Temporal Branch of the Facial Nerve and Its Relationship to Fascial Layers

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Objectives: To eliminate the inconsistency in the nomenclature, to anatomically and definitively describe the topographic relationship of the temporal branch of the facial nerve to the fascial layers and the fat pads, and to create an effective algorithm to define the safest approaches and planes for surgical procedures in this area.

Methods: The study was performed using 18 hemifacial cadaveric specimens. In 12 hemifacial specimens, the facial halves were coronally sectioned and dissected. In 6 hemifacial specimens, planar dissection was performed layer by layer.

Results: The temporal branch of the facial nerve that traversed inside the deep layers of the temporoparietal fascia and the superficial musculoaponeurotic system coursed along the zygomatic arch as 1 (14.3%), 2 (57.1%), 3 (14.3%), and 4 (14.3%) twigs in the specimens. The temporoparietal fascia had no attachment to the zygomatic arch and continued caudally as the superficial musculoaponeurotic system. Adhesions were between the temporoparietal fascia and the superficial layer of the deep temporal fascia around the zygomatic arch. In most specimens, the superficial layer of the deep temporal fascia continued as the parotideomasseterica fascia, and a deep layer abutted the posterosuperior edge of the zygomatic arch.

Conclusion: An easy and safe surgical approach in this area is to elevate the superficial layer deep to the intermediate fat pad directly on the deep layer of the deep temporal fascia descending to the periosteum along the zygomatic arch.

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The temporal branch of the facial nerve has become of great importance with advanced techniques of deep-plane face-lifting, subperiosteal midface-lifting, endoscopic forehead-lifting, and interfascial dissections in craniofacial and trauma surgery. Injury to the temporal branch of the facial nerve results in cosmetic defects as a result of paralysis of the corrugator supercili, frontalis, and orbicularis oculi muscles. Understanding the anatomy of this area and the trajectory of the temporal branch of the facial nerve is critical to preserve it from injury. Despite many studies in the literature, controversy remains about the topographic relationship of the fascias, the fat pads, and the temporal branch of the facial nerve and its nomenclature. The objectives of this study were to eliminate the inconsistency in the nomenclature, to anatomically and definitively describe the topographic relationship of the temporal branch of the facial nerve to the fascial layers and the fat pads, and to create an effective algorithm to define the safest approaches and planes for surgical procedures in this area.

Methods

The study was performed using 18 hemifacial specimens from fixed and fresh cadavers obtained from the Department of Anatomy, Faculty of Medicine, Ankara University, Ankara, Turkey. Before dissection, the course of the temporal branch of the facial nerve was marked on the skin of each cadaver’s face. First, the Pitanguy line (connecting the lobule with one-half the distance between the superior border of the external auditory canal and the lateral canthus) was drawn, and the point at which that line bisected the zygomatic arch was marked. Two other points that were 1.5 cm anterior and 1.5 cm posterior to the first point were marked, depending on the length of each cadaver’s face. First, the Pitanguy line (connecting the lobule with one-half the distance between the superior border of the external auditory canal and the lateral canthus) was drawn, and the point at which that line bisected the zygomatic arch was marked. Two other points that were 1.5 cm anterior and 1.5 cm posterior to the first point were marked, depending on the length of the zygomatic arch. Then, second and third lines that bisected the second and third points separately were drawn from the temporal region to the cheek. These 2 coronal strips of tissue were incised down to the temporal muscle above and to the masseter muscle below, including a coronal segment of the zygomatic arch (Figure 1). The 2 sections were en bloc resected, and the

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anterior and posterior halves of the coronal strips were dissected under an operating microscope using magnification of \( \times 6 \) to \( \times 40 \). In 6 hemifacial specimens, planar dissection from the skin to the bone was performed layer by layer under the operating microscope.

The nomenclature in the literature is inconsistent for certain fascias and the fat pads of this region. Therefore, preferred names (given in the Table and in Figure 2) are used herein to avoid confusion.

