Temporalis.

The Frontal Branch of the Facial Nerve across the Zygomatic Arch: Anatomical Relevance of the High-SMAS Technique

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Background: The frontal branch has a defined course along the Pitanguy line from tragus to lateral brow, although its depth along this line is controversial. The high–superficial musculoaponeurotic system (SMAS) face-lift technique divides the SMAS above the arch, which conflicts with previous descriptions of the frontal nerve depth. This anatomical study defines the depth and fascial boundaries of the frontal branch of the facial nerve over the zygomatic arch.
Methods: Eight fresh cadaver heads were included in the study, with bilateral facial nerves studied ($n = 16$). The proximal frontal branches were isolated and then sectioned in full-thickness tissue blocks over a 5-cm distance over the zygomatic arch. The tissue blocks were evaluated histologically for the depth and fascial planes surrounding the frontal nerve. A dissection video accompanies this article.
Results: The frontal branch of the facial nerve was identified in each tissue section and its fascial boundaries were easily identified using epidermis and periosteum as reference points. The frontal branch coursed under a separate fascial plane, the parotid-temporal fascia, which was deep to the SMAS as it coursed to the zygomatic arch and remained within this deep fascia over the arch. The frontal branch was intact and protected by the parotid-temporal fascia after a high-SMAS face lift.
Conclusions: The frontal branch of the facial nerve is protected by a deep layer of fascia, termed the parotid-temporal fascia, which is separate from the SMAS as it travels over the zygomatic arch. Division of the SMAS above the arch in a high-SMAS face lift is safe using the technique described in this study. (*Plast. Reconstr. Surg.* 125: 1221, 2010.)

The cutaneous course of the frontal branch was described initially in 1966 by Pitanguy and Ramos.[1] Their findings of an anatomical study showed that the frontal branch coursed from 0.5 cm from the tragus to 1.5 cm lateral to the supraorbital rim. This has provided a topographic guide for the nerve, although its depth in three dimensions continues to be confusing. Numerous studies have described its location but there has not been a consensus as to the depth or its fascial boundaries.[2–11]

The fascial relationships of the frontal branch of the facial nerve vary remarkably within the literature.[2–40] It remains ambiguous in part because of the lack of a standardized nomenclature, and in part because of considerable variation in the described depth of the nerve at various levels

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across the zygomatic temporal region. As shown by the works of Furnas, Gosain, and Stuzin et al., no consistency exists as to the exact fascial plane and safe plane of dissection in and across the zygomatic arch. Confounding the issue further are the numerous names attributed to the various fascial layers. The temporoparietal fascia, which is a continuation of the superficial musculoaponeurotic system (SMAS), has multiple names and has been referred to as the superficial temporal fascia and the galeal aponeurotica.[4,5,12] The deep temporal fascia envelops the temporalis muscle and extends down to the zygomatic arch, fusing with the periosteum anterior and posterior. This layer is often broken down into superficial and deep portions that are separated by the temporal fat pad as described by Stuzin et al.[4,5] With regard to the superficial deep temporal fascia, several names exist in the literature and include the intermediate fascia and the innominate fascia.[4,5,20] Finally, there are descriptions of the loose areolar plane between the temporoparietal fascia and the deep temporal fascia, and some authors refer to this area as a separate fascial plane and have referred to it as the innominate fascia, or subaponeurotic plane.[4,5,12–17] These variations and discrepancies are partly to blame for the lack of consistency with respect to the depth and location of the frontal branch of the facial nerve across the zygomatic temporal region. The thought that the nerve branch travels within the SMAS has clinically correlated with the alteration of face-lift technique.[41–50] Stuzin et al. describe a lateral low-SMAS fasciotomy to protect the frontal branch with a superior extension to the lateral canthus.[41] In the high-SMAS technique, the SMAS is incised transversely at a level above the arch. The advantage of this technique would be to provide a vertical vector to the face lift with a composite flap containing SMAS and subcutaneous cheek tissue.[51,52] One would think that, based on previous studies, there would be a 100 percent incidence of frontal branch injury, though in reality the senior author (F.E.B.) has not had any permanent nerve injury.[53] The technique to prevent nerve injury in this procedure includes a subcutaneous temporal dissection superficial to the frontal branch 2 cm above the arch at the level of the lateral canthus. After the SMAS has been elevated, the level of SMAS transection is then incised with a push-cut across the arch to the orbicularis oculi while maintaining the temporal mesentery. The purpose of this study was to evaluate the depth of the frontal branch as it traverses the zygomatic arch (Fig. 1).

