Discussion

Surgical Anatomy of the Ligamentous Attachments in the Temple and Periorbital Regions

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Discussion by David M. Knize, M.D.

This article by Drs. Moss, Mendelson, and Taylor introduces some thoughtful ideas about the nature and function of the connective tissues of the temporal fossa and periorbital areas. The study of anatomy is an adynamic science from which the anatomist works to develop a notion of function. The terms used to describe anatomic structures reflect the anatomist's conception of how that structure may have functioned. The major portion of this article is devoted to the development of terminology and a system to describe the connective tissues of the temporal fossa and periorbital areas.

The system the authors develop is based on the concept that the superficial temporal fascia and galea planes of the upper face constitute the SMAS plane of the upper face. The connective tissues that fix this SMAS plane of the upper face to either periosteum or deep temporal fascia are the "ligaments" of the upper face. They propose a classification of ligaments that describes three forms: (1) true ligaments, (2) "septa," and (3) "adhesions" (Figs. 1 through 3 of their article). A true ligament would be defined as a connective tissue structure fixed to either the deep fascia or the periosteum from which it passes through the SMAS plane to stabilize the skin plane by anchoring to dermis. I agree with the authors that there are no such true ligaments in the upper face like the osteocutaneous ligaments of the midface, which Furnas[1] has named "retaining ligaments." Only those connective tissues that the authors classified as "septa" and "adhesions" can be found in the temporal fossa and periorbital areas. They describe both septa and adhesions as ligaments whose function is limited to stabilizing the SMAS plane by connecting deep fascia or periosteum to the *undersurface* of the SMAS plane. The basic structural difference between septa and adhesions is how they connect (Figs. 1 through 3). Septa are connective tissue planes that are fixed to deep fascia or periosteum along one edge and to the SMAS plane along another edge. Adhesions are connective tissue planes that are fixed to deep fascia or periosteum over their deep surface and to the SMAS plane over their superficial surface. The authors further describe retinacula cutis or dermal insertions that work in concert with the septa and adhesions to fix the outer surface of the SMAS plane to dermis and stabilize the overlying skin plane. On this basis, they argue that their septa and adhesions of the temporal fossa and periorbital areas *function* as retaining ligaments, even though they are not the true retaining ligaments, as Furnas described. I can agree with the authors that this mechanism exists in the temporal fossa area; however, I have not seen evidence that the same mechanism exists in the superior periorbital area and over the lower frontal bone medial to the anterior end of their "superior temporal septum" (Fig. 3).

My anatomic studies[2] confirm that some connective tissues of the temporal fossa do provide the effect of a retaining ligament as described above. Shown here in my Figure 1, *left*, is such a structure that I have called the "orbital ligament"[2] and which the authors call the "temporal ligament." It would be a component of the

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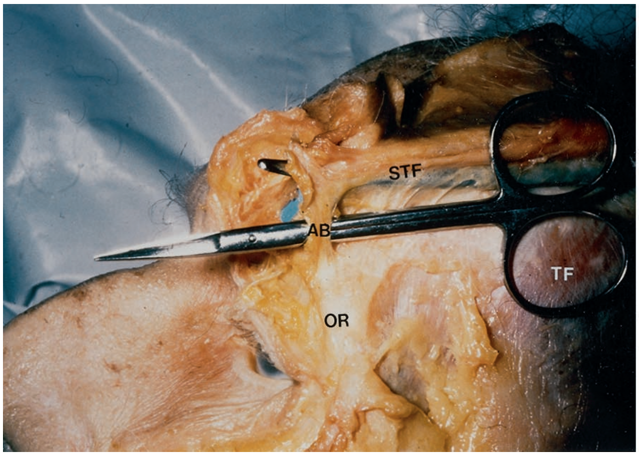

FIG. 1. Connective tissue with retaining ligament effect. (*Left*) This ligament (AB) has a bony origin near the orbital rim (OR), and it connects to the deep surface of the superficial temporal fascia (STF) or SMAS. It can provide a retaining ligament effect for the overlying soft tissues lateral to the "glide plane space" cleft in the deep galea plane, because fibrous bands present between the surface of the SMAS plane and dermis support the skin plane. The deep temporal fascia (TF) is labeled. (*Right*) A hemostat is pulling on the ligament from below. Note the indentation in the skin that results. (From Knize, D. M. An anatomically based study of the mechanism of eyebrow ptosis. *Plast. Reconstr. Surg.* 97: 1321, 1996.)

