The Course of the Frontal Branch of the Facial Nerve in Relation to Fascial Planes: An Anatomic Study

Cori A. Agarwal, M.D.
Shaun D. Mendenhall, III, M.S.
K. Bo Foreman, Ph.D.
John Q. Owsley, M.D.

Salt Lake City, Utah; and San Francisco, Calif.

Background: Despite a wealth of literature describing the anatomy of the temporal region, controversy still exists over the depth of the frontal branch of the facial nerve as it travels over the zygomatic arch. It is commonly stated that the frontal branch travels within the superficial musculoaponeurotic system (SMAS) as it crosses the zygomatic arch. Clinically, however, it is apparent that the nerve runs at a deeper level as it crosses the arch, allowing for safe elevation and division of the SMAS to a point at or above the superior border of the zygomatic arch. The purpose of this study was to define the path of the frontal branches along fascial planes and to clarify the relationship of the fascial layers of the cheek and temporal region.

Methods: Eighteen fresh-frozen cadaver hemifaces were dissected in a layer-by-layer fashion to evaluate the relationship between the nerve and the fascial planes above and below the zygomatic arch. Histologic evaluation was performed on six hemifaces.

Results: In all dissections, the frontal branch traveled within the innominate fascia as it crossed the zygomatic arch into the temporal region. A fascial transition zone was identified in a region 1.5 to 3.0 cm above the zygomatic arch and 0.9 to 1.4 cm posterior to the lateral orbital rim, where the frontal branches crossed from the innominate fascia to run within the superficial temporal fascia.

Conclusion: As the frontal branch crosses the zygomatic arch, it is within the innominate fascia, a plane deep to the SMAS and superficial temporal fascia. (*Plast. Reconstr. Surg.* 125: 532, 2010.)

The position of the frontal branches of the facial nerve has been well described in the literature, but emphasis is placed on two-dimensional nerve trajectory, with sparse and often conflicting descriptions of the fascial planes surrounding the nerve. Studies by Furnas[1] and Pitanguy and Ramos[2] describe the trajectory of a single ramus in relation to the tragus and the lateral brow, whereas more recent studies by Zani et al.[3] and Gosain et al.[4] demonstrate the presence of multiple rami crossing an area spanning nearly two-thirds of the central zygomatic arch. None of these studies, however, definitively addresses the fascial depth of the frontal nerve branches. It is commonly stated and taught that the frontal branch travels within the superficial temporal fascia as it crosses the zygomatic arch.[5] Clinically, however, it has been recognized that it travels at a deeper layer, as evidenced by safe performance of procedures such as the high–superficial musculoaponeurotic system (SMAS) face lift in which the SMAS is routinely elevated and divided above the zygomatic arch.[6–8] In a review of the literature, we found conflicting descriptions of the fascial depth of the nerve, ranging from subcutaneous,[9] within the superficial temporal fascia,[5] traveling in the loose areolar layer,[10,11] and in close proximity to

From the Division of Plastic Surgery, University of Utah Health Sciences Center; the Department of Neurobiology and Anatomy, University of Utah School of Medicine; the Division of Plastic Surgery, University of California Medical Center; and the California Pacific Medical Center, Davies Campus.
Received for publication June 23, 2009; accepted August 28, 2009.
Presented in part at the American-Brazilian Aesthetic Meeting, in Park City, Utah, February 20, 2009.

DOI: 10.1097/PRS.0b013e3181c82e9d

Disclosure: *The authors have no financial or commercial conflicts of interest to disclose.*

the zygomatic periosteum.[12] The confusion stems in part from the dense adherence of fascial planes to each other as they cross the arch, a problem that is compounded when trying to dissect the planes in preserved cadavers, in which the layers are even more adherent. Understanding the anatomy in this region is made more difficult by the inconsistency of nomenclature used to describe the different fascial layers.

The most superficial layer beneath the skin and subcutaneous tissue in the temporal region is the superficial temporal fascia (temporoparietal fascia), which is continuous with the galea superiorly, the frontalis muscle anteriorly, and the SMAS and platysma inferiorly. Deep to this is a loose areolar plane that, when it is recognized as a distinct fascial layer, is called the innominate fascia. Immediately deep to the innominate fascia is the deep temporal fascia, which covers the temporalis muscle and fuses with the cranial periosteum at the temporal crest where the temporalis originates. The deep temporal fascia splits into two layers at the level of the supraorbital margin. The superficial layer of the deep temporal fascia (which has been called the intermediate fascia, superficial lamina, and sometimes innominate fascia) and the deep layer of the deep temporal fascia are separated by the superficial temporal fat pad.

