

## THE SUPERFICIAL MUSCULO-APONEUROTIC SYSTEM (SMAS) IN THE PAROTID AND CHEEK AREA

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There is a "superficial muscular and aponeurotic system" (SMAS) in the parotid and cheek areas. This SMAS is partially described in Gray's<sup>9</sup> textbook of anatomy: "The facial muscles (muscles of expression) are cutaneous muscles lying within the layers of the superficial fascia . . ."

A careful study of the SMAS may lead to its proper use during surgical procedures on the face. Thus, in this paper, we consider both the anatomy and the potential surgical applications of the SMAS.

### MATERIALS AND METHODS

We studied 15 fresh cadavers, and in these we dissected 14 hemifacial preparations on 7 cadavers, aged 50 years or more.

Then 3 heads were each serially sectioned in one of 3 planes—sagittal, frontal, and horizontal. Each section was one cm thick. Prior to the sectioning the vessels were injected with Radiocorrodan<sup>10</sup> (Fig. 5) to opacify the very small arteries and veins. Each section was then studied radiographically.

Another 3 heads were similarly sectioned without preliminary injection and X-rayed, using an ultrathin focus (0.1 mm).

The histological specimens were stained with Masson's trichrome stain. (With this, the muscles stain red or black, the connective tissue stains green.)

Thus, each preparation was subjected to dissection, arteriography in serial sections, macrosections with macroscopic

and ultraradiographic studies, and microsections with microscopic studies. Particular attention was paid to the border zones—temporozygomatic area, mandibular area, nasolabial fold, and the pretragal area.

The dissections demonstrated the general features of the SMAS. The radiopaque dye injections on the serial sections located the avascular plane precisely. The ultraradiographic plates demonstrated the fibrous layers. The macroscopic (and, more importantly, the microscopic) sections demonstrated the delicate structure of the SMAS and its relations with each fibromuscular layer.

### FINDINGS

The SMAS in the parotid and cheek areas was always present. Sometimes it was thick, and sometimes thin, and it was in intimate relationship with the entire *fascia superficialis* of the head and neck.

### DESCRIPTION

Gray<sup>9</sup> writes "On the cheeks and lips, it (the *fascia superficialis*) contains a considerable amount of fat, and it is tougher and more fibrous especially in man."

The SMAS divides the subcutaneous fat in two layers. Superficial to it, small fat lobules are enclosed by fibrous septa running from the SMAS toward the dermis. Deep to the SMAS the fat is abundant, it lies between deep facial muscles, and it is not divided by such fibrous septa.

Thus, only after the fat lying superficial to the SMAS is removed is fibrous longitudinal structure apparent (Figs. 1, 2). In the parotid-masseteric area, the SMAS is thick and there it is attached to the parotid sheath. It is also still present anteriorly, superficial to the facial muscles, as shown by our dissections and histology studies. However, the SMAS becomes thin and discontinuous in the cheek area.

In most of our dissections, when the cadaver was more than 50 years old the SMAS appeared fibrotic. Therefore, we considered it as a fascia belonging to the cervicocephalic fascia (Couly *et al*<sup>2</sup>), continuous from the head to the neck (Fig. 2, center). Gray<sup>3</sup> writes "The superficial fascia of the face is directly continuous over the mandible with that of the neck . . ."

Our dissections showed that the SMAS is in continuity with the posterior part of the *frontalis* muscle in the upper part of the face (Fig. 2, center), and with the platysma muscle in the lower part of the face (Fig. 6). Gray<sup>3</sup> clearly expressed this last point. The su-

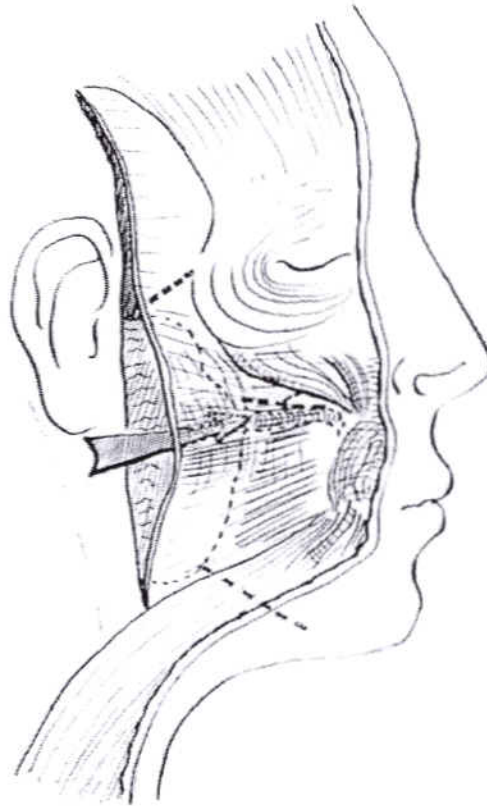


FIG. 1. Schema of the SMAS. The arrow goes deep to the SMAS, which extends from the *frontalis* to the *platysma* muscle.



