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An Atypical Anatomical Variation in Facial Nerve Position: Temporal Branch Lateral and Main Trunk Medial to the Retromandibular Vein in a Series of Three Cadaveric Cases With Clinical Implications

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Keywords: anatomical variation | cadaveric case | facial nerve | retromandibular vein | temporal branch

ABSTRACT

Objectives: The position of the retromandibular vein relative to the facial nerve branches can vary among individuals, adding a layer of complexity to surgical planning. In some cases, the vein may cross over or under certain nerve branches, necessitating meticulous dissection to avoid vascular or neural damage. Understanding these variations is critical for optimizing surgical outcomes, minimizing complications, and ensuring the preservation of both vascular and neural integrity.

Methods: During the routine dissection of the right hemi-faces of 49 human donor bodies preserved for educational use, an unusual anatomical relationship between the extratemporal facial nerve and the retromandibular vein was observed and recorded in three cases (6%). The facial skin flaps were retracted laterally, and the parotid gland was meticulously dissected to expose and examine the nerves and vessels. The retromandibular vein's pathway was traced to identify the main trunk and branches of the extratemporal facial nerve within the parotid gland. The dissection also included the auriculotemporal nerve and the superficial temporal artery.

Results: In all three cases, a single facial nerve trunk was identified, with its branching pattern classified as Type V and VI according to Davis (1956) in two cases; in one of the cases, the trifurcation of the main trunk of the facial nerve was observed. The extratemporal facial nerve followed an atypical route, passing deep (medial) to the retromandibular vein, while its temporal branch ran superficially (lateral) to the retromandibular vein.

Conclusions: The aforementioned atypical course of the temporal branch places the nerve at a greater risk of injury during the surgical procedures. Recognizing and accounting for such variations is critical in minimizing complications and ensuring patient safety.

Level of Evidence: Level 4 (case-series).

1 | Introduction

The facial nerve (FN), or cranial nerve VII, is a mixed nerve with motor, sensory, special sense (taste) and parasympathetic components, playing a pivotal role in facial expression, taste, and glandular secretion. Originating in the brainstem, the nerve arises from the pons, where it comprises two distinct roots: the larger motor root and the smaller nervus intermedius (intermediate nerve of Wrisberg, 7b). These roots converge at the internal acoustic meatus, where the nerve enters the temporal bone.

Within the temporal bone, the FN follows a complex course, traversing the facial canal and forming the geniculate ganglion. After this intricate intratemporal pathway, the nerve exits the skull through the stylomastoid foramen, marking the beginning of its extracranial segment. This transition from the protected confines of the temporal bone to the more exposed extracranial environment underscores the vulnerability and clinical importance of this segment.

The extracranial portion of the FN is central to its motor functions. Upon emerging from the stylomastoid foramen, the nerve gives off its first extracranial branches: the posterior auricular nerve and motor branches to the posterior belly of the digastric and the stylohyoid muscles. The nerve then enters the parotid gland, where it undergoes a remarkable division into two primary trunks: the temporofacial (TFT) and cervicofacial (CFT) trunks. These trunks further branch into five key terminal branches—the temporal (TB), zygomatic (ZB), buccal (BB), marginal mandibular (MMB), and cervical (CB) branches—forming the characteristic radiating network known as the *pes anserinus*.

Within the parotid gland, these branches exhibit a precise anatomical organization. The TB ascends to supply the frontalis, orbicularis oculi, and corrugator supercilii muscles, facilitating movements of the forehead and eyelids. The ZB courses medially to innervate the orbicularis oculi and other periorbital muscles, contributing to eye closure and expressions of emotion. The BB extends anteriorly to control the buccinator, orbicularis oris, and other muscles of the upper lip and cheek, essential for articulation, mastication, and smiling. The MMB descends along the lower border of the mandible to innervate muscles of the lower lip, while the CB activates the platysma.

In 1956, Davis et al. [1] conducted a study on the anatomical variations of the FN, utilizing the largest number of cadavers reported to date. Since then, it has become evident that the so-called "classic" anatomy of the FN—characterized by branches that are isolated from one another, without fiber interchange or numerous anastomoses—is rarely observed.