anterior end of the authors' "superior temporal septum." Clinically, we transect this structure along with the other adjacent connective tissue elements that fix the SMAS plane undersurface to bone or deep fascia to permit forehead flap transposition. The SMAS and its overlying skin effectively transpose as a unit without the need for skin tension,[3] because dermal insertions connect the outer surface of the SMAS plane to skin (my Fig. 1, *right*).

I disagree with the authors, however, that the connective tissues along the lower frontal bone (Fig. 3) similarly function like a retaining ligament to anchor that overlying skin plane. Over the lower frontal bone, only the deepest layer of the multi-layered deep galea plane (there is a superficial galea plane over the frontalis muscle and a deep galea plane under the frontalis muscle) fuses to periosteum. In my view, the adhesions described by the authors along the lower frontal bone do stabilize the deepest layer of the galea, but this has no demonstrable effect on the overlying dermis. Shown in the cadaver dissection in my Figure 2 is an example of the large cleft that I have always found between two of the lower layers of the deep galea plane. I call this cleft the "glide plane space," because its floor and roof glide over each other with contraction of the corrugator muscle located within the roof. The glide plane space contains areolar tissues with no connective tissue elements of any substance crossing this space. Similarly, I found no connective tissue elements of the nature to function as a retaining ligament crossing the galea fat pad, which is enveloped by a more superficial cleft in the deep galea plane superficial to the glide plane cleft and deep to frontalis muscle. The inferior half of the frontalis muscle slides freely over the galeal fat pad. I found no retaining-type ligaments entering its deep surface. On the

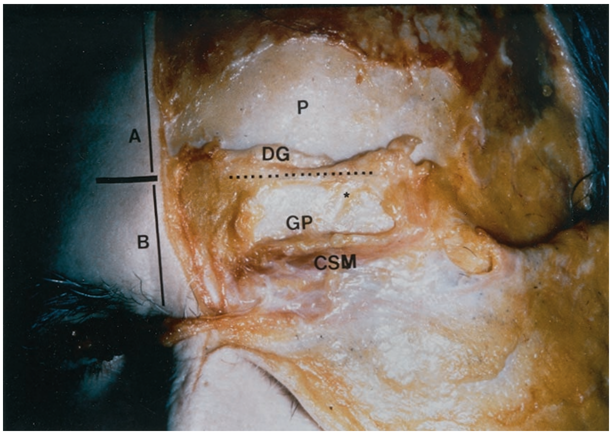

FIG. 2. Galeal cleft. This cadaver dissection demonstrates the large area cleft (GP) in the deep galea plane (DG) under frontalis muscle and over the lower frontal bone periosteum (P). The corrugator supercilii muscle (CSM) is part of the roof of this cleft. No connective tissue fibers that could constitute a "retaining ligament" pass across this galeal cleft. In the upper forehead area (A), the galeal plane under frontalis muscle is a single plane, whereas in the lower forehead area (B), the galea is multilayered to form clefts. The *dotted line* represents the level below which the deepest layers of galea and periosteum fuse together to form the floor of the cleft (GP). (From Knize, D. M. An anatomically based study of the mechanism of eyebrow ptosis. *Plast. Reconstr. Surg.* 97: 1321, 1996.)

outer surface of the frontalis muscle, however, I found dermal insertions that passed through the superficial galea plane and anchored the muscle to the overlying skin. These dermal insertions allow the mobile lower half of the frontalis muscle and the overlying lower forehead skin to move as a unit.