FIG. 2. (left) The continuous line is the posterior muscular border of the SMAS. The dotted lines are its superior and inferior limits. (center) The skin has been removed, showing the SMAS in the parotid and cheek areas. (right) Metzenbaum scissors are inserted between the SMAS and the parotid fascia.



perior and the inferior muscle attachments of the SMAS probably have physiological implications, which we shall discuss.

#### MACROSCOPIC AND MICROSCOPIC STRUCTURE OF THE SMAS

The SMAS can be divided into two broad areas: the parotid area and the cheek area (Fig. 2, left).

##### *The Parotid Area*

Here the SMAS is a condensed mesh, distinct from the fascia of the parotid gland. Adherent in the pretragal area for one or two cm, the SMAS then becomes separate from the parotid sheet (Figs. 3-7).

The microscopic slides showed that the SMAS can be composed of one to 3 layers between the parotid fascia proper and the skin. Sometimes the muscular fibers are obvious within the fibrous layer; hence the term musculo-aponeurotic system (Fig. 7).

##### *The Cheek Area*

Here the SMAS becomes thinner and can be followed microscopically. Under-



FIG. 3. The dissection of the SMAS in the parotid area must respect the parotid fascia. The SMAS is a part of the *fascia superficialis* which extends throughout the cervicofacial area.

neath the dermis, the SMAS is a continuous fibrous net sending several extensions out to the dermis (Figs. 4, 9, 10). This network constantly covers the facial muscles. The SMAS comprises all the attachments from these muscles to the dermis (Fig. 6).

#### RELATIONSHIP OF THE SMAS TO OTHER FACIAL STRUCTURES

Gray<sup>9</sup> writes "The superficial fascia (*tela subcutanea*) of the head invests the facial muscles and carries the superficial blood vessels and nerves." We

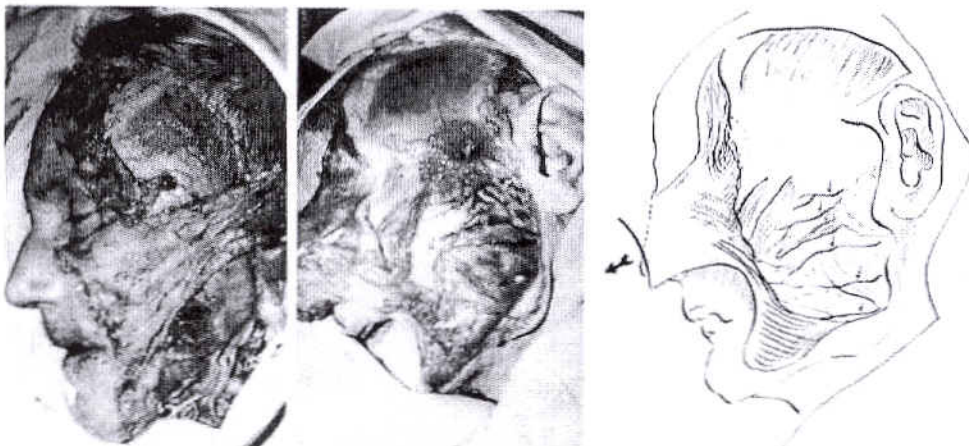


FIG. 4. (left) The SMAS is pulled. This has a strong effect on stretching the perioral facial muscles. (center, right) The SMAS has been dissected; Stensen's duct and the facial motor branches have been preserved (arrows).



FIG. 5. A macrosection, with arteries injected by Radiocorrodan. View is of the frontal plane, through the vertical rami of the mandible. The arrow indicates the avascular plane where the SMAS lies.

found this to be only partially true: the motor branches of the facial nerve lie deep to the SMAS.

#### Nerves

In the parotid area, only the sensory nerves (branches of the anterior cervical plexus) are located between the dermis and the SMAS (Fig. 9). The facial nerve and its branches run deep into the parotid gland; there they are protected by the parotid fascia and the external lobe of the gland.