The facial nerve branches lie within the 4th layer of the face, which corresponds to the loose areolar tissue (the gliding plane or the plane of dissection in deep plane facelift procedures). They travel within or just superficial to the deep fascia but remain deep to the superficial musculoaponeurotic system (SMAS) [2]. The SMAS (3rd layer) serves as a protective layer over the nerve branches, meaning that safe surgical dissection should stay either above the SMAS to avoid nerve injury or deep to the nerve plane when performing a deep plane facelift.

In close anatomical proximity to the extracranial FN lies the retromandibular vein (RMV), a key vascular structure in the parotid region. The RMV's anatomical course places it in close topographical relationship with the FN, particularly within the parotid gland. This intimate relationship is of considerable clinical significance, as the vein serves as an important landmark during parotid surgeries and other interventions in the region. The nerve and vein's shared anatomical space within the gland creates potential risks for iatrogenic injury to one structure while attempting to preserve the other.

Furthermore, the RMV's position relative to the facial nerve branches can vary among individuals, adding a layer of complexity to surgical planning. In some cases, the vein may cross over or under certain nerve branches, necessitating meticulous dissection to avoid vascular or neural damage. Understanding these variations is critical for optimizing surgical outcomes, minimizing complications, and ensuring the preservation of both vascular and neural integrity.

The facial nerve (FN) and the retromandibular vein (RMV) develop in close anatomical proximity during fetal growth, but their positional relationship varies significantly. The FN's full or partial variability in position according to the RMV is attributed to several factors in embryonic development. The FN arises from the second pharyngeal (hyoid) arch, while the venous system undergoes extensive remodeling. Differences in the timing of these developmental processes can influence their final arrangement. The parotid gland, which envelops portions of both structures, also plays a role in their shifting positions. Additionally, mesenchymal tissue remodeling and genetic factors contribute to individual anatomical differences [3].

The temporal branch of the facial nerve demonstrates a close anatomical relationship with the superficial temporal artery (STA) as it courses across the temporal region. Typically, the TB travels in a plane superficial to the deep temporal fascia, often intersecting or running parallel to the STA. This proximity is clinically significant, particularly in surgical procedures involving the temporal region, as inadvertent injury to the nerve can result in functional deficits of the facial muscles innervated by the TB.

The extracranial FN may emerge from the stylomastoid foramen as two trunks: the temporofacial trunk (TFT) and the cervicofacial trunk (CFT) [4–6]. Additionally, the main trunk of the FN may trifurcate [7]. The position of the FN, along with its divisions and branches in relation to the RMV, also varies. The RMV may lie either lateral (superficial) or medial (deep) to the FN and its components [8–10].

An important consideration for surgeons is the potential interconnections between the branches of the FN and the auriculotemporal nerve [11]. Awareness of these variations is crucial during surgical procedures to minimize the risk of nerve damage.

In this paper, we present a series of three cadaveric cases illustrating a rare atypical course of the facial nerve relative to the retromandibular vein.

2 | Methods

The right hemi-faces of 49 human donor bodies prepared for educational purposes at the University of California, San Diego (UCSD) School of Medicine were dissected, and the relationship between the extratemporal facial nerve and the retromandibular vein was observed and documented. Dissection of the facial area was performed exclusively on the right side, preserving the left side for an upcoming dissection to be conducted by first-year medical students at UCSD. The facial skin flaps were reflected laterally, the parotid gland was meticulously dissected, and the nerves (facial and auriculotemporal) as well as the vessels (superficial temporal artery and retromandibular vein) were exposed and examined. The course of the retromandibular vein was traced to identify the main trunk and divisions of the facial nerve within the parotid gland.

3 | Results

During the dissection of the right hemi-faces of 42 human donor bodies, we obtained three cases of the extratemporal facial nerve passing deep (medial) to the retromandibular vein, while its temporal branch ran superficially (lateral) to it (6% of cases).

3.1 | Case 1—A 93-Year-Old Male Donor Body

A single trunk of the facial nerve (FN) was identified, and its branching pattern was classified as Type V according to Davis (1956). The FN ran deep (medial) to the retromandibular vein (RMV), while its temporal branch coursed superficially (lateral) to the RMV (Figure 1). The right auriculotemporal nerve (ATN) followed its typical course, with no connections observed between the FN and ATN. The anatomically aberrant temporal branch of the right FN, the right ATN, and the right STA were found to be in close proximity.