METHODS

Eight fresh frozen cadaver heads were used in the study. They were donated from the Willed Body Program at the University of Texas Southwestern. Institutional review board approval was granted through the Department of Plastic Surgery Human Tissue Program. The cadaver heads were identified by number and hemiface, and then cutaneous markings were measured and marked. Points 0.5 cm from the tragus and 1.5 cm from the lateral orbital rim were connected with a line demonstrating the Pitanguy line, which theoretically correlated to the course of the frontal branch (Fig. 2). A pretragal incision was then used to identify the main frontal branch trunk lateral to the parotid gland. This was traced distally to the secondary trunk of the zygomatic frontal trunk anterior to the parotid (Fig. 3). The tissue overlying the preplaced marks was then excised en bloc to the lateral orbital rim over the zygomatic arch, including skin, all subcutaneous tissue down to the zygomatic periosteum, and deep temporal fascia (Fig. 4). This gross tissue block measured approximately 8 × 4 cm. The tissue superior to the

Fig. 1. The frontal branch of the facial nerve sectioned into 1-cm blocks over the zygomatic arch.

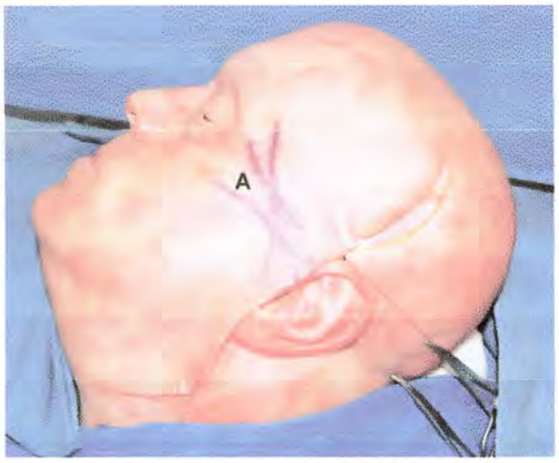

Fig. 2. Cutaneous markings of the course of the frontal branch over the zygomatic arch (*A*). The nerve was marked using the Pitanguy line from 0.5 cm from the tragus to 1.5 cm lateral to the superior lateral orbital rim.

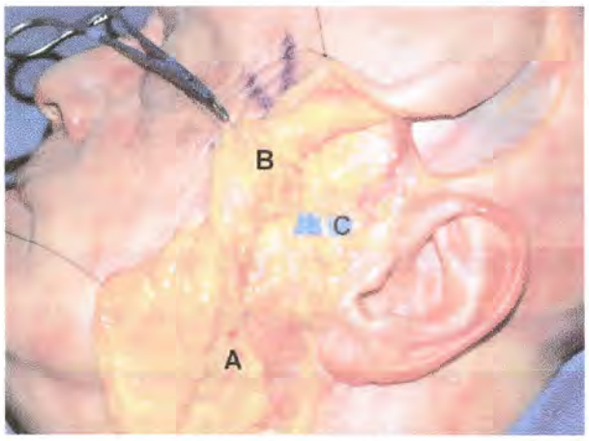

Fig. 3. The proximal frontal branch (*C*) identified under the SMAS (*A*) and the parotid temporal fascia (*B*).

proximal nerve was subsectioned into approximately five 1-cm^2 blocks per hemiface and then preserved in formalin. The tissue specimens were mounted and stained with hematoxylin and eosin and Bucholsky nerve stain. Pathologic evaluation was performed by a board-certified pathologist, and clinical correlation was performed by the senior authors (F.E.B. and A.P.T.). Each 1-cm tissue section did have frontal nerve within it, and the fascial layers superficial and deep to the nerve were identified and traced in each block.