In the cheek area, the facial motor nerves run deeper than the SMAS (Fig. 4, right). Thus, the only nerves which go through the SMAS are the sensory nerves; the motor branches reach the superficial layer of the facial muscles

through their deeper aspect. An important layer of fat is often located between the SMAS and the dermis; this subcutaneous fat is completely separated from Bichat's fat pad by the SMAS (Fig. 8).

#### Muscles

The SMAS invests and extends into the external part of the superficial facial muscles—involving fibers of the *risorius*, the *frontalis*, the platysma, and the peripheral part of the *orbicularis oculi* (Figs. 1-6).

#### Vessels

The main vessels—the facial artery and vein—lie deep to the SMAS; their

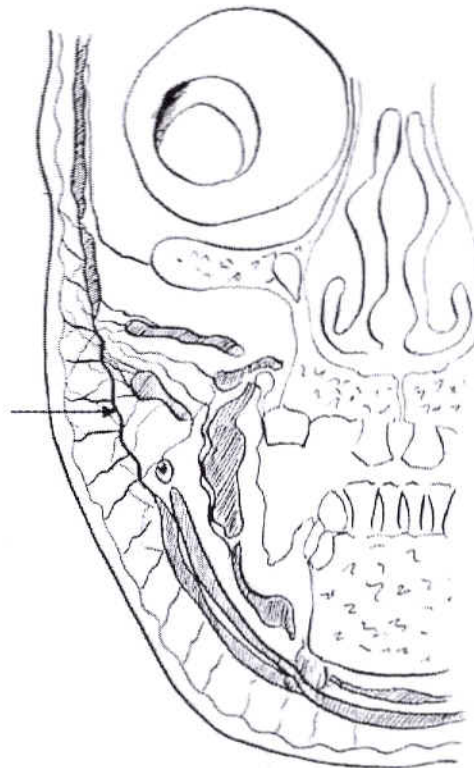


FIG. 6. Schema of a macrosection through the premaxillary frontal plane. The arrow points to the SMAS. The SMAS is stretched up and down by the superficial facial muscles.



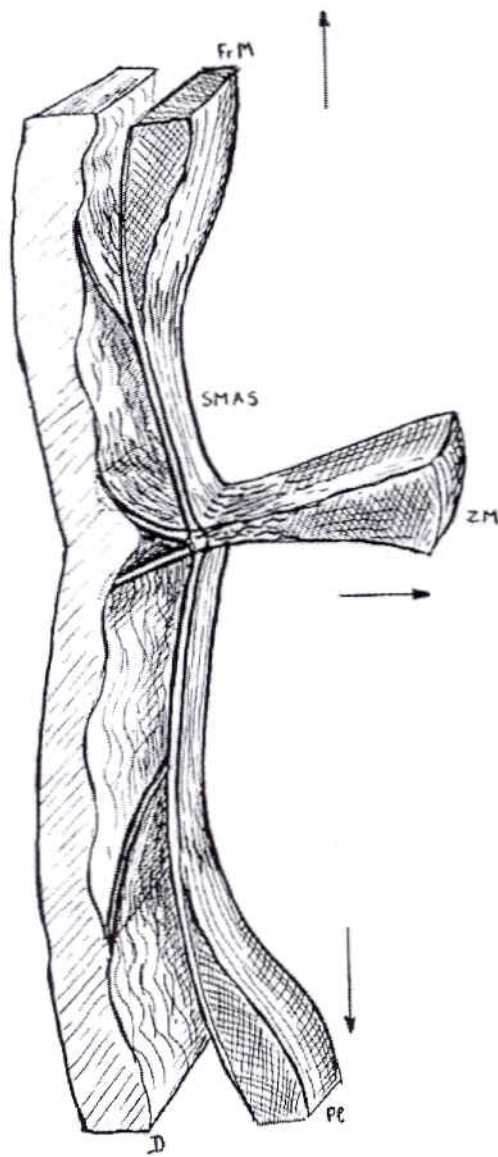


FIG. 7. Schema of the functional structure of the SMAS. (FrM = frontalis muscle; ZM = zygomatic muscle; D = dermis; Pl = platysma) In this way the SMAS acts as a distributor of the contractions of the facial muscles.

perforating branches go through it and the subdermal vascular network lies superficial to it. Thus, the SMAS forms the deep border of the neurovascular and muscular cutaneous complex.