3.2 | Case 2—A 105-Year-Old Male Donor Body

A single trunk of the facial nerve (FN) was identified, and its branching pattern was classified as trifurcation. The FN ran deep (medial) to the retromandibular vein (RMV), while a part of its temporal branch coursed superficially (lateral) to the RMV, and the other part—medially. Between both temporal branches, a communication running superficially (lateral) to the RMV was obtained (Figure 2). The right auriculotemporal nerve (ATN) followed its typical course, with no connections observed between the FN and ATN. The anatomically aberrant temporal branch of the right FN, the right ATN, and the right STA were found to be in close proximity.

3.3 | Case 3—A 91-Year-Old Female Donor Body

A single trunk of the facial nerve (FN) was identified, and its branching pattern was classified as Type VI according to Davis (1956). The FN ran deep (medial) to the retromandibular vein (RMV), while its temporal branch coursed superficially (lateral) to the RMV (Figure 3). The right auriculotemporal nerve (ATN) followed its typical course, with no connections observed between the FN and ATN. The anatomically aberrant temporal branch of the right FN, the right ATN, and the right STA were found to be in close proximity.

4 | Discussion

The anatomical relationship between the temporal branch of the facial nerve and the superficial temporal artery at the level of the superior helix holds significant clinical importance for various surgical, aesthetic, and trauma-related procedures in the temporal region. Understanding this relationship is essential for minimizing complications and optimizing patient outcomes.

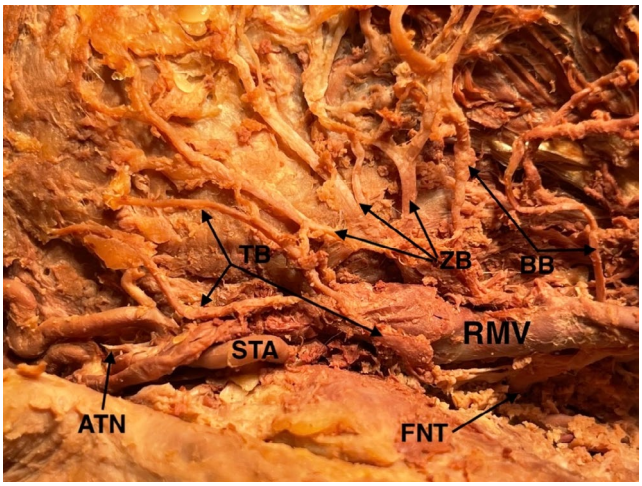

FIGURE 1 | Case 1—the relation between the facial nerve's branches, retromandibular vein, superficial temporal artery, and auriculotemporal nerve. ATN, auriculotemporal nerve; BB, buccal branch; FNT, facial nerve trunk; RMV, retromandibular vein; STA, superficial temporal artery; TB, temporal branch; ZB, zygomatic branch.

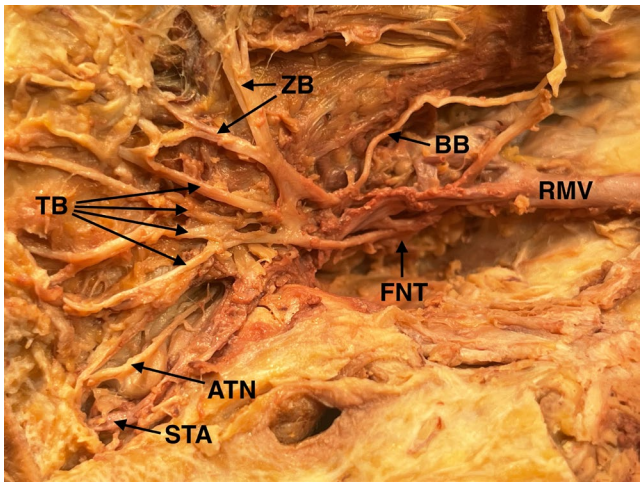

FIGURE 2 | Case 2—the relation between the facial nerve's branches, retromandibular vein, superficial temporal artery, and auriculotemporal nerve. ATN, auriculotemporal nerve; BB, buccal branch; FNT, facial nerve trunk; RMV, retromandibular vein; STA, superficial temporal artery; TB, temporal branch; ZB, zygomatic branch.