### RESULTS

#### FASCIAL LAYERS AND FAT PADS

The temporoparietal fascia and the deep temporal fascia were identified on the anterior, middle, and posterior parts of each coronal strip. Above the zygomatic arch, the temporoparietal fascia was composed of multiple (3–4) layers (Figure 3 and Figure 4) that were integrated with thin fibrous septa immediately deep to the subcutaneous layer.

The temporoparietal fascia could be easily dissected from the superficial layer of the deep temporal fascia above the zygomatic arch (Figures 5, 6, 7, and 8). Descending to the zygomatic arch, a discrete fatty layer called the superficial fat pad was encountered between the superficial layer of the deep temporal fascia and the temporoparietal fascia (Figures 3 and 5). This fat pad disappeared below the middle level of the zygomatic arch. The superficial fat pad was encountered in middle parts of all specimens. However, this fatty layer was not visible in 27.3% of posterior parts and 9.1% of anterior parts of specimens. The mean vertical lengths of the superficial temporal fat pad were 14, 20, and 25 mm, respectively, in posterior, middle, and anterior parts of specimens. Although this layer was thin (≥2 to <3 mm) in 36.3% of posterior, 36.4% of middle, and 27.3% of anterior parts of specimens, it was too thin (≥1 to <2 mm) in 27.3% of posterior, 27.3% of middle, and 27.3% of anterior parts of specimens, and was thick (≥3 to <4 mm) in 9.1% of posterior, 36.3% of middle, and 36.3% of anterior parts of specimens.

The temporoparietal fascia had no attachment to the zygomatic arch and became a foamy tissue (Figures 3 and 6). The level of change varied and was observed at approxi-
mately 1 cm above the zygomatic arch in 18% of specimens (6 of 33 sides of 11 specimens), in the upper level of the zygomatic arch in 64% (21 of 33 sides of 11 specimens), and in the middle of the zygomatic arch in 18% (6 of 33 sides of 11 specimens). The fascia continued as a superficial musculoaponeurotic system (SMAS) below the zygomatic arch (Figure 3 and Figure 9). Beginning from a level between the upper edge and the middle of the zygomatic arch, tight adhesions were observed between the temporoparietal fascia and the superficial layer of the deep temporal fascia, which covered the zygomatic arch, the masseter muscle, and the parotid gland (Figure 9 and Figure 10). Below this level, the plane could only be found using sharp dissection between these layers (Figure 9). However, at the level of the parotid gland, fibrous indentations were observed from the temporoparietal fascia into the superficial layer of the deep temporal fascia as it descended to the zygomatic arch, and a fibrofatty tissue called the intermediate fat pad filled the space between these layers (Figures 3, 4, and 7 and Figure 11). The deep layer of the deep temporal fascia could be easily dissected from the intermediate fat pad (Figure 11). However, dissection of the superficial layer of the deep temporal fascia from the intermediate fat pad was more difficult because of extensions of a fibrous network of the fat pad and arteriovenous perforators. In 10 specimens, the layers of the deep temporal fascia did not fuse above

Figure 2. Preferred names of the anatomic structures given in the Table. The asterisk marks where the deep layer of the deep temporal fascia (D-DTF) abuts the posteroinferior surface of the zygomatic arch (ZA) on 10 sides. The superficial layers and the deep layers of the deep temporal fascia (DTF) fuse at the anterosuperior surface of the ZA on 4 sides of the cadaveric heads. DFP indicates deep fat pad; IFP, intermediate fat pad; MM, masseter muscle; PG, parotid gland; PMF, parotideomasseterica fascia; S, skin; S-DTF, superficial layer of the DTF; SFP, superficial fat pad; SMAS, superficial musculoaponeurotic system; TM, temporal muscle; TPF, temporoparietal fascia.

Figure 3. Coronal strips (A) and corresponding depictions (B) of the anterior (right), middle (center), and posterior (left) thirds of the specimen.
the zygomatic arch. In these specimens, the deep layer abutted the peristeum of the posterosuperior edge of the zygomatic arch (Figure 3), and the superficial layer descended through the anterior surface of the zygomatic arch to form the parotideomasseterica fascia inferiorly (Figure 5). However, on 4 sides of the cadaveric heads, the superficial layer and the deep layer of the deep temporal fascia fused at the anterosuperior edge of the zygomatic arch and continued inferiorly as a single layer to form the parotideomasseterica fascia (Figure 2).