### The Parotid Gland

In the pretragal area, the SMAS and the parotid fibrous fascia are united in a dense layer of connective tissue. Here a surgical dissection of the SMAS is possible and safe. Anterior to this area, the SMAS is completely independent of the fibrous fascia surrounding the parotid gland. However, because it is thin and covers the motor nerve branches, its surgical dissection anteriorly becomes difficult and dangerous.

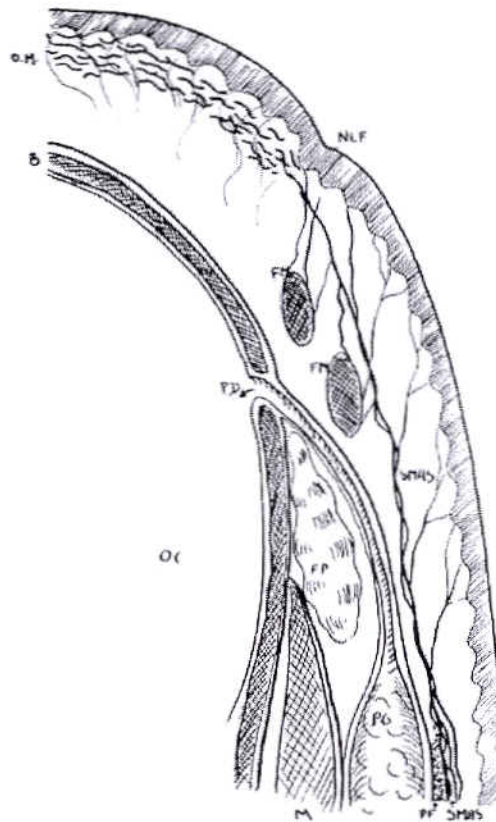


FIG. 8. Schema of the horizontal plane of a macrosection through the nasolabial fold. (NLF = nasolabial fold; B = buccinator muscle; FM = facial muscle [zygomaticus major and minor]; PD = parotid duct; PG = parotid gland; PF = parotid fascia; OC = oral cavity; OM = orbicularis muscle fibers; FP = fat pad) This shows the SMAS (superficial musculo-aponeurotic system).

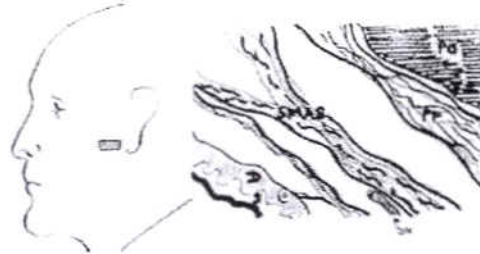
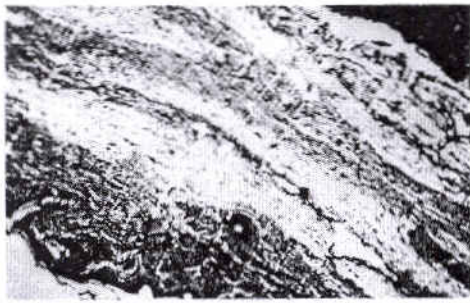


FIG. 9. (above) Horizontal section of the SMAS at the outer part of the parotid gland. ( $\times 40$ ) (below) Schematic view. (PG = parotid gland; SN = sensitive nerve; D = dermis; S = skin; PF = parotid fascia)

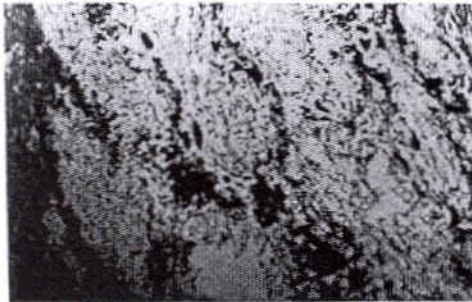


FIG. 10. (above) Horizontal section of the SMAS at the level of the nasolabial fold ( $\times 40$ ). (below) The schema indicates the area of the study. (D = dermis; FM = facial muscle; Exp = expansion of the SMAS to the skin). (Compare this with the schema in Figure 8.)