The goal of this study was to define the path of the frontal branches of the facial nerve along fascial planes, with an emphasis on transition points of the nerves between them. In the process, we attempted to clarify the relationship of the fascial planes of the cheek and temporal region in relation each other using consistent nomenclature and to clinically correlate our findings.

METHODS

This study used both cadaveric dissections and histologic evaluation. Eighteen fresh-frozen, unfixed cadaver hemifaces were dissected in a layer-by-layer fashion to evaluate the relationship of the nerve and the fascial planes both above and below the zygomatic arch. The fascial layers were elevated above and below the arch, stopping where adhesions to underlying layers were encountered or where crossing nerve branches were identified. The frontal branches were identified from both antegrade and retrograde approaches. The facial nerve trunk was identified at the stylomastoid foramen, and frontotemporal branches were followed through the substance of the parotid gland and across the zygomatic arch into the temporal region to their target muscles, the orbicularis oculi and the frontalis. The position of the nerve branches within fascial layers was observed with particular attention to transitions from one fascial plane to another. The transition points of the most anterior and most posterior branches were then measured in relation to the lateral orbital rim (x axis) and the superior border of the zygomatic arch (y axis). The descriptive statistics and the 95 percent confidence intervals were calculated using Microsoft Excel 2004 for Mac, version 11.4.1 (Microsoft Corp., Redmond, Wash.).

Histologic evaluation was performed on six cadaver hemiface specimens. Strips of the tissue 8 cm tall and 4 cm wide were harvested in the plane of the zygomatic arch extending down through the underlying muscles of mastication. Serial coronal sections were cut 3 μm thick, stained with hematoxylin and eosin or Masson's trichrome stain, mounted on slides, and evaluated with light microscopy.[13,14]

RESULTS

In the anatomical dissections, the SMAS in the cheek was elevated in continuity with the superficial temporal fascia above the arch (Fig. 1). Immediately deep to this layer in the

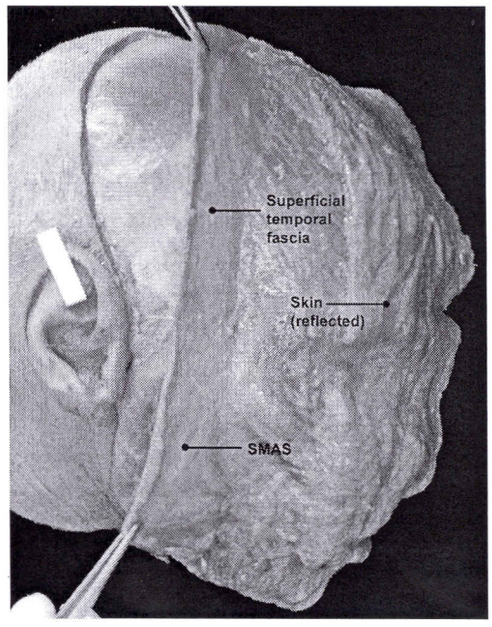

Fig. 1. Reflection of the skin, followed by elevation of the superficial temporal fascia in the temporal region in continuity with the SMAS in the cheek.

temporal region, the innominate fascia was elevated from the underlying superficial layer of the deep temporal fascia. This innominate fascia was present overlying the zygomatic arch and was in loose continuity with the parotid-masseteric fascia in the cheek (Fig. 2). The frontotemporal branch of the facial nerve divided into two to four frontal branches that exited the parotid gland within the parotid-masseteric fascia and continued within the innominate fascia across the zygomatic arch (Fig. 3). At a consistent region above the arch (termed the *fascial transition zone*), the frontal branches transitioned from the innominate fascia to run on the undersurface of the superficial temporal fascia before entering the frontalis or orbicularis oculi muscle. In the 18 dissected hemifaces, 34 nerve branches were followed and the fascial transition points of the most anterior and posterior branches were recorded (Table 1). Using a 95 percent confidence interval, the fascial transition zone extended from 1.5 to 3.0 cm above the superior border of the zygomatic arch (y axis) and 0.9 to 1.4 cm posterior to the lateral orbital rim (x axis) (Fig. 4).

