The Suborbicularis Oculi Fat (SOOF) and the Fascial Planes
Has Everything Already Been Explained?

Chiara Andretto Amodeo, MD; Andrea Casasco, MD; Antonia Icaro Cornaglia; Robert Kang, MD, MPH; Gregory S. Keller, MD

IMPORTANCE During anatomic and surgical dissections, a connection was seen between the superficial layer of the deep temporal fascia and the prezygomatic area. These findings were in contrast to previous evaluations. This study defines this connection, which is important to understand from both surgical and anatomic standpoints.

OBJECTIVE To define the connection between the superficial layer of the deep temporal fascia and the prezygomatic area and demonstrate the presence of a deep fascial layer in the midface.

DESIGN AND SETTING Anatomical study performed at the Laboratoire d'Anatomie de la Faculté de Médecine de Nice, Sophia Antipolis, France; at the Centre du Don des Corps de l'Université Paris Descartes, Paris, France; and at the Department of Experimental Medicine, Histology, and Embryology Unit of the University of Pavia, Pavia, Italy. Twenty-four hemifaces of 14 white cadavers were dissected to define the relationship between deep temporal fascia and the midface. Four biopsy samples were harvested for histologic analysis.

MAIN OUTCOMES AND MEASURES Dissection of 24 hemifaces from the fresh cadavers revealed the following findings. There is a connection of the deep fascia of the temple (superficial layer of deep temporal fascia) to the midface that divides the fat deep to the orbicularis muscle into 2 layers. One layer of fat is the so-called suborbicularis oculi fat (SOOF), which is superficial to the deep fascia, and the other layer of fat (preperiosteal) is deep to the deep fascia and adherent to malar bone. These findings are in contrast to previous anatomical findings.

RESULTS In 12 hemifaces, the superficial layer of the deep temporal fascia directly reached the prezygomatic area as a continuous fascial layer. In 16 hemifaces, the superficial sheet of the deep temporal fascia inserted at the level of the zygomatic and lateral orbital rim and continued as a deep fascial layer over the prezygomatic area. In all specimens, a deep fascial layer was present in the prezygomatic-infraorbital area. This deep fascial layer is adherent to the muscles of the infraorbital area, and it divided the fat located deep to the orbicularis oculi muscle into 2 layers: the SOOF and a deeper layer. Histologic examination of the biopsy samples confirmed these findings.

CONCLUSIONS AND RELEVANCE This study demonstrates the existence of a deep fascial layer in the midface. This fascia is connected to the superficial layer of the deep temporal fascia, and it divides the fat deep to the orbicularis oculi muscle into 2 layers. This new finding carries interesting implications related to the classic concept of the superficial musculoaponeurotic system.

LEVEL OF EVIDENCE NA.
The surgical anatomy of the temporal, malar, and infraorbital areas is complex and for this reason has been widely investigated. This anatomical study challenges 2 classic concepts regarding these facial areas that we believe can no longer be considered as paradigms. The first concept is that the deep temporal fascia always inserts at the level of the zygomatic arch, and therefore no communication exists between the temporal area and the malar-infraorbital area in the plane deep to the deep temporal fascia. The second concept is that no deep fascia exists in the midface.

In contrast to these previous observations, during our surgical cadaver dissections, an anatomic connection was seen between the temporal area and the malar-infraorbital area. The superficial layer of the deep temporal fascia has a key role in this relationship.

This study defines this connection and demonstrates the presence of a deep fascial layer in the midface. These new concepts are important to understand from an anatomic standpoint, and they reasonably carry surgical implications explaining the effectiveness of techniques already used in reconstructive and aesthetic facial surgery such as suture and traction on this deep fascia in the infraorbital region.

Methods

Cadaver Dissection
Twenty-four hemifaces of 14 fresh cadavers were dissected by the first author (C.A.A.) at the Laboratoire d’Anatomie de la Faculté de Médecine de Nice, Sophia Antipolis, France, and at the Centre du Don des Corps de l’Université Paris Descartes, Paris, France, to verify the presence of a deep fascial plane in the prezygomatic area medially, deep to the suborbicularis oculi muscle and related to the deep temporal fascia laterally.

Incisions were placed in the temporal scalp, a sub-SMAS (superficial musculoaponeurotic system) dissection was performed toward the infraorbital area, and the temporoparietal fascia and orbicularis oculi muscle were elevated. The same procedure was performed for the superficial layer of the deep temporal fascia (Figure 1). Photographs were taken at each step of the procedure.