The mean vertical lengths of the intermediate fat pad were 23, 24, and 37 mm, respectively, in posterior, middle, and anterior parts of specimens. The intermediate fat layer was divided into several lobules by a fibrous network (Figure 3). There were arteries (1-2 mm in diameter) and veins (2-3 mm in diameter) in the fat pad (Figure 11). Although small vessels were common, several larger vessels were also encountered in each coronal strip at 5 to 24 mm from the zygomatic arch.

Another fat pad (called the deep fat pad) was observed between the deep temporal fascia and the temporo-
Division of the temporal branch of the facial nerve occurred in the parotid gland. The temporal branch of the facial nerve emerged from the parotid gland below the zygomatic arch (Figures 6 and 10) and traversed inside the temporoparietal fascia over the zygomatic arch (Figures 5 and 7) following the Pitanguay line. The numbers of temporal branch twigs passing over the zygomatic arch were 1 (14.3%), 2 (57.1%), 3 (14.3%), or 4 (14.3%) in the specimens (Figure 8). There was approximately 3 mm between the frontal nerve and the bone over the zygomatic arch in the fresh cadaver specimens (Figure 10). Although the frontal nerve traversed inside the deep layers of the SMAS and the temporoparietal fascia (Figure 7), no obvious dissection plane was encountered between the superficial layer of the deep temporal fascia and either the SMAS or the temporoparietal fascia surrounding the temporal branch twigs over the zygomatic arch. Above the zygomatic arch, a fat layer called the superficial fat pad was observed between the temporoparietal fascia and the deep temporal fascia, and a thin

TEMPORAL BRANCH OF THE FACIAL NERVE

Division of the temporal branch of the facial nerve occurred in the parotid gland. The temporal branch of the facial nerve emerged from the parotid gland below the zygomatic arch (Figures 6 and 10) and traversed inside the temporoparietal fascia over the zygomatic arch (Figures 5 and 7) following the Pitanguay line. The numbers of temporal branch twigs passing over the zygomatic arch were 1 (14.3%), 2 (57.1%), 3 (14.3%), or 4 (14.3%) in the specimens (Figure 8). There was approximately 3 mm between the frontal nerve and the bone over the zygomatic arch in the fresh cadaver specimens (Figure 10). Although the frontal nerve traversed inside the deep layers of the SMAS and the temporoparietal fascia (Figure 7), no obvious dissection plane was encountered between the superficial layer of the deep temporal fascia and either the SMAS or the temporoparietal fascia surrounding the temporal branch twigs over the zygomatic arch. Above the zygomatic arch, a fat layer called the superficial fat pad was observed between the temporoparietal fascia and the deep temporal fascia, and a thin
layer of the temporoparietal fascia covered the temporal branch of the facial nerve medially in all specimens (Figure 5).

