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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anterior and posterior halves of the coronal strips were dissected under an operating microscope using magnification of $\times6$ to $\times40$. 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 ($\geq 2$ to $< 3$ mm) in 36.3% of posterior, 36.4% of middle, and 27.3% of anterior parts of specimens, it was too thin ($\geq 1$ to $< 2$ mm) in 27.3% of posterior, 27.3% of middle, and 27.3% of anterior parts of specimens, and was thick ($\geq 3$ 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 facial nerve or temporal branches of the facial nerve. The temporoparietal fascia descending to the zygomatic arch lost its fascial layers 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 covering the parotid gland (Figure 6), and no dissection plane was noted among the SMAS, the superficial layer of the deep temporal fascia, and the parotid fascia (Figure 9).

The deep temporal fascia lay under the superficial fat pad and covered the temporal muscle. The thick single layer of the upper part of the deep temporal fascia separated into the superficial layer and the deep layer 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
the zygomatic arch. In these specimens, the deep layer abutted the periosteum 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 tempo-
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 temporozygomatic 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 remained as the SMAS across the zygomatic arch but was not in anatomic continuity with the periosteum of the zygomatic arch. However, Gossain et al claimed that the SMAS was not in anatomic continuity with the temporoparietal fascia. Gassner et al supported the finding by Gossain 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 parotidomasseterica 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.

Tellioglu 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 claimed that the SMAS was not in anatomic continuity with the periosteum of the zygomatic arch, and continued along the deep surface of the zygomatic arch, and blends with the "temporoparietalis." Ramirez et al found that the deep layer and the superficial layer of the deep temporal fascia fuses at 1 cm above the zygomatic arch and are attached to the superficial surface of the zygomatic arch, blending with the attachment to 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 parotidomasseterica 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 Beheiely demonstrated 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 tempoparietal 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 parotidomasseteric 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 parotidomasseteric fascia in 27% of specimens (9 of 33 sides of 11 specimens).

Kim and Matic26 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 al24 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 parotidomasseteric 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. Researchers7,8,10,14,20 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 subfacial dissection (deep to the deep temporal fascia layer). In contrast, other authors10,12,18 have noted the temporal branch of the facial nerve in the deepest tempoparietal fascia above the zygomatic arch. Beheiry and Abdel-Hamid19 reported that the temporal branch of the facial nerve coursed first between the layers of the superficial lamina of the tempoparietal fascia and then coursed between the deep layer and the superficial layer of the tempoparietal fascia. Consistent with these findings, Salas et al9 and Yasargil et al21 recommended interfascial dissection. Ammirati et al20 showed that terminal twigs of the temporal branch of the facial nerve penetrated the tempoparietal fascia at different levels. They cautioned against mistaking the superficial fat pad for the intermediate fat pad and endangering the temporal branch of the facial nerve by interfascial dissection and instead recommended deeper dissection to preserve the facial nerve. In contrast, Stuzin et al4 claimed that a safe surgical plane is ensured by beginning dissection in the superficial fat pad of the temporal region and by deepening the dissection at 2 cm above the zygomatic arch into the intermediate temporal fat pad to expose the zygomatic arch. Ramirez et al19 reported in 1991 that there was no structure between the peristeum of the zygomatic arch and the tempoparietal fascia. Therefore, they suggested that subgaleal dissection should be deepened through the layers of the deep temporal fascia at about 3 cm above the zygomatic arch and that subperiosteal dissection should be performed at the level of and along the entire length of the zygomatic arch. In 2002, Ramirez25 described some changes in his surgical technique, noting that the zygomatic arch could be entered at 2 to 3 mm above the superior border of the zygomatic arch. As part of their midface-lift technique, Quatela and Olney published the recommendation “to elevate deep to the intermediate fat pad directly on the deep layer of the deep temporal fascia and then deep to the peristium.”17(p217) Krayenbühl et al14 suggested that subgaleal fascia dissection can be performed up to the adhesions between the tempoparietal fascia and the deep temporal fascia and that interfascial or interlaminar dissection (between the 2 lamina of the deep temporal fascia) or subfacial dissection could then be performed to protect the facial nerve.

In light of our findings and the results of the studies reviewed herein, 3 approaches may be used to reach the zygomatic arch through the intermediate fat pad. The dissection plane is incised down to the periosteum (subperiosteal) on the zygomatic arch in all 3 approaches (Figure 11). The first approach is a subgaleal dissection (superficial to the superficial layer of the deep temporal fascia), deepening into the intermediate fat pad just above the zygomatic arch. Our study demonstrates that the temporal branch of the facial nerve is covered by a thin layer of the tempoparietal fascia above the zygomatic arch and that there is a superficial fat pad between the tempoparietal fascia and the superficial layer of the deep temporal fascia. However, our study also shows that this fat pad disappears and that adhesions are observed at the dissection plane beyond the upper edge of the zygomatic arch. Our findings suggest that continuous dissection on the subgaleal plane to the upper edge of the zygomatic arch is safe and easy. Beyond this level, subgaleal dissection carries the risk of injury to the temporal branch of the facial nerve. Therefore, the surgeon will need to continue deep dissection to at least a few millimeters above the zygomatic arch. The second approach begins with subgaleal dissection as in the first approach but deepens into the intermediate fat pad at 1 to 2 cm above the zygomatic arch. Our study shows that there are widespread vessels in the intermediate fat pad located 5 to 24 mm
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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