A high-SMAS face lift with transverse fasciotomy was performed after the proximal nerve was identified on two additional heads. The nerve was then dissected under loupe magnification

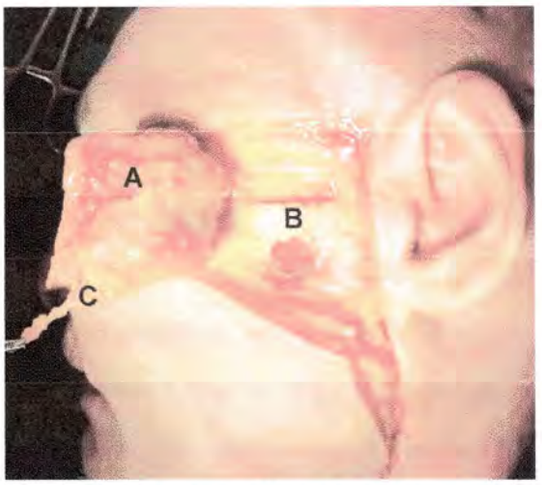

Fig. 4. The full-thickness, gross tissue block (*A*) removed over the zygomatic arch (*B*), with the proximal nerve branch (*C*) attached to the specimen.

across the zygomatic arch to confirm its continuity and the fascial planes above it.

RESULTS

Eight fresh frozen cadaver heads were successfully used in this study. The cutaneous landmarks previously described by Pitanguy were found to be 100 percent accurate on every cadaver. This was used as a cutaneous landmark in identifying the nerve. The frontal branch of the facial nerve consistently arose from the substance of the parotid as the zygomatic frontal trunk. It was covered by the parotid capsule, which transitioned superiorly to a fibrofatty layer, which was easily dissected off of the SMAS. The trunk then divided into its terminal branches of the zygomatic branch and frontal branch approximately 1 to 2 cm after exiting the parotid gland. The frontal branch had multiple fascicles; however, they were all in close proximity and easily identifiable with 2.5× loupes. All fascicles appeared to travel in a superomedial direction in alignment with the cutaneous landmarks. This was confirmed with the histologic en bloc evaluation of the tissue overlying the zygomatic arch. There was a consistent layer of fascia covering the frontal nerve that was identified clinically and confirmed as a separate layer on histologic evaluation. Histologic evaluation was performed on 1-cm^2 blocks over a 5-cm distance across the zygomatic arch (Fig. 5). At the zygomatic arch, the frontal branch is in close proximity to the periosteum and covered by a fascial layer separate from the SMAS. As the nerve crosses above the arch, periosteum is replaced with deep temporal fascia and tem-