COMMENT

Despite many studies, controversy remains about the topography of the temporoparietal fascia, which comprises a fascial layer just under the subcutaneous tissue in the temporal region extending to the parietal region. After description of the SMAS of the face by Mitz and Peyronie, the temporoparietal fascia was recognized as important to the temporal branch of the facial nerve. These authors stated that the SMAS was a fibromuscular network located between the facial muscles and the dermis. According to their observations, the SMAS "crosses in front of the zygomatic arch and belongs to the temporofacymatic SMAS" and is independent of the parotid fascia. In 1988, Hing et al noted that the temporoparietal fascia was attached to the zygomatic arch. In 1989, Stuzin et al demonstrated in cadaver dissections that the temporoparietal fascia continued as the SMAS across the zygomatic arch but was not in anatomic continuity with the periosteum of the zygomatic arch. However, Gosain et al claimed that the SMAS was not in anatomic continuity with the temporoparietal fascia. Gassner et al supported the finding by Gosain et al and stated that the SMAS and the temporoparietal fascia were in corresponding anatomic layers but lost their anatomic continuity when they fused with the zygomatic arch. In contrast, Campiglio and Candiani and Coscarella et al claimed that the temporoparietal fascia abutted the zygomatic arch and comprised the parotidomasseteric fascia below the zygomatic arch. Our results agree with the observation by Stuzin et al that the temporoparietal fascia had no attachment to the zygomatic arch. Our findings are consistent with most studies in the literature reporting that the temporoparietal fascia continues as the SMAS below the zygomatic arch. However, we demonstrated herein that the temporoparietal fascia becomes a foamy tissue between the upper level of the zygomatic arch and approximately 1 cm above the zygomatic arch. We also show that there are adhesions between the temporoparietal fascia and the superficial layer of the deep temporal fascia between the upper and middle levels of the zygomatic arch. Because of the fusion, elevation requires sharp dissection between these layers; this could endanger the temporal branch of the facial nerve, which is protected by only a thin layer of spongiosis-type temporoparietal fascia or SMAS over the zygomatic arch. However, we observed fibrous indentations from the SMAS into the superficial layer of the deep temporal fascia covering the parotid gland, which could reflect fusion of the SMAS and the parotid fascia to form a single layer.

Telliog˘lu et al reported that the temporoparietal fascia was composed of inner and outer parts. They stated that the outer layer extended as the SMAS below the zygomatic arch. The inner layer blended with the superficial layer of the deep temporal fascia on the zygomatic arch and continued to the masseteric fascia. Hata disagreed with their findings, arguing that the outer layer of the fascia was “temporoparietalis” and that the inner part of the fascia was the “loose areolar layer” or the “subgaleal fascia.” Behei and AbdiHamid demonstrated that the temporoparietal fascia splits into the superficial layer and the deep layer and that the superficial layer splits into 2 other layers in the lower half of the temporal muscle. We show herein that the temporoparietal fascia is composed of multiple fascial layers that are integrated with thin fibrous septa.

The deep temporal fascia is a dense uniform aponeurotic layer covering the temporal muscle. There is agreement that the deep temporal fascia is a single layer attached along the length of the superotemporal line, where it blends with the peristeum and splits into the superficial and deep lamina above the level of the zygomatic arch. However, it is controversial where the deep temporal fascia splits and where and if its layers abut the zygomatic arch or continue as the masseteric fascia over the zygomatic arch. Yaşargil et al demonstrated that the deep temporal fascia is divided into 2 layers at the orbital level. According to them, the superficial layer and the deep layer of the fascia that are attached to the lateral and medial borders of the zygomatic arch are separated by an intermediate fat layer. Stuzin et al subsequently showed that the deep temporal fascia splits into 2 layers below the supero-orbital margin. They documented that the superficial layer of the deep temporal fascia is attached to the superior margin of the zygomatic arch, overlies the peristeum of the zygomatic arch, and blends with the parotidomasseteric fascia. Salas et al argued that the deep layer of the deep temporal fascia is attached to the posterosuperior margin of the zygomatic arch, continues along the deep surface of the zygomatic arch, and blends with the “posterosmasseteric fascia.” Ramirez et al found that the deep layer and the superficial layer of the superficial temporal fascia fuse at 1 cm above the zygomatic arch and are attached to the superficial surface of the zygomatic arch, blending with the attachment of the fascia of the masseter muscle. Ammirati et al reported that 2 layers of this fascia are attached to the anterior portion of the zygomatic arch and continue with the parotidomasseteric fascia below the zygomatic arch. Campiglio and Candiani noted that the temporal muscle fascia split into 2 sheets at 5 cm above the zygomatic arch, with the superficial sheet abutting the anterior surface of the zygomatic arch and the deep sheet abutting the posterior surface of the zygomatic arch. These 2 fascial layers were fused in the anterior and posterior thirds of the zygomatic arch but were separated by a fat pad in the middle. Similarly, Hwang and Kim demonstrated that the superficial layer and the deep layer of the deep temporal fascia fused and abutted the superior margin of the zygomatic arch in 18 dissections (56%) and abutted the superolateral surface in 14 dissections (44%). Coscarella et al and Behei and Abdi-Hamid reported that the fascia of the temporal muscle split into 2 layers at 1 to 2 cm above the zygomatic arch or over the lower half of the temporal muscle, and the superficial fascia attached to the lateral side of the zygomatic arch. The deep fascia abutted the medial side of the zygomatic arch. In contrast, Accioli de Vasconcellos et al found that the deep
temporal fascia was independent of the zygomatic arch (like the temporoparietal fascia) and continued caudally as the masseter muscle fascia. Our results are in agreement with the observations of all of these studies that the deep temporal fascia splits into the superficial layer and the deep layer. However, our findings demonstrate that the point where the fascia splits differs at the anterior, middle, and posterior portions of the zygomatic arch because of the fat pad between the layers of the fascia. We also show that the layers of the deep temporal fascia do not fuse above the zygomatic arch, but the 2 layers could be seen as a single layer if a cross-section was obtained near the lateral orbital rim. In most of our specimens, the superficial layer continues as the parotidomasseterica fascia, and the deep layer abuts the posterosuperior edge of the zygomatic arch. However, the superficial layer and the deep layer of the deep temporal fascia continued together across the zygomatic arch as the parotidomasseterica fascia in 27% of specimens (9 of 33 sides of 11 specimens).

