Extratemporal Facial Nerve Branching Patterns: Surgical Anatomy and Clinical Relevance

Padrões de ramificação do nervo facial extratemporal: Anatomia cirúrgica e relevância clínica

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Abstract

Background In facial plastic and reconstructive surgery, precise identification of the extratemporal facial nerve is critical to prevent iatrogenic injury. Surgical landmarks such as the tragal pointer, posterior belly of the digastric muscle, tympanomastoid suture, and retromandibular vein are commonly used to locate the facial nerve trunk. However, anatomical variations in branching patterns increase operative complexity.
Objective To evaluate the branching pattern and topographic relationships of the extratemporal facial nerve with clinically relevant surgical landmarks.
Methods The extratemporal segment of the facial nerve was dissected in 50 sides from 25 adult cadavers of both sexes (M: 21; F: 4) during routine dissections performed between 2016 and 2022. Length of the main trunk, division pattern within the parotid gland, relationship to the retromandibular vein, and interbranch communications were documented.
Results A single facial nerve trunk was observed at the stylomastoid foramen in all specimens. The trunk length ranged from 1.8 cm to 2.2 cm. In all cases, the nerve divided into temporofacial and cervicofacial divisions within the parotid gland. The facial nerve was located lateral to the retromandibular vein in 96% of sides. Multiple patterns of interbranch communications were identified, indicating anatomical variability relevant to surgical dissection planes.
Conclusion Knowledge of extratemporal facial nerve variations and its connection to operative landmarks is essential for improving surgical safety in parotidectomy, facial reconstruction, rhytidectomy, and aesthetic facial procedures. These findings support preoperative planning and careful intraoperative dissection to minimize nerve injury.

Keywords
- facial nerve
- surgical anatomy
- parotid gland
- facial nerve injuries
- parotidectomy
- anatomical variation

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Resumo

Introdução Na cirurgia plástica facial e reconstrutiva, a identificação precisa do nervo facial extratemporal é fundamental para prevenir lesões iatrogênicas. Marcos anatômicos cirúrgicos como o ponteiro trágico, o ventre posterior do músculo digástrico, a sutura timpanomastoidea e a veia retromandibular são amplamente utilizados para localizar o tronco principal do nervo facial. Entretanto, variações anatômicas podem aumentar a complexidade cirúrgica.

Objetivo Avaliar o padrão de ramificação e as relações topográficas do nervo facial extratemporal com marcos anatômicos de importância cirúrgica.

Métodos O segmento extratemporal do nervo facial foi dissecado em 50 lados de 25 cadáveres adultos de ambos os sexos (M: 21; F: 4), durante dissecações de rotina realizadas entre 2016 e 2022. Foram analisados o comprimento do tronco principal, o padrão de divisão na glândula parótida, a relação com a veia retromandibular e as comunicações entre os ramos terminais.

Resultados Observou-se um único tronco do nervo facial na saída pelo forame estilomastoideo em todos os casos. O comprimento do tronco variou entre 1,8 cm e 2,2 cm. Em todas as dissecações, o nervo dividiu-se em ramos temporofacial e cervicofacial. O nervo facial localizou-se lateralmente à veia retromandibular em 96% dos lados. Foram identificados diferentes padrões de comunicações entre os ramos terminais.

Conclusão O conhecimento das variações anatômicas do nervo facial extratemporal e de sua relação com marcos cirúrgicos é essencial para aumentar a segurança em parotidectomias, cirurgias reconstrutivas faciais, ritidoplastias e procedimentos estéticos.

Palavras-chave

- nervo facial
- anatomia cirúrgica
- glândula parótida
- lesões do nervo facial
- parotidectomia
- variação anatômica

Introduction

The facial nerve, which is the seventh cranial nerve, is at risk during facial plastic, reconstructive, and parotid surgeries. It has six segments: intracranial, meatal, labyrinthine, tympanic, mastoid and extratemporal. The extratemporal frees up the posterior auricular nerve and then innervates facial muscles through its terminal branches and is responsible for facial expression. The trunk of the facial nerve, which emerges from stylomastoid foramen, runs for 1 cm and then enters the posteromedial surface of the parotid gland, where it usually bifurcates into upper temporofacial and lower cervicofacial divisions. Both divisions give rise to five terminal branches: temporal, zygomatic, buccal, marginal mandibular, and cervical,[1] which are frequently encountered during procedures such as parotidectomy, rhytidectomy, facial reconstruction, and cosmetic surgery.