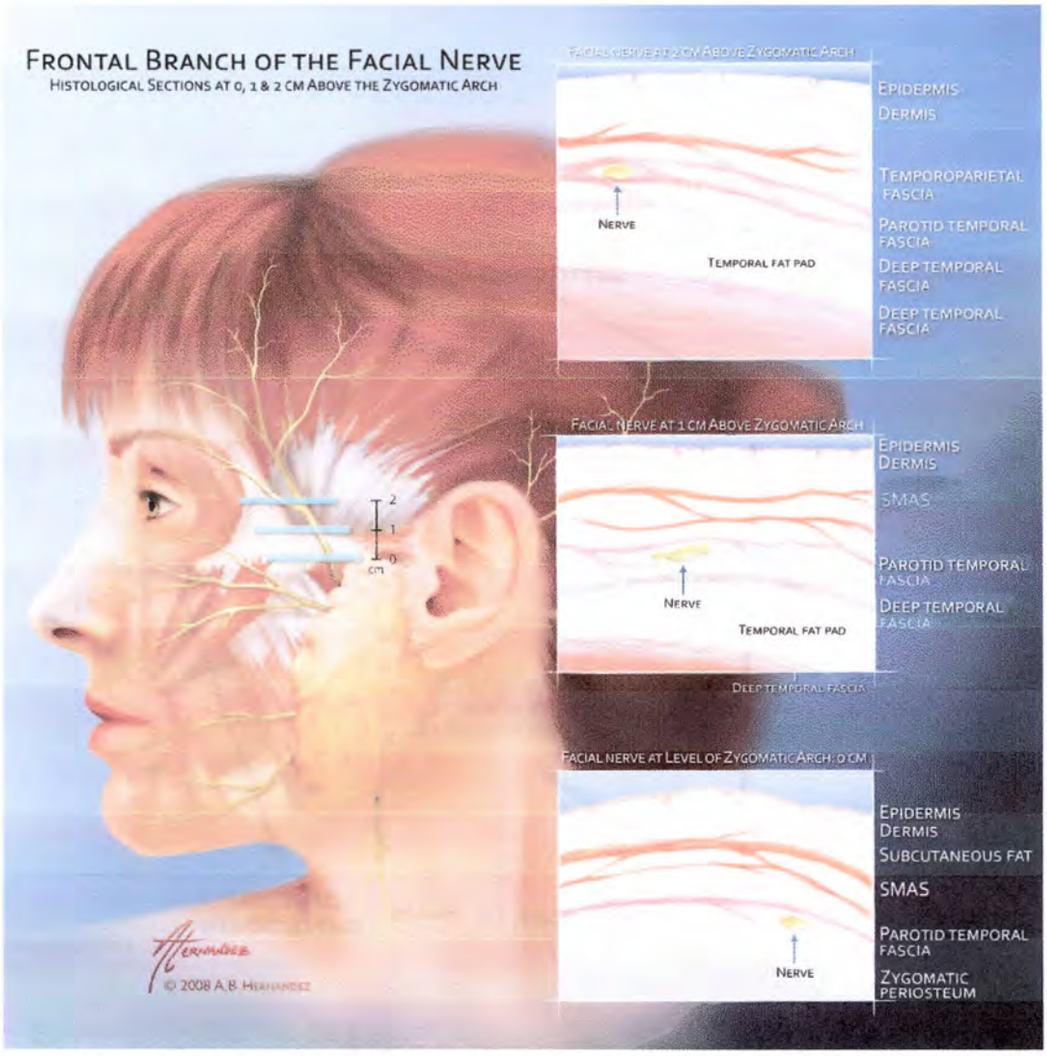

Fig. 5. Schematic depiction of histologic tissue sections harvested at 1-cm intervals over the zygomatic arch.

poroparietal fascia superficially. This relationship is preserved to approximately 2 cm above the arch, where the nerve appears to transition through the temporoparietal fascia to merge with the anterior branch of the superficial temporal artery.

The dissections confirmed a distinct fascial layer separating the nerve from the temporoparietal fascia. This previously unnamed fascia or "innominate fascia" is termed the "parotid temporal fascia" in this article. This is a distinct layer that separates the nerve from the SMAS/temporoparietal fascia and the deep temporal fascia. At the level of the zygomatic arch, the nerve is below this layer and abuts the periosteum of the arch (Figs. 6 and 7). As the nerve proceeds in a superior direction 1 cm above the zygomatic arch, it remains below this layer but becomes more superficial as the dissection proceeds (Figs. 8 and 9). The frontal branch of the facial nerve pierces a septum along its course approximately 2 cm above the arch but remains just deep to the temporoparietal fascia (Figs. 10 and 11). In all dissections, the frontal branch of the facial nerve remained below the temporoparietal fascia to a level of 2 cm above the zygomatic arch and at no time was within the substance of the SMAS–temporoparietal fascia complex.