Histologic Analysis
The histologic portion of this study was performed at the Histology and Embryology Unit of the Department of Experimental Medicine, University of Pavia, Pavia, Italy. Four full-thickness biopsy samples were harvested from 4 different hemifaces at the level of the zygomatic bone, lateral to the lateral orbital rim, between the temporal and infraorbital areas (Figure 2A) to analyze the disposition and course of the fascial planes in this region. Surgical dissections were performed on one side, and surgical findings were confirmed by histologic analysis of samples taken from the contralateral side.

Biopsy samples were fixed in 4% paraformaldehyde in 0.1M phosphate-buffered saline at a temperature of 20°C for 24 hours, cut into smaller portions (Figure 2B) in a cross-sectional caudal-cranial direction, and washed. Specimens were then transferred for cryopreservation in tissue-freezing medium (30% sucrose in phosphate-buffered saline) and stored at 4°C until cryotomy was performed. Cryosections, 10 to 15 μm, were obtained and stained with hematoxylin-eosin.

Results
In 8 hemifaces (2 bilateral and 4 unilateral specimens), surgical dissections showed that the superficial layer of the deep temporal fascia directly reached the prezygomatic-infraorbital area, passing over the zygomatic bone, without inserting into the anterior third of the zygomatic arch, but always inserting over the middle and lateral third of the zygomatic arch.

This deep fascia was a thin but strong, real fascial layer, and it divided the fat located deep to the orbicularis oculi muscle into 2 layers: a superficial layer corresponding to the suborbicularis oculi fat (SOOF) and a deeper layer (Figure 3 and Figure 4) (Video 1 and Video 2).

Histologic examination of biopsy samples harvested from the contralateral hemifaces of 4 of these 6 specimens confirmed the surgical findings, showing a continuous fascial layer from the temporal region crossing the zygomatic arch, to reach...
The superficial layer of the deep temporal fascia was a continuous layer from the temporal area to the prezygomatic area in 12 of 28 hemifaces (43% [8 surgically dissected + 4 histologically analyzed]). In 16 specimens (8 cadavers [57% of cases]), the superficial layer of the deep temporal fascia inserted at the level of the zygomatic bone and lateral orbital area, as classically described, continuing after this insertion as a defined deep fascial layer over the malar area (Figure 6A). This fascia was revealed through an incision just caudal to the point of insertion of the superficial layer of the deep temporal fascia.

In all specimens, this deep fascial layer was present in the prezygomatic-infraorbital area. It divided the fat located deep to the orbicularis oculi muscle into 2 layers; the SOOF and a deeper fat layer, with the latter situated in the same plane as the superficial temporal fat pad (the fat pad between the 2 layers of deep temporal fascia). This fascia is very adherent to the zygomaticus major and minor muscles and continues medially toward the nasal pyramid. It also covers the levator labii superioris and levator anguli oris muscles, becoming extremely thin at the level of the levator labii superioris alaeque nasi muscle (Figure 6B). Cranially it is attached to the lower orbital rim, and caudally it follows the zygomaticus major muscle and the other muscles of the infraorbital area where they reach the fibrous component of the SMAS layer toward the orbicularis oris muscle. In fact, the zygomaticus major muscle served as a useful reference landmark in the dissection from the malar area toward the lower third of the face. This fascia is in the same plane as the orbital septum, and the fat deep to this fascia is in the same surgical plane as the superficial temporal fat pad (Figure 4B).

Macroscopic inspection areas of the 4 hemifaces from where the histologic biopsy samples were harvested revealed the following fat and fascial layers from superficial to deep: superficial subcutaneous fat, SMAS, SOOF, deep fascia, and deep fat. The fat lobules appeared distinct in color and shape within each of the various layers (Figure 2A): round and yellow in the subcutaneous plane, elongated and yellowish in the SOOF plane, and round and white in the plane deep to the deep fascia. In these 4 hemifaces the fascial planes appeared continuous, and there was no macroscopic evidence of insertion of the superficial layer of the deep temporal fascia.