Preserving these branches is essential to avoid postoperative facial paralysis and functional deficits. The branching of FN was first described by Davis et al, who described six types of facial nerve branching patterns (I, II, III, IV, V, and VI) based on the presence or absence of communications between its divisions and terminal branches.[2] Another classification was described by Katz et al, with nine types of branching patterns (IA, IB, II, IIIA, IIIB, IIIC, IVA, IVB, and V) based on the number of trunks of facial nerve, the origin of the buccal branch, and communications between terminal branches.[3] A new classification with three additional "double-trunk" types (VA, VB, and VC) was proposed by Kopuz et al.[4] Several anatomical landmarks commonly used in plastic and head-and-neck surgery—including the stylomastoid foramen, posterior belly of the digastric muscle, tragal pointer, tympanomastoid suture, and retromandibular vein—serve as guides for identifying the facial nerve trunk intraoperatively. However, anatomical variations in branching patterns and interbranch communications increase the complexity of surgical dissection.

Methods

During routine educational dissections conducted between 2016 and 2022 in the Department of Anatomy, the extratemporal segment of the facial nerve was examined in 50 sides from 25 adult cadavers of both sexes (M: 21; F: 4). All cadavers had been embalmed using a 10% formaldehyde solution.

A preauricular surgical incision was employed, extending posteriorly behind the ear lobe over the mastoid process and inferiorly along the mandibular border, simulating operative exposure used in parotid and facial surgeries. The skin, subcutaneous tissue, and superficial fascia were carefully reflected to expose the parotid gland. The main trunk of the facial nerve was identified at the stylomastoid foramen using deep anatomical landmarks and traced through the gland to its terminal branching pattern.

The facial nerve trunk was followed meticulously along its intraparotid course, and its terminal branches were

dissected and documented. All findings were recorded and photographed.

The study protocol included assessment of:

1. Number of facial nerve trunks emerging from the stylomastoid foramen.
2. Length of the main trunk from stylomastoid foramen to its intraparotid divisions.
3. Pattern of intraparotid divisions.
4. Relationship of the facial nerve to the retromandibular vein.
5. Terminal branching and interbranch communications based on Davis classification.[2]

Results

Number of Facial Nerve Trunks Exiting the Stylomastoid Foramen

In the present study, in all the dissections of 25 adult cadavers, there was only one trunk of facial nerve at the stylomastoid foramen. No double or triple trunks of facial nerve exiting through the stylomastoid foramen were observed in the present study.

Length of the Facial Nerve Trunk

In this study, length of the main trunk of facial nerve from stylomastoid foramen to its bifurcation point in the parotid gland ranged from 1.8 cm to 2.22 cm. The mean length was 1.9 cm and the SD for the mean length was 1.18 cm.

Number of Divisions of Facial Nerve Inside the Parotid Gland

The main trunk of the facial nerve on entering the parotid gland divided into upper temporofacial and lower cervicofacial divisions in all fifty sides. No other variations of divisions were observed in the present study.

Relation of Facial Nerve to Retromandibular Vein

The facial nerve was present lateral to the retromandibular vein in 96% of sides. In 4% of cases, facial nerve branches were found both lateral and medial to retromandibular vein.

Terminal Branches of Facial Nerve and Its Communications

The five branches—namely the temporal, zygomatic, buccal, marginal mandibular, and cervical—arose from the two divisions of the facial nerve in all sides. The temporal and zygomatic branches originated from the temporofacial division and marginal mandibular and cervical branches originated from the cervicofacial division in all specimens. The buccal branch of facial nerve arose from both divisions in 20 sides (►**Fig. 1**).

Communications of facial nerve were classified according to Davis et al:[2]

Type I: In seven sides (14%), there was no major communication between the divisions and branches of facial nerve (►**Fig. 2**).