Dissection of the two cadavers after high-SMAS face lift confirmed the nerve to be deep to the SMAS at the level of the high-SMAS transection over the zygomatic arch. The SMAS was easily separable from the underlying parotid temporal fascia. An areolar plane separating the SMAS from the parotid temporal fascia was consistent

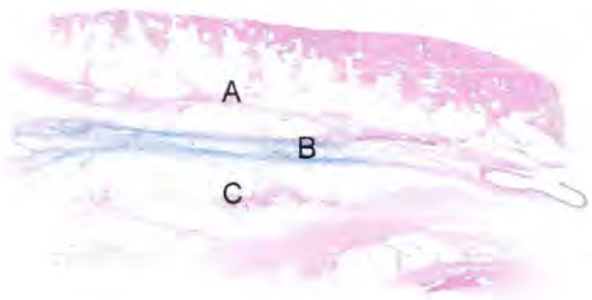

Fig. 6. Histologic example of specimen at the caudal zygomatic arch. Frontal branch nerve (*C*) covered by parotid temporal fascia (*B*) and SMAS (*A*) with periosteum deep to the nerve.

from the parotid capsule to above the zygomatic arch. The frontal branch was confirmed to be contained and preserved in all specimens after the high-SMAS dissection. This is demonstrated in the **Video, Supplemental Digital Content 1,** which demonstrates the dissection technique used in this anatomical study, ***http://links.lww.com/PRS/A153***. It identifies the separate fascial planes that cover the frontal branch of the facial nerve as it courses over the zygomatic arch. A transverse high-SMAS fasciotomy is performed that demonstrates the depth and maintenance of the nerve with this face-lift technique.

DISCUSSION

The high-SMAS face lift uses a multiplanar sub-SMAS and subcutaneous dissection to mobilize the cheek and then a transverse SMAS fasciotomy above the zygomatic arch to allow for a vertical vector of soft-tissue repositioning. This direction of face lift restores the facial soft tissue as a composite unit to a youthful and natural position. The transverse SMAS incision has been one point of contention in gaining acceptance of this procedure secondary to the lack of consensus on the course of the frontal branch and the inherent risk of frontal branch injury.[4–10,41–50] This study demonstrates that if the procedure is performed appropriately, the frontal branch is deep to the SMAS above the zygomatic arch and also has an additional fascial layer, termed the parotid temporal fascia, covering it. The clinical maneuvers to protect the frontal branch in a high-SMAS face lift include (1) subcutaneous finger dissection above the zygomatic arch coupled with (2) deep sub-SMAS dissection on the deep temporal fascia to form a mesentery that reliably contains the frontal nerve, and (3) push-cut transection of the SMAS flap above the arch to the orbicularis oculi.

This fascia was first described in 1965 by Furnas as a laminated areolar tissue continuous with the galea.[3] Additional descriptions have described a superficial temporal fascia, temporoparietal fascia, and innominate fascia. We propose that the fascia be named by its origin and insertion, like that of the parotid-masseteric fascia and temporoparietal fascia, so that the terminology is uniform in this region. The parotid temporal fascia is not a novel fascia, as demonstrated by previous

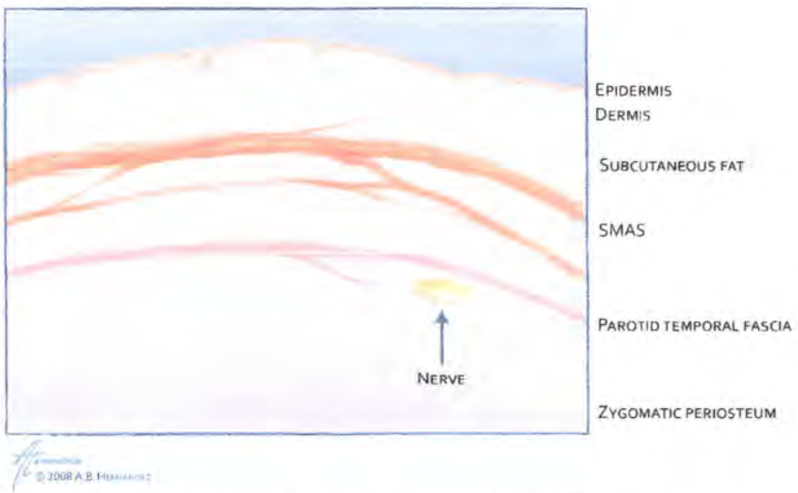

Fig. 7. Schematic depiction of the frontal branch at the zygomatic arch.