Evaluation of the histologic cross-sections showed that the frontal branches were consistently within the innominate fascia (the fibrofatty layer deep to the SMAS) overlying the zygomatic arch periosteum. Nerve branches were identified in a more superficial position as they approached the frontalis and orbicularis oculi muscles (Fig. 5).

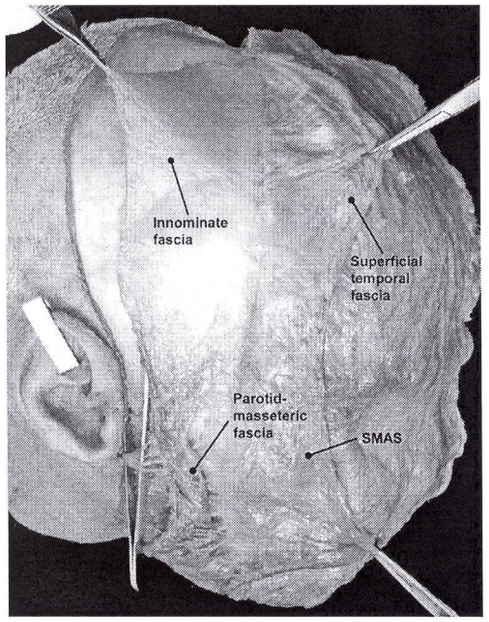

Fig. 2. Elevation of the innominate fascia in the temporal region, which was found to be in loose continuity with the parotid-masseteric fascia in the cheek.

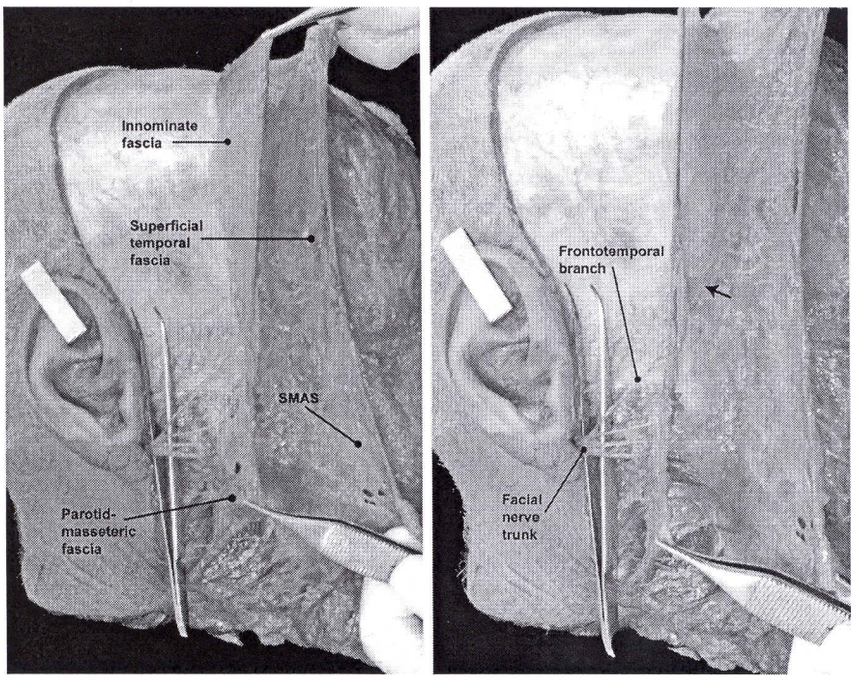

Fig. 3. Display of the facial nerve (*left*) and the path of the frontal branch (*right*) as it traverses the innominate fascia before entering the superficial temporal fascial layer.