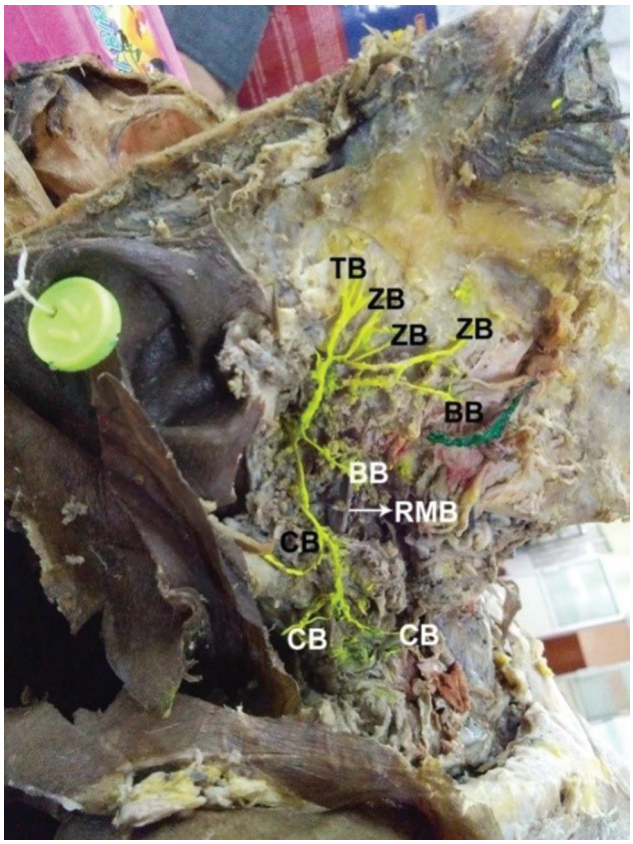


Fig. 1 Buccal branch arising from two divisions of facial nerve.

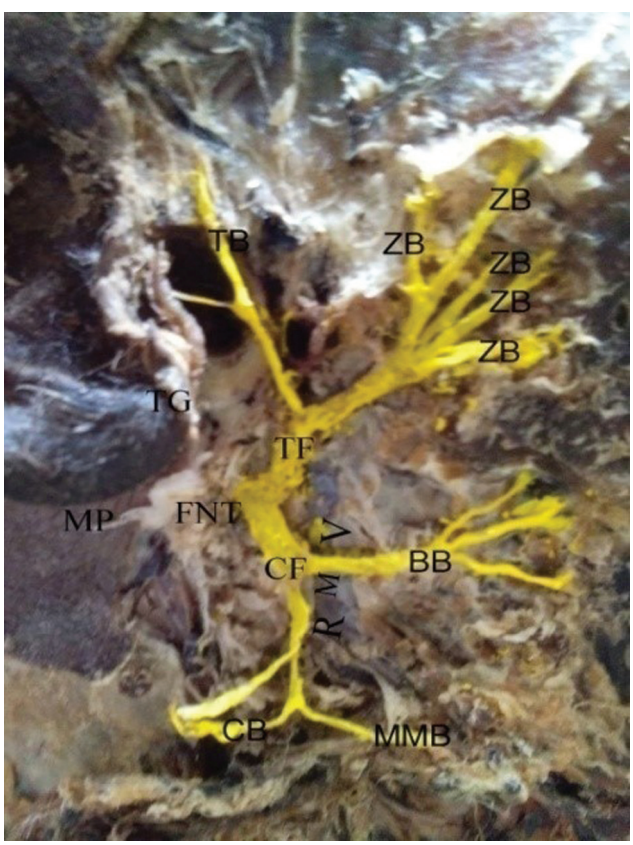


Fig. 2 Type I branching pattern of Davis et al.

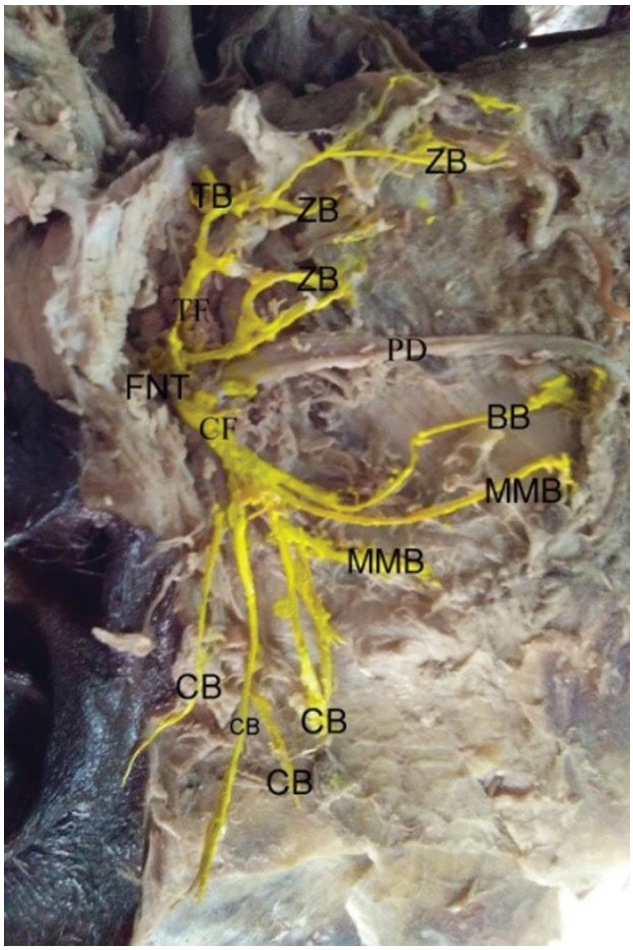


Fig. 3 Type II branching pattern of Davis et al.