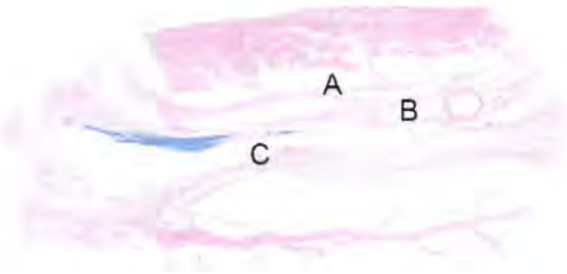

Fig. 8. Histologic example of specimen at 1 cm above the zygomatic arch. Frontal branch nerve (*C*) consistently covered by parotid temporal fascia (*B*) and SMAS (*A*) with deep temporal fascia and temporal fat pad deep to the nerve.

descriptions, although this term is a plea for consistency so that the course of the frontal branch can be easily related to the fascial boundaries over the zygomatic arch. This study uses both gross dissections under loupe magnification and histologic evaluation of 1-cm intervals over the arch. The frontal branch of the fascial nerve can be easily identified by its cutaneous course from the tragus to the lateral brow. The cutaneous landmarks defined by Pitanguy were confirmed to be accurate in this study, although this was not the focus of the study. The frontal branch was identified in all cadaver dissections through a pretragal incision and a sub-SMAS dissection with elevation of the parotid and identification of the zygomaticofrontal trunk of the facial nerve. This trunk was covered uniformly by the investing fascia of the parotid, which then extended superiorly as the parotid temporal fascia, where the nerve traveled in a heterogeneous fat pad. The SMAS was easily elevated off of this fascia, as there was an areolar plane between them. This plane was elevated easily to above the arch, with the SMAS maintaining its integrity but thinning as it becomes more fascia-like and homogenous. The parotid temporal fascia can also be elevated off of the nerve to above the zygomatic arch. This is demonstrated in the dissection video that accompanies this article. The histologic evaluation reinforces the dissection findings and demonstrates that there are two independent fascial planes below the arch that are maintained to approximately 2 cm above the arch when the frontal branch penetrates the temporoparietal fascia and travels with the anterior branch of the superficial temporal artery.

The findings of this study include the observation that the frontal branch has a defined anatomical course and uniform fascial plane within which it travels. The nerve does not travel within the SMAS, which is the thought and teaching that has been passed on in the anatomical teaching in this area.[4,5] This inaccurate description imposes a false sense of security when approaching the arch and midface from a superior and deep plane. This is echoed in the past descriptions of the subperiosteal face lift, with a high number of frontal branch palsies, reported be as high as 11 percent.[54–58] In evaluating the histologic specimens, the nerve closely abuts the periosteum of

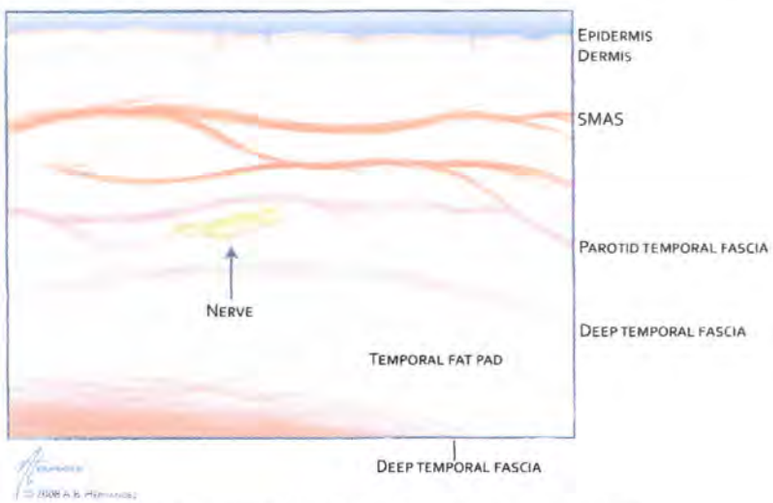

Fig. 9. Schematic of frontal branch 1 cm above the zygomatic arch.