Table 1. Transition Points of the Frontal Branch Nerve from the Innominate to the Superficial Temporal Fascia

	x Axis		*y* Axis	
Hemiface	Anterior (cm)	Posterior (cm)	Anterior (cm)	Posterior (cm)
1	1.8	N/A	2.0	N/A
2	1.5	N/A	1.8	N/A
3	1.5	1.4	1.7	2.5
4	1.4	1.4	2.0	3.1
5	1.0	1.0	1.8	3.2
6	1.0	1.0	1.5	3.0
7	1.0	1.0	2.5	3.0
8	1.8	1.9	2.2	3.4
9	0.9	0.9	0.5	1.5
10	1.0	1.0	0.9	1.9
11	1.6	1.3	1.8	2.4
12	0.8	0.7	2.0	3.3
13	1.5	1.5	2.0	3.0
14	1.7	1.7	1.7	2.8
15	0.8	0.8	2.0	2.5
16	1.5	1.0	1.4	1.8
17	1.0	1.0	1.3	2.8
18	0.6	0.5	2.8	3.5
Mean	1.24	1.13	1.77	2.73
Mode	1.00	1.00	2.00	3.00
Range	0.6–1.8	0.5–1.9	0.5–2.8	1.5–3.5
SD	0.38	0.37	0.53	0.59
95% CI	1.07–1.42	0.95–1.31	1.53–2.02	2.44–3.02

N/A, not applicable; CI, confidence interval.

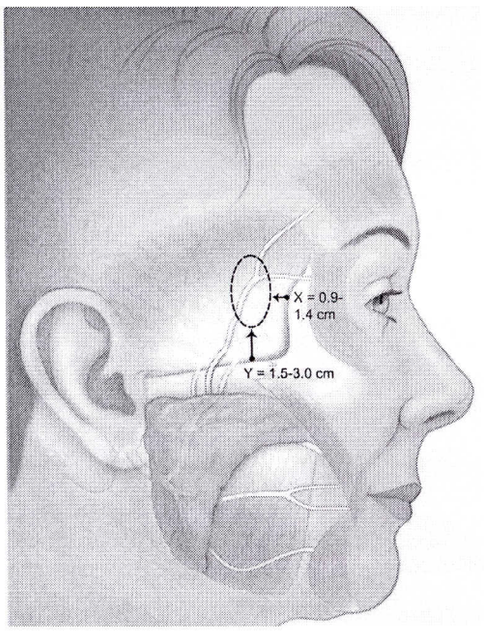

Fig. 4. Illustration depicting the fascial transition zone (*dotted circle*) where the frontal branches transition from the innominate fascia to the superficial temporal fascia. The *x* axis measurement was the distance posterior to the lateral orbital rim and the *y* axis measurement was the distance superior to the upper border of the zygomatic arch.

DISCUSSION

Anatomical descriptions of the fascial planes in the temporal region are often contradictory and confusing, in part because of the dense adhesions between fascial layers in this area, and are further complicated by inconsistent use of nomenclature. In addition, many of the previous anatomical investigations used preserved cadavers, in which the fascial planes can be much more difficult to separate and identify compared with those in unfixed cadavers that were used in this study. Because of these complicating factors, the three-dimensional path of the frontal branches of the facial nerve has been poorly understood. Although the traditional and often quoted understanding is that the nerve branches travel "within the temporoparietal fascia across the zygomatic arch,"[5] this anatomical study demonstrates that the frontal branches travel at a fascial plane distinct from, and deep to, the SMAS and superficial temporal fascia as they cross the zygomatic arch. Appreciation of the innominate fascia as a distinct and significant fascial plane and the relationship of the nerve branches within it is key to a clear understanding of the anatomy in this region. From the point at which the nerve branches exit the parotid gland to their point of transition to the superficial temporal fascia in the fascial transition zone, they run just above the periosteum within the innominate fascia, which is a fibrofatty layer that can be elevated as a distinct layer deep to the SMAS and superficial temporal fascia. At the fascial transition zone, dense adhesions exist between planes that limit dissection and serve to protect the nerve from injury.