Discussion

To our knowledge, the existence of a deep fascial plane in the midface has not been described, aside from the parotid fascia. This study demonstrates that a deep fascial plane exists in the midface and that it is a true fascial layer as opposed to a septum between the periosteum and cheek skin or a membrane lining the walls of a prezygomatic space and covering like a coating the upper surfaces of the zygomatico-cutaneous ligaments. In fact, in 6 of 14 cases (43%), the superficial layer of the deep temporal fascia continued directly from the temporal area to reach the prezygomatic-infraorbital area, where it divided the fat deep to the orbicularis oculi muscle into 2 layers. Even when the superficial layer of the deep temporal fas-
The existence of this deep fascial layer between the SMAS and the facial mimic muscles that lift the upper lip and its path from the superficial surface of the infraorbital facial muscles area to the undersurface of the SMAS, where it is classically described as thin and discontinuous, carries new important considerations in the classic understanding of the SMAS, which will be discussed in future studies.\textsuperscript{10}

Figure 3. Surgical Dissections

A, View from the right temporal area. The superficial layer of the deep temporal fascia is elevated. It continues over the anterior third of the zygomatic arch toward the infraorbital region to form the deep fascia. Note: deep to this fascial layer laterally, the zygomaticus major muscle appears (blue arrow). Medial to this is the deep fat layer (red arrow). The suborbicularis oculi fat is visible superficial and medial to the deep fascia (green arrow). B, View from the left temporal area. The superficial layer of the deep temporal fascia continues toward the prezygomatic-infraorbital area to form the deep fascia. Deep to this fascial layer, the prezygomatic fat is visible. The red arrow points to the nasal pyramid. C, The superficial layer of the deep temporal fascia continues inferomedially over the zygoma. Black arrow: whitish deep fat layer. D, View from the left temporal area. Note again the continuous deep fascial layer from the temporal area toward the malar region over the anterior third of the zygomatic arch. Deep to this deep fascial layer the deep fat layer appears.

Figure 4. Deeper Fascial Layer From the Temporal Area to the Prezygomatic-Infraorbital Area

A, The superficial musculoaponeurotic system layer has been elevated (the transected superficial temporal artery is visible laterally). The superficial layer of the deep temporal fascia has been dissected. Note its continuity inferomedially toward the prezygomatic area. B, Same specimen as in part A. The deep fascia has been elevated from the orbital margin (blue arrow). The zygomaticus major and minor and levator labii superioris muscles appear. The deep fascia continues toward the nasal pyramid, very adherent to the underlying muscles. Note that the deep fascia is in the same plane as the orbital septum, which was left intact (red arrow).
The subcutaneous tissue. The color, shape, and disposition of the fat lobules in this specimens is reminiscent of the classic anatomic description of the subcutaneous tissue by Velpeau in 1825 and by Sterzi in 1910: the subcutaneous tissue in many body areas is divided by the superficialis fascia (in this case, the orbicularis oculi muscle) into a superficial layer and a deeper layer, where the fat lobules present exactly the color and shape characteristics described in the present study.

The function of this deep fascia, which is adherent to the muscles that can be considered the lifting system of the upper lip, could be one of the classic functions of deep fascias in other parts of the body, which is to coordinate muscle activity and to transmit load between compartments and muscles. The force of the contraction of one muscle in the infraorbital area is transmitted to the other muscles covered by this deep fascia coordinating their activity. This is why it seems that traction on this fascia at the level of the zygomatic bone and inferior orbital rim lifts the SOOF and that this lifting is transmitted down to the lower third of the face. According to this hypothesis, in individuals in whom this fascia is a continuous layer without insertion into the zygoma, its function could be to position the upper lip, acting on its “lifting system,” while the temporal muscle is lifting the mandible, balancing the position of the lips “in toto.”

Conclusions

This study demonstrates the existence of a deep fascia in the midface and that the temporal and the prezygomatic-infraorbital area are connected through the superficial layer of the deep temporal fascia. In 12 hemifaces (43% of specimens), this fascia continued directly from the superficial layer of the deep temporal fascia into the prezygomatic-infraorbital area without inserting over the zygomatic arch. In 16 hemifaces (57% of specimens), it started at the insertion of the superficial sheet of the deep temporal fascia.

This fascia was present in all specimens, and it always separated the fat deep to the orbicularis oculi muscle into the SOOF and a deeper fat layer, the latter being in the same plane as the superficial temporal fat pad. Furthermore, according to these findings, the SOOF appears to be in a deep subcutaneous plane separated from the superficial subcutaneous plane by the orbicularis oculi muscle, which can be considered the superficialis fascia in this area. This deep fascia is an anatomic and surgical plane between the orbicularis oculi muscle (SMAS layer) and the zygomaticus major and minor, the levator labii superioris, and the levator anguli oris muscle, such that the facial mimic muscles are covered by this deep fascia. This new finding carries interesting implications related to the classic concept of SMAS.
Jean-Rémy Hadadou, technician at Centre du Don des Corps de l’Université Paris Descartes, Paris, France, provided technical support during the dissections.

Additional Information: In memory of Valerio Micheli-Pellegrini, MD (1919-2011).

Correction: This article was corrected online July 10, 2013, for a graphical error in Figure 2.

REFERENCES