*Temporozygomatic Area*

Here the SMAS crosses in front of the zygomatic arch and belongs to the temporozygomatic SMAS, which adheres to the periosteum by thin expansions. The superior frontal branch of the facial nerve lies deep to the SMAS; the sensory nerve branches run between the SMAS and the dermis. However, this space overlying the external part of the zygomatic arch is very narrow, so that dissection of the SMAS here is difficult and dangerous. A better plane of dissection is found superficial to the SMAS, between it and the skin.

*Mandibular Area*

Here the SMAS is in close contact with the superficial fibers of the platysma. A safe plane of dissection is found deep to the platysma and the SMAS, because the mandibular branch of the facial nerve runs deeper there. This plane has been cited by some authors who use and elevate the platysma during rhytidoplasty (Guerrero-Santos *et al*<sup>6</sup>). We found loose fibrous connections present between the SMAS and the periosteum of the inferior margin of the mandible, particularly in its anterior part.

*Mastoid Area*

Here the SMAS is intimately attached to the dermis and to the fibrous tissue around the insertions of the sternoclavicular muscles. It is rather difficult to isolate the SMAS around the ear, because the various fibrous layers are closely entwined.

*Nasolabial Fold (Fig. 10)*

The SMAS is deep and is thin in this area; it is separated from the dermis by a large amount of fat. Several thin muscle expansions run forward, slanting from the SMAS to the dermis; it is diffi-



cult to trace one of these expansions to an underlying facial muscle or to the nasolabial fold at the surface. This fold appears to be a cutaneous fold where the SMAS ends as a distinct layer, rather than a fold caused by the insertions of specific muscles.

#### REVIEW OF THE LITERATURE

Gray<sup>8</sup> describes the superficial fascia precisely. He does not indicate that the fascia was tensed upward by the *frontalis* muscle and tensed downward by the platysma muscle, and he does not point out any value in its surgical dissection.

Charpy<sup>1</sup> discusses Gegenbaur's<sup>9</sup> and Futamura's<sup>4</sup> descriptions of the superficial muscular layers of the face. He does not assess clearly either the relations or the function of the SMAS.

Podwyssovsky<sup>11</sup> describes the insertions of the facial muscles in the deep aspect of the dermis; he sketches them as numerous columns which are perpendicular to the skin, and he connects them to a superficial musculo-aponeurotic system.

Saban<sup>7</sup> writes "The *superficialis* fascia, which covers the body, ends therefore at the neck: its extension above the facial muscles would hinder all expression . . ."

Farisse *et al*<sup>12</sup> have carefully studied the parotid fascia, looking for surgical applications in otolaryngology. By combining dissections and histological sections, they describe 3 layers in the parotid fascia: the subcutaneous layer, the parotid layer proper around the gland, and the intraglandular layer, which divides the gland into several compartments. However, they do not clearly assess the SMAS layer, and its muscular connections are not described.

Couly *et al*<sup>2</sup> describe a cervicofacial fascia, without pointing out the muscu-

lar and dermal relationships of the SMAS. They only consider this fascia to be a sliding system on the subcutaneous fat and periosteum.

To us the SMAS appears to be a fibromuscular network located between the facial muscles and the dermis, one which covers the facial motor nerves.

Such a double attachment between the muscles deep and the skin superficially through the SMAS does not hinder the expressive function of those muscles, but rather transmits it.

#### *The SMAS is Stretched Superiorly and Inferiorly (Fig. 7)*

The SMAS is kept tensed superiorly by the superficial temporal muscles, the external part of the *frontalis* muscle, and the *orbicularis oculi* muscles. It is kept tense inferiorly by the platysma muscle. It is attached posteriorly to the tragus and the mastoid area. Such a peripheral stretching explains how the SMAS could be an *amplifier* of the contractions of the facial muscles; the more it is tensed, the less energy is necessary for the muscle to transmit its action (Figs. 6, 7).

#### *The SMAS Transmits Facial Muscle Action Through Two Directions*

The SMAS acts as a *distributor* of all facial muscular contractions to the skin: each muscle contraction follows one preferential direction in the network. An infinite number of resultant actions are possible because (1) the SMAS relays the contractions of the facial muscles along the longitudinal network parallel to the skin plane (Fig. 6) and (2) the SMAS transmits the resultant effect in a perpendicular direction toward the facial skin, through the fibrous expansions from the SMAS to the dermis (Fig. 7).

Thus, the human face has its wonderful ability to express so many different

nuances and shades of expression. It is erroneous to assume that each facial muscle is specific for a particular facial expression; rather, each expression is the result of contractions of several muscles, transmitted in combinations by the SMAS network to the skin. Aging weakens the elastic fibers of the SMAS and thus lessens the efficiency of the transmission of muscle contractions to the skin.