A better understanding of the frontal branch anatomy in three dimensions enables safer surgery in various planes of dissection. During cadaver dissections and in live dissections during face lifts and brow lifts, we have observed that this fascial transition zone is characterized by dense adhesions between fascial planes. This anatomical characteristic serves to caution the surgeon as the region is approached and aids in the performance of safe surgery. Over the lateral portion of the zygomatic arch, elevation of the SMAS up to and slightly above the superior border of the arch can be performed easily and without resistance. As the central portion of the arch is approached, however, adhesions between the SMAS and the underlying innominate fascia are encountered and limited blunt dissection along the lower border of the arch is recommended. The safety of this dissection clinically is supported by the experience of

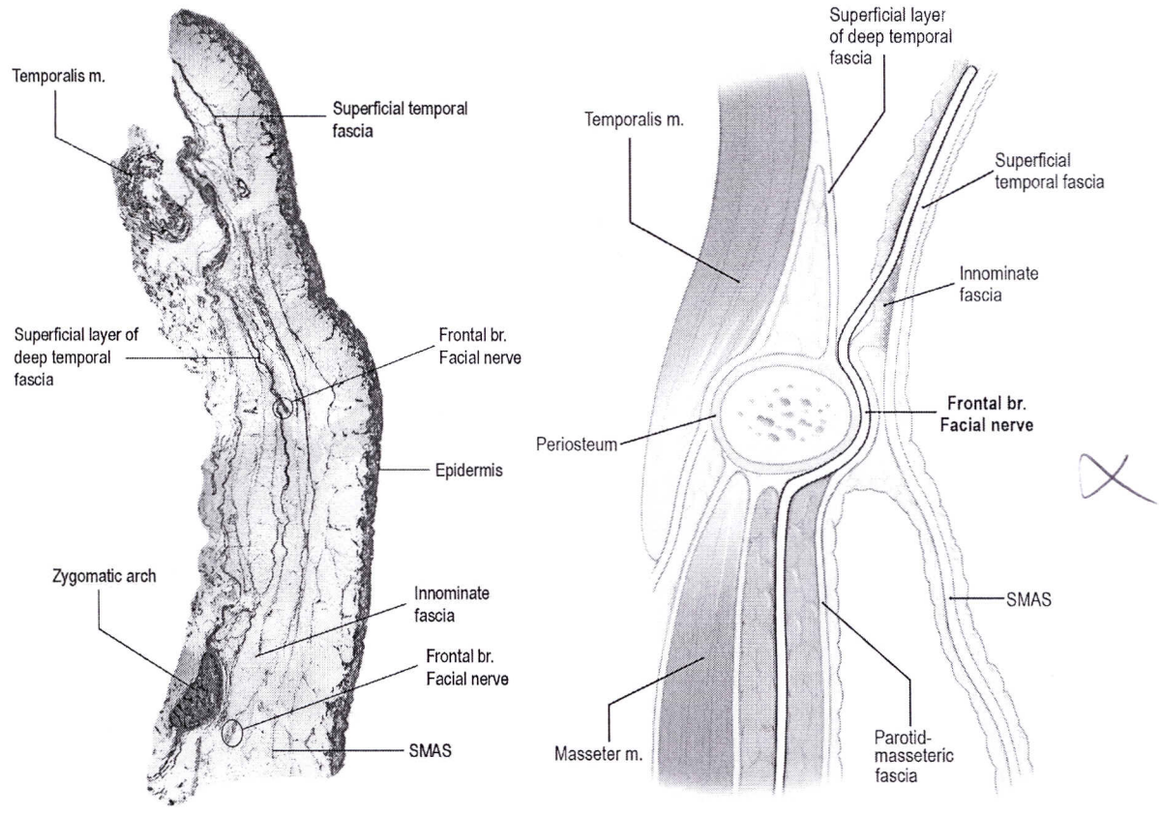

Fig. 5. (*Left*) Representative histologic section of this region stained with Masson's trichrome stain. At the level of the zygomatic arch, a frontal branch is identified deep to the SMAS running just above the periosteum within the fibrofatty innominate fascia. Superior to the zygomatic arch, a branch is present within the innominate fascia, deep to the superficial temporal fascia. (*Right*) Schematic illustration depicting the fascial planes of the cheek and temporal region and the path of the frontal branch in this area. After exiting the parotid gland, the frontal branch traverses over the zygomatic arch within the innominate fascia, where it remains until a point 1.5 to 3.0 cm (95 percent confidence interval) above the superior border of the arch (fascial transition zone), where it becomes more superficial and travels on the undersurface of the superficial temporal fascia until innervating its target muscles.

the senior author (J.Q.O.), who routinely elevates and divides the SMAS at the superior border of the zygomatic arch.[6] In his review of over 2000 SMAS-platysma face lifts, there were no instances of frontal branch injury.[15] In addition, the safe performance of the high-SMAS face lift argues for the deep position of the nerve branches as they cross the arch.[7,8]