Kim and Matic18 observed that a fibrous network divides the intermediate fat pad into lobules and that there is a dual arterial supply to the intermediate fat pad from perforators originating from the middle and deep temporal arteries, which pierce the superficial layer and the deep layer of the deep temporal fascia. Our study confirms that the intermediate fat pad is divided into several lobules by a fibrous network and that there are vessels inside the fat pad, especially at 5 to 24 mm from the zygomatic arch. We also show that perforators are more common between the intermediate fat pad and the superficial layer and the deep layer of the deep temporal fascia.

Researchers have called attention to the number of temporal branch twigs at the level of the zygomatic arch. Gosain et al23 demonstrated that 2 to 4 rami of the temporal branch of the facial nerve cross the zygomatic arch. Zani et al22 noted that the temporal branch of the facial nerve is composed of 1 twig in 28% of cases, 2 twigs in 32% of cases, 3 twigs in 16% of cases, and 4 twigs in 4% of cases at the level of the zygomatic arch. Ammirati et al20 showed that the temporal branch of the facial nerve is divided into anterior, middle, and posterior rami after piercing the parotidomasseterica fascia. In our study, the temporal branch of the facial nerve traversed along the zygomatic arch as 1 twig in 14.3%, as 2 twigs in 57.1%, as 3 twigs in 14.3%, and as 4 twigs in 14.3% of specimens.

Various approaches have been described for a safe surgical dissection around the temporal branch of the facial nerve and the zygomatic arch. Researchers7,8,11,14,20 have observed that the temporal branch of the facial nerve courses within the superficial fat pad. Because of this finding, Coscarella et al8 proposed submuscular dissection (deep to the temporal muscle) or subfascial dissection (deep to the deep temporal fascia layer). In contrast, other authors9,12,18 have noted the temporal branch of the facial nerve in the deepest temporal subfascial layer. In our study, the temporal branch of the facial nerve courses first between the layers of the superficial lamina of the temporoparietal fascia and then courses between the deep layer and the superficial layer of the temporal fat pad.
from the zygomatic arch. Although dissection using this approach would be safer than the first approach, more bleeding may occur. The third approach is to dissect the deep layer of the deep temporal fascia (deep to the intermediate fat pad) beginning from the division point of the layers of the deep temporal fascia. Our study shows that the intermediate fat pad can be easily dissected from the deep layer of the deep temporal fascia and that only a few small vessels are encountered along the dissection plane. Our results suggest that this approach is as safe as the second approach in terms of injury to the temporal branch of the facial nerve but that less bleeding and disruption of the fat pad occur compared with the second approach.

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