The SMAS is quite an important structure for the plastic surgeon, and its characteristics should be utilized whenever possible.

#### SURGICAL APPLICATIONS OF THE SMAS

##### *Meloplasty*

The classic approach, undermining the skin superficial to the SMAS, destroys the fibrous connections between it and the dermis. It seems to us that another plane of dissection can sometimes be used deep to the SMAS; this procedure is anatomically possible and it is safe in the parotid area, but not anteriorly. This deeper fascial dissection respects the function of the SMAS, and it allows a stronger pullback of the fascia and skin together (Fig. 4, *left*). When the excess part of the SMAS is resected and sutured to the pretragal area, the anterior muscles and the skin may be pulled back (or "lifted"). This approach also lessens the area which has to be undermined, as only the parotid area has to be freed to obtain this pullback.

##### *Facial Palsy*

The entire SMAS can be used in the palliation of facial palsy, where there is no fear of injury to the facial nerve. When we freed the SMAS forward to the nasal fold on fresh cadavers, we were surprised at how much we could stretch the oral commissures (Fig. 4, *left*).

#### DISSECTION OF THE SMAS (FIGS. 2-4)

Dissection underneath must be done very carefully to avoid damage to the branches of the facial nerve. Such an injury can occur during a retrofascial dissection when (1) the SMAS is thin; (2) the superficial lobe of the parotid is short and does not protect the nerves; (3) the retrofascial dissection is carried too far forward (beyond the anterior border of the parotid gland).

The dissection must start in front of the tragus, and can be done by inserting Metzenbaum scissors between the SMAS and the parotid fascia. The SMAS is freed carefully from this fascia, and this becomes easy once the proper plane is found (Figs. 2, 3).

The dissection is not carried further upward than one cm below the zygomatic arch, or lower than one cm above the inferior margin of the mandible. Once the SMAS is freed from the parotid fascia, it becomes possible to lift the face much more easily and strongly than by the usual simple skin undermining (Fig. 4, *left*).

#### SUMMARY

We have investigated the superficial musculo-aponeurotic system (SMAS) in the parotid and cheek areas by anatomical dissections, by radiographs, and by histological sections.

The SMAS may be helpful in corrective surgery for facial palsy and during face lifting operations if a retrofascial approach is used. This procedure, safe in the parotid area, can become dangerous in the area anterior to the parotid gland.

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## REFERENCES

1. Charpy, A.: In *Abrégé d'Anatomie*, Edited by P. Poirier, A. Charpy, and B. Cuneo. Masson, Paris, 1908.
2. Couly, C., Hureau, J., and Vaillant, J. M.: Le fascia superficialis cephalique. *Ann. chir. plast.*, 20: 171-182, 1975.
3. Farisse, J. et al.: A propos de l'anatomie chirurgicale de la région parotidienne. *C.R. Ass. Anat.*, 147: 254-261, 1972.
4. Futamura, R.: Über die entwicklung der facialis musculatur des menschen. *Anat. hefte*, 30: 433-516, 1906.
5. Gasser, R. F.: The development of the facial muscles in man. *Am. J. Anat.*, 120: 357-376, 1966.
6. Gegenbaur, C.: *Lehrbuch der Anatomie des Menschen*, 4th ed., Vol. 2, pp. 448-449. Wilhelm Engelmann, Leipzig, 1890.
7. Saban, P.: In *Traite de Zoologie*, Edited by P. P. Grasse. Masson, Paris, 1972.
8. Guerrero-Santos, J., Espaillet, L., and Morales, F.: Rhytidoplasty with sectioning and lifting of the platysma muscle. Presented at the Sixth Internat. Cong. Plast. & Reconstr. Surg., Paris, 1975.
9. Gray, H.: *Anatomy of the Human Body*, 25th ed., p. 352. Lea & Febiger, Philadelphia, 1949.
10. Mitz, V., Lassau, J. P., and Delcourt, A.: Essai d'injection repletive par resine colorée et radioopaque. *Arch. Anat. Path.*, 20: 385-388, 1972.
11. Podwyssovsky: In *Traite d'Anatomie Humaine*, Edited by L. Testut, and A. Latarjet. Doin, Paris, 1948.
12. Testut, L., and Latarjet, A.: *Traite d'Anatomie Humaine*. Doin, Paris, 1948.