of the plexiform Type VI pattern in the present series is also consistent with previous anatomical reports, suggesting that although complex plexiform branching exists, it is less commonly encountered in routine surgical anatomy [9].

The mean facial nerve trunk length before bifurcation in the present study was 16.8 ± 4.2 mm. This value falls within the range documented in contemporary morphometric studies, which have reported considerable individual variability in trunk length and emphasized its relevance during identification of the nerve at surgery [10,11]. Shorter trunks may lead to early branching within the gland, increasing the difficulty of nerve preservation during superficial or total parotidectomy.

The classical bifurcation pattern was observed in 81.7% of specimens, whereas trifurcation and multiple primary divisions were less frequent. Comparable frequencies have been described in recent anatomical studies, although the exact distribution varies across populations [8,12]. Such differences may reflect ethnic or regional anatomical diversity, differences in classification criteria, or methodological variations in cadaveric dissection.

A notable finding in the present study was the high prevalence of communicating branches between major divisions of the facial nerve. Anastomotic communications were identified in more than three-fourths of specimens, supporting the view that interbranch connections are a common and functionally important component of facial nerve anatomy. Recent studies have similarly highlighted the frequent occurrence of communicating loops and complex neural interconnections within the parotid gland [9,13]. These communications may partially explain the variability in clinical deficits observed after partial nerve injury.

Variations in terminal branching were also common, particularly the presence of accessory buccal branches and duplicated marginal mandibular branches. Accessory buccal branches represented the most frequent variation in our material. Similar patterns have been reported in recent cadaveric analyses, where buccal and marginal mandibular branches showed the greatest variability in number and course [7,14]. Such variations are clinically important because these branches are particularly vulnerable during facelift procedures, submandibular surgery, and parotid operations.

No significant side-wise differences were identified in the present study. This finding agrees with previous reports that failed to demonstrate consistent right-left asymmetry in facial nerve branching patterns [11,14]. Nevertheless, occasional unilateral variations can still pose intraoperative challenges, emphasizing the need for meticulous nerve identification on both sides.

The clinical implications of these findings are substantial. Detailed knowledge of intraparotid facial nerve anatomy can aid surgeons in selecting safer dissection planes, anticipating aberrant branches, and reducing the incidence of postoperative facial weakness. In addition, these anatomical data may contribute to improved teaching models and preoperative planning strategies.

Conclusion

The present cadaveric study demonstrates considerable anatomical variability in the intraparotid branching pattern of the facial nerve. Although the classical bifurcation into temporofacial and cervicofacial divisions was the most common arrangement, numerous variations were observed, including trifurcation, complex branching patterns, accessory terminal branches, and extensive interbranch communications. Type II Davis classification was the predominant pattern, while communicating branches were present in the majority of specimens. These findings highlight the intricate anatomy of the facial nerve within the parotid gland and underscore the importance of thorough anatomical knowledge during parotid, maxillofacial, and reconstructive surgical procedures to minimize the risk of iatrogenic facial nerve injury and improve surgical outcomes.

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