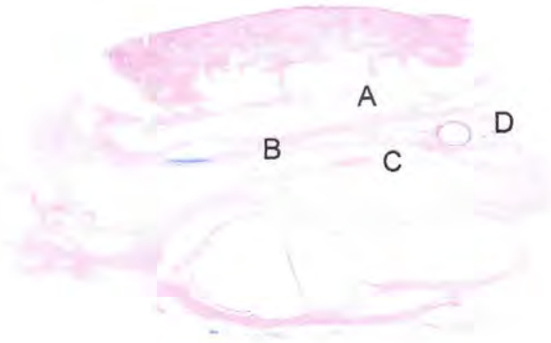

Fig. 10. Histologic example of specimen at 2 cm above the zygomatic arch. Frontal branch nerve (*C*) consistently covered by parotid temporal fascia (*B*) and SMAS (*A*), though the fascial layers fuse at the anterior branch of the superficial temporal artery to form the temporal parietal fascial layer (*D*).

Video. Supplemental Digital Content 1 demonstrates the dissection technique used in this anatomical study, ***http://links.lww.com/PRS/A153***. It identifies the separate fascial planes that cover the frontal branch of the facial nerve as it courses over the zygomatic arch. A transverse high-SMAS fasciotomy is performed that demonstrates the depth and maintenance of the nerve with this face-lift technique.

the arch, and if the arch is to be dissected, it should be done by bilaminating the deep temporal fascia and/or elevating the periosteum off of the arch. Also, the SMAS can be elevated to above the arch and exists as a layer on histologic evaluation, which contradicts a previous study that demonstrated that the SMAS does not traverse the arch.

All of these findings are clinically correlated by the fact that the senior author (F.E.B.) has performed over 1000 high-SMAS face lifts without any permanent nerve injuries. This clinical finding demonstrates that the high-SMAS face lift is safe and the frontal branch of the facial nerve is protected by the parotid temporal fascia at the zygomatic arch.

CONCLUSIONS

The frontal branch of the facial nerve is protected by a deep layer of fascia called the parotid temporal fascia, which is separate from the SMAS as it traverses the zygomatic arch. Division of the

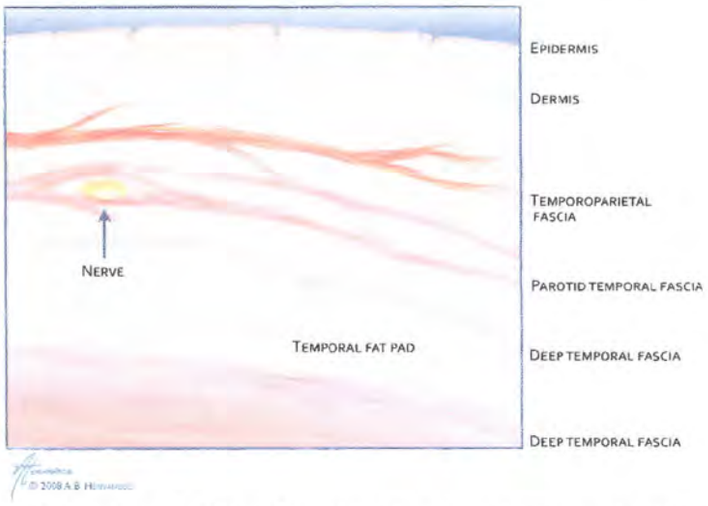

Fig. 11. Schematic of frontal branch at 2 cm above the zygomatic arch.

SMAS above the arch in a high-SMAS face lift is safe using the technique described in this study.

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