Fig. 4 Type III branching pattern of Davis et al.

Type II: In nine sides (18%), communications between the branches of temporofacial divisions were observed (►**Fig. 3**).

Type III: In 14 sides (28%), a single communication between the temporofacial and cervicofacial divisions was observed (►**Fig. 4**).

Type IV: In 12 sides (24%), a single communication between the temporofacial and cervicofacial divisions and communications among the temporofacial branches were observed (►**Fig. 5**).

Type V: In four sides (8%), double communications between the temporofacial and cervicofacial divisions were observed.

Type VI: In four sides (8%), complex communications between the branches of facial nerve were observed (►**Fig. 6**).

Discussion

A single facial nerve trunk exiting through the stylomastoid foramen has been described in the standard textbooks and in the previous literature.[2,5] Some authors have described that two facial nerve trunks exit from the stylomastoid foramen.[6,7] The presence of a single facial nerve trunk emerging from the stylomastoid foramen corresponds with classical anatomical descriptions and is consistent with previous studies. However, reports of multiple trunks emphasize the importance of cautious identification during surgical exposure. The mean distance between the emerging point of the facial nerve trunk from the stylomastoid foramen and its bifurcation point was 14.38 ± 3.04 mm according to Pascual et al.[8] The measured trunk length in this study provides practical guidance for surgeons during deep parotid dissection, as excessive traction or blind dissection within this short segment increases the risk of nerve injury. Touré and Vacher classified the connection of the facial nerve to retromandibular vein in the parotid gland into six types, the most common type being that in which the facial nerve is lateral to retromandibular vein in 65.2% (Type I) of cases and medial to vein in 28% (Type II) of cases.[9]

Cruveilhier early on described six terminal branches, and Hovelacque later described eight terminal branches of facial nerve.[10,11] Davis et al simplified these earlier classifications of terminal branches of facial nerve and described five terminal branches of the facial nerve.[2]

Earlier classifications of communications among terminal branches of facial nerve were proposed by McCormack et al, Dargent and Duroux, and Pons-Tortella.[12–14] Then, Davis et al in 1956 described a six-type classification based on the connections between the terminal branches.[2]

Type 1 (13%): No major communications between branches of facial nerve.

Type II (20%): Communications between the branches of temporofacial division only.

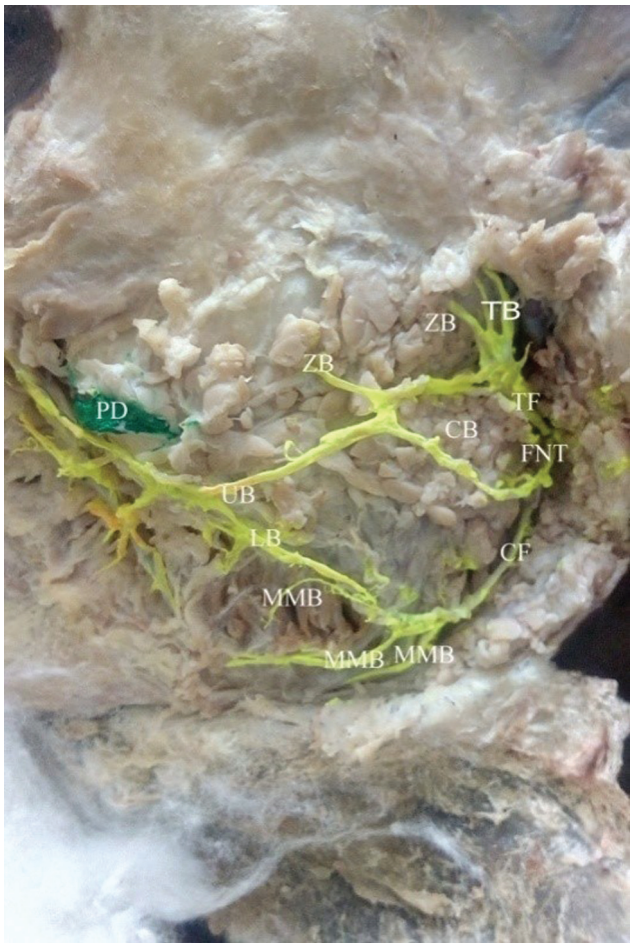


Fig. 5 Type IV branching pattern of Davis et al.