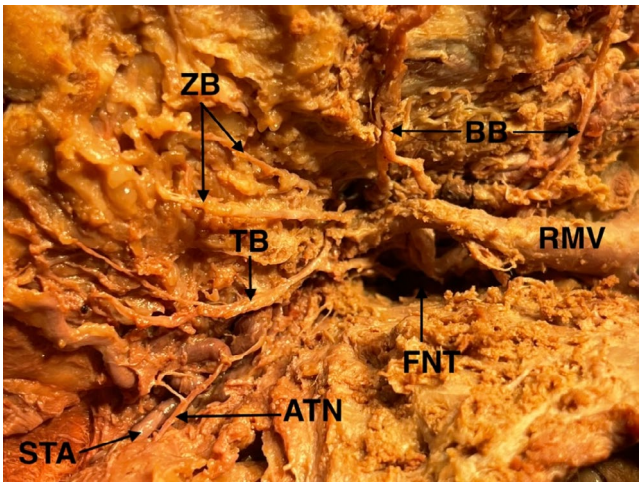

FIGURE 3 | Case 3—the relation between the facial nerve's branches, retromandibular vein, superficial temporal artery, and auriculotemporal nerve. ATN, auriculotemporal nerve; BB, buccal branch; FNT, facial nerve trunk; RMV, retromandibular vein; STA, superficial temporal artery; TB, temporal branch; ZB, zygomatic branch.

The temporal branch of the facial nerve plays a critical role in controlling the frontalis, orbicularis oculi, and corrugator muscles, which are integral to forehead movement, eyebrow elevation, and eye closure. Damage to this nerve can result in brow ptosis, asymmetry, or functional deficits such as impaired eye closure, all of which can have profound aesthetic and functional implications. The nerve's superficial course above the superficial temporal artery at the superior helix level renders it particularly vulnerable during surgical interventions such as facelifts [12], brow lifts [13], temporal artery biopsies [14], and skin cancer excision or reconstruction in the temporal region [15]. Surgeons performing these procedures must account for this vulnerability to prevent iatrogenic injury.

The superficial temporal artery serves as a valuable landmark for identifying and avoiding the temporal branch of the facial nerve during surgical procedures. Its palpable and often visible course provides a guide for precise dissection [16]. This relationship underscores the importance of meticulous anatomical awareness in minimizing nerve damage and ensuring patient safety.

In cases of temporal or lateral facial trauma, the anatomical proximity of the nerve and artery becomes crucial in the assessment and repair of injuries. Surgeons managing patients with temporal swelling or trauma must carefully evaluate the potential for nerve compression or injury [17]; particularly in the context of vascular complications such as post-traumatic superficial temporal artery pseudoaneurysms [18].

Furthermore, this relationship has implications for procedures beyond surgery. For instance, during auriculotemporal nerve blocks, injecting posterior to the mandibular condyle poses a risk of inadvertently injuring the temporal branch of the facial nerve [19]. Awareness of this potential complication is vital for clinicians performing regional anesthesia in the temporal area.

Notably, the variation observed in this study, where the temporal branch of the facial nerve coursed superficially (lateral) to the retromandibular vein, introduces an additional layer of vulnerability. This atypical course places the nerve at an even greater risk of injury during the procedures discussed. The superficial and lateral positioning relative to this vascular structure necessitates heightened caution and precision in surgical and anesthetic interventions in the temporal region. Recognizing and accounting for such variations is critical in minimizing complications and ensuring patient safety.

In summary, the close anatomical relationship between the temporal branch of the facial nerve and the superficial temporal artery, along with variations such as the nerve's superficial course relative to the retromandibular vein, underscores the importance of detailed anatomical knowledge. Whether in surgical planning, trauma management, or regional anesthesia, this understanding is pivotal in reducing complications and optimizing outcomes for patients undergoing interventions in the temporal region.

5 | Conclusions

An unusual anatomical relationship between the facial nerve and the retromandibular vein was observed in three out of 49 cases (6%), where the temporal branch passed laterally to the vein, while the main trunk and all other branches passed medially. The proximity of this aberrant facial nerve branch to the auriculotemporal nerve and the superficial temporal artery increases its vulnerability during medical interventions in the temporal region.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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