Eyebrow position is not maintained by retaining ligaments, in my opinion. Rather, eyebrow position is the result of a dynamic state of equilibrium between the suspensory force of the frontalis muscles and the depressor forces of the orbicularis oculi, depressor supercilii, corrugator supercilii, and procerus muscles. With aging, we classically see the lateral eyebrow segment becoming ptotic earlier than the medial segment. I do not believe that this difference is the effect of retaining ligaments. Rather, I believe that it is the result of an anchoring effect on the medial eyebrow segment produced by the supraorbital and supratrochlear nerves and vessels that pass through the medial lower frontalis muscle, plus some support from the corrugator supercilii muscle. At the same time, the lateral eyebrow segment is subjected to forces that make it move lower. These forces are produced by the gravity-driven descending temporal soft-tissue mass and the contraction of the lateral orbicularis oculi muscle. For these reasons, I must question the authors' extension of the retaining ligament mechanism concept found in the temporal fossa region to the superior periorbital region.

Regarding a related issue, the authors said that the "periorbital septum" (septum orbitale) provides a "bony origin" for frontalis muscle. I found that the septum orbitale continues cephalad as part of the deep galea plane, and I observed no direct or indirect connections to the frontalis muscle. There are some connections between the septum orbitale and the suborbicularis fascia plane. These connections might indirectly "limit" frontalis muscle elevation of the eyebrow, because frontalis muscle interdigitates with orbicularis oculi muscle. However, I do not believe that it effectively stabilizes either frontalis muscle or eyebrow position relative to the skull, because the lower half of frontalis muscle has a range of motion of at least 1.5 cm in most individuals.

I must question the authors on one final point. They said that only loose areolar tissue is found in the space between the palpebral portion of the orbicularis muscle and the septum orbitale. This space often can contain a preseptal fat pad (see Fig. 3 in my reference 2 and Fig. 8 in my reference 4).

I raise these issues of variation in our respective views of the upper facial anatomy as an honest difference of opinion. Two anatomists can examine the same structures and come away with different visions of the function of those structures.

A valuable part of this article is the well-described and nicely illustrated technique for protecting the rami of the temporal branch of the facial nerve when the surgeon who is doing a foreheadplasty through scalp incisions dissects over the deep temporal fascia. The authors divide the area over the surface of the deep temporal fascia into an "upper temporal compartment" and a "lower temporal compartment" (Fig. 2). These two "compartments" are separated by the "inferior temporal septum," the line of fusion between the superficial temporal fascia and the deep temporal fascia that is found near the level that the belly of the temporalis muscle begins to form its tendon. Under direct vision, the criss-crossed fibers that form from the decussation of the superficial temporal fascia and the deep temporal fascia planes can be observed clearly at surgery. The authors point out that no critical structures will be injured by dissection from a scalp incision over the deep temporal fascia until the "inferior temporal septum" is reached. That fusion line is the "marker" for the location of the rami of the temporal branch of the facial nerve. Isse made a similar observation when dissecting this area using the endoscope.[5] The authors demonstrate that the rami of the temporal branch run immediately inferior to this fusion line and parallel with it; therefore, these nerves are at risk for injury when dissection proceeds through the "inferior temporal septum." The surgeon must exercise caution when dissecting beyond this level to protect not only the rami of the temporal branch of the facial nerve, but the adjacent medial and lateral zygomaticotemporal vessels and the medial and lateral zygomaticotemporal nerves. These latter structures pass perpendicularly through the space between the "inferior temporal septum" and the zygomatic arch in an almost straight row as they leave the deep temporal fascia plane ("floor") to pierce the superficial temporal fascia plane ("roof"). Isse has called this anatomic picture the "telephone pole" formation.[5] His analogy is that the zygomaticotemporal vessels and nerves resemble "telephone poles," with the rami of the temporal branch appearing to be the "wires" as they run in the deep layers of the superficial temporal fascia that forms the "roof" of this space. The surgeon unfamiliar with dissecting in this area will be well served by visualizing this concept, which is nicely illustrated in Figure 11.

I greatly appreciate the authors' painstaking anatomic studies, which allowed them to contribute a classification system for the connective tissues of the temporal fossa and periorbital areas and provide a detailed description of the relationships of these connective tissue planes to local nerves and vessels. Any systemization applied to anatomy helps with understanding and visualizing the relationships of the structures seen at surgery. This has the benefit of making surgery safer for both the surgeon and the patient. It is a gift when the anatomist can provide the surgeon with an opportunity to enrich his/her understanding of human anatomy. Indeed, this study is a gift to all of us.

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