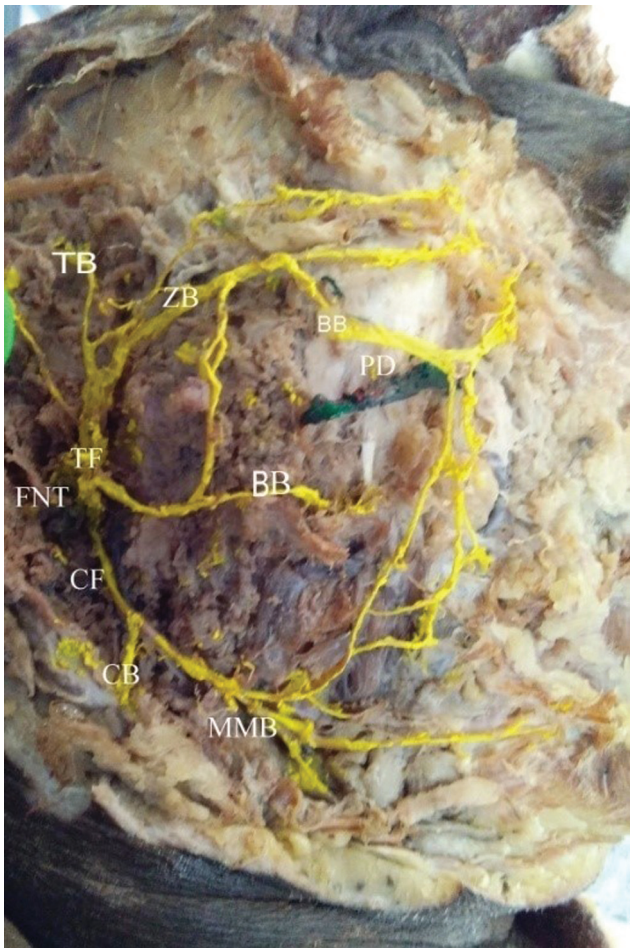


Fig. 6 Type VI branching pattern of Davis et al.
Abbreviations: BB, buccal branch; CB, cervical branch; CF, cervicofacial division; FNT, facial nerve trunk; MMB, marginal mandibular branch; MP, mastoid process; PD, parotid duct; RMV, retro mandibular vein; TB, temporal branch; TF, temporofacial division; TG, tragus; ZB, zygomatic branch.

Type III (28%): Single communication between temporofacial and cervicofacial divisions.
Type IV (24%): Communications between branches of temporofacial division and also between temporofacial and cervicofacial divisions.
Type V (9%): Double communications between temporofacial and cervicofacial divisions.
Type VI (6%): Complex plexiform communications between the terminal branches.

Katz and Catalano proposed a new classification of communications based on the origin of buccal nerve and the number of trunks of the facial nerve.[3] A newer classification of communications of facial nerve into 12 types has been described by Pascual et al.[8] It is well known that connections are more commonly found in the temporofacial division than in the cervicofacial division.[2,14] The observed communication patterns between branches highlight the complexity of intraparotid facial nerve anatomy. Such plexiform arrangements can obscure clear branch identification and increase the likelihood of inadvertent injury during facial lifting, parotidectomy, and reconstructive procedures.

Conclusion

Several variations in the branching pattern of facial nerve may increase the probability of a facial palsy after surgery if the surgeon is not aware of these anatomical variations.[15] Variations in extratemporal facial nerve branching patterns and intraparotid communications significantly influence surgical safety. Detailed knowledge of these anatomical relationships and operative landmarks is essential to minimize postoperative facial nerve palsy during facial plastic surgery, parotid surgery, and reconstructive interventions.

Data Availability Statement

Data will be available upon request to the corresponding author.

Authors' Contributions

CR: Data acquisition, writing of the final version of the manuscript; SKR: Drafting and revision of the manuscript.

Ethical Approval

This study was approved by the Institutional Ethics Committee.

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Conflict of Interests

The authors have no conflict of interests to declare.

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