When dissecting in the temporal region, a safe plane of dissection is along the surface of the superficial layer of the deep temporal fascia, provided that the innominate layer is carefully swept up with the overlying superficial temporal fascia. As the fascial transition zone is approached, the crossing sentinel vein is encountered, followed by dense fascial adhesions that mark the end of the safe dissection plane. Access to the arch should then proceed deep to the superficial layer of the deep temporal fascia within the superficial temporal fat pad or along the surface of the temporalis muscle to best avoid nerve injury.

Cori A. Agarwal, M.D.
Division of Plastic Surgery
University of Utah Health Sciences Center
30 North 1900 East, 3B400
Salt Lake City, Utah 84132
cori.agarwal@hsc.utah.edu

ACKNOWLEDGMENTS

The authors thank Kerry Peterson, Wayne Woodward, David Morton, Ph.D., Sheryl Scott, Ph.D., Blake Anderson, Kurt Albertine, Ph.D., and the University of Utah Body Donor Program for their support of this project. They also greatly appreciate Rick Webster and Tina Burton for dissection assistance.

REFERENCES

1. Furnas DW. Landmarks for the trunk and the temporofacial division of the facial nerve. *Br J Surg.* 1965;52:694–696.
2. Pitanguy I, Ramos AS. The frontal branch of the facial nerve: The importance of its variations in face lifting. *Plast Reconstr Surg.* 1966;38:352–356.
3. Zani R, Fadul R Jr, Da Rocha MA, Santos RA, Alves MC, Ferreira LM. Facial nerve in rhytidoplasty: Anatomic study of its trajectory in the overlying skin and the most common sites of injury. *Ann Plast Surg.* 2003;51:236–242.
4. Gosain AK, Sewall SR, Yousif NJ. The temporal branch of the facial nerve: How reliably can we predict its path? *Plast Reconstr Surg.* 1997;99:1224–1233; discussion 1234–1236.
5. Stuzin JM, Wagstrom L, Kawamoto HK, Wolfe SA. Anatomy of the frontal branch of the facial nerve: The significance of the temporal fat pad. *Plast Reconstr Surg.* 1989; 83:265–271.
6. Owsley JQ, Agarwal CA. Safely navigating around the facial nerve in three dimensions. *Clin Plast Surg.* 2008;35:469–477.
7. Connell BF, Semlacher RA. Contemporary deep layer facial rejuvenation. *Plast Reconstr Surg.* 1997;100:1513–1523.
8. Alpert B, Nahai F. Paper presented at the American Society for Aesthetic Plastic Surgery Meeting; April 15-21, 2004; Vancouver, British Columbia, Canada.
9. Ammirati M, Spallone A, Ma J, Cheatham M, Becker D. An anatomicomicrosurgical study of the temporal branch of the facial nerve. *Neurosurgery* 1993;33:1038–1043; discussion 1044.
10. Abul-Hussan HS, von Drasek Ascher G, Acland RD. Surgical anatomy and blood supply of the fascial layers of the temporal region. *Plast Reconstr Surg.* 1986;77:17–28.
11. Lettieri S. Frontal branch of the facial nerve: Galeal temporal relationship. *Aesthet Surg J.* 2008;28:143–146.
12. Campiglio GL, Candiani P. Anatomical study on the temporal fascial layers and their relationships with the facial nerve. *Aesthetic Plast Surg.* 1997;21:69–74.
13. Krayenbuhl N, Isolan GR, Hafez A, Yasargil MG. The relationship of the fronto-temporal branches of the facial nerve to the fascias of the temporal region: A literature review applied to practical anatomic dissection. *Neurosurg Rev.* 2007; 30:8–15.
14. Accioli de Vasconcellos JJ, Britto JA, Henin D, Vacher C. The fascial planes of the temple and face: An en-bloc anatomical study and a plea for consistency. *Br J Plast Surg.* 2003;56: 623–629.
15. Daane SP, Owsley JQ. Incidence of cervical branch injury with "marginal mandibular nerve pseudo-paralysis" in patients undergoing face lift. *Plast Reconstr Surg.* 2003;111:2414–2418.