ANATOMICAL AND FUNCTIONAL ORGANIZATION OF THE MUSCULAR APONEUROTIC CERVICOFACIAL SYSTEM

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ABSTRACT

Superficial muscular aponeurotic system (SMAS) is a musculoskeletal sheath extending from the frontal muscle to the platysma and it acts as a "contraction amplifier of the facial muscles". SMAS action is to transmit muscular contraction to the skin: each muscle contraction follows a preferential direction in the network. The aim of this study is to highlight anatomical-functional features of SMAS, which can be applied in buccoomaxilofacial and aesthetic surgery. The study was conducted on 12 cephalic extremities, meticulously dissected in the "Ion Iancu" Anatomy Institute of "Grigore T. Popa" University of Medicine and Pharmacy, Iași, Romania. On each stage of dissection, mesoscopic images were captured using the Kaps SOM 62 operating microscope. SMAS presents two parts in continuity with each other: cervicofacial, with predominantly aponeurotic structure and cervical, with essentially muscular structure. We highlighted through dissections the existence of cervicofacial SMAS, its limits, as well as the neighboring relations with the fasciae and vasculonervous elements which are important from a surgical point of view. Knowing regional SMAS can have a great applicability in surgical practice, especially in pathological interventions in the buccomaxilofacial field, but also in surgery for facial rejuvenation**.**

Key words: rejuvenation surgery, mimic muscles, anatomy

INTRODUCTION

The soft tissue architecture of the face can be described as being arranged in a series of concentric layers: skin, subcutaneous adipose tissue, superficial fascia, mimics muscles, deep fascia (parotid masseteric), facial nerve plane, parotid duct, and oral fat pad (1, 2).

The term of SMAS, introduced in 1974, defines a musculoskeletal sheath that continues the frontal muscle to the platysma and acts as a "contraction amplifier of the facial muscles". SMAS action is to transmit muscular contraction to the skin: each muscle contraction follows a preferential direction in the network. An infinite number of actions are possible because, on the one hand, SMAS conveys the contraction of the muscles along the parallel network to the skin plane, and on the other hand it transmits the resulting effect in a direction perpendicular to the skin through fibrous expansions, from SMAS towards dermis.

In the beginning the notion of SMAS was proposed to designate an anatomical-surgical structure that is individualized from the platysma muscles. The main description was made in the parotid and cheeks regions, which stimulated many surgeons to perform dissection on each planes of the face regions (3). As a result, the initial description has been completed over the years, without full consensus of all the authors. The most

complete descriptions are made in the cheek region (4). It is admitted that the fascial plane that cover the parotid gland it is made by parotid and masseteric part of SMAS and skin (5, 6, 7).

Some researchers (8) consider this extension to all face regions to be abusive without sufficient data.

Other researchers (9) consider SMAS as a strictly surgical superficial anatomical structure derived from primitive platysma and risorius muscle. Another group of researchers consider as beeing formed by a distinct fibromuscular layer made by platysma muscle, parotid fascia and fibromuscular layer of the cheek (10).

There is a great variability in the histological aspect of SMAS in different facial regions, describing individual and regional peculiarities at the same person (11, 12). Due to the large microanatomic variability, SMAS can be histologically identified in the continuation of some reference structures such as platysma. It is characterized by extreme variability in terms of thickness, from one individual to another, but also in the same individual, right / left. A particular attention should be given to patients with a history of malignant tumors or metabolic disorders such as diabetes mellitus (13, 14, 15). These patients require particular attention due to tissue fragility caused by paraneoplasm syndrome (16, 17).

The purpose of this study is to highlight certain anatomical-functional features of SMAS, which can be applied in buccomaxilofacial and aesthetic surgery.

MATERIAL AND METHODS

Our study highlighted the existence of SMAS at cervical and facial level and the corresponding neurovascular elements. The study was made on 12 cephalic extremities, which were dissected in the Anatomy Institute of "Grigore T. Popa" U.M.Ph., Iaşi, Romania. Each specimen was previously preserved in formaldehyde. Dissections were performed layer by layer and, on each stage of dissection mesoscopic images were captured by using the Kaps SOM 62 operating microscope. The conclusive aspects were acquired, examined and further processed to underline the regional stratigraphic differences. The dissection was performed perpendicular to the surface of the epidermis in order to be able to follow the correct sequence of the planes.

RESULTS AND DISCUSSIONS

SMAS presents two parts in continuity with each other: cervicofacial, mainly aponeurotic and cervical, mainly muscular (Fig. 1, 2 , 3, 4, 5).

Cervicofacial SMAS

Cervicofacial SMAS consists of two parts: parotidomasseteric and jugal (Fig. 6).

Parotidomasseteric SMAS (Fig. 1)**,** well represented, may contain some muscle fibers. It covers the parotid lodge and masseter muscle. It is fixed on the articular cartilage and establishes deep adhesions with the parotid capsule. In the subangulomandibular and mastoid regions, it adheres to the superficial cervical aponeurosis that covers the sternocleidomastoid muscle (Fig. 3).

Jugal SMAS is thin and interrupted, difficult to be dissected, gradually thinning from the posterior to the anterior and does not exceed the nasolabial groove. It contains the risorius muscle that is paracomisually directed to the modiol, and pulls it back in the smile. This muscle develops in SMAS thickness, before masseter aponeurosis, without inserting on it.

Cervical SMAS

Cervical SMAS (Fig. 2, 4) can be confused with the platysma muscles at the lower edge of the mandible. The platysma muscle, located on the lateral part of the neck, extending from the clavicle region to the

mandible region (Fig. 5), consists of 2 fascicles with different actions:

- *Lateral fascicle (*pars buccalis), in the shape of S italic, slides on the posterior part of the mandibular basilar border and over the angle of the mandible to attach on the comissure;
- *Medial fascicle* (pars mentalis)

SMAS limits are:

- Backward, the cartilaginous part of the external auditory conduct and the mastoid region, on which is firmly attached (fixed point)
- Anteriorly (mobile point), it is extended superiorly by greater zygomatic muscle and inferior to the oral comissure is gradually reduced, the cutaneous muscles of this level not beeing included in SMAS. In fact, the color of these muscles is violet, not pink-salmon like platysma and rizorius muscles. SMAS sets only a few adhesions with perioral cutaneous muscles. The lack of SMAS in the lower part explains the reduced efficacy of the SMAS flaps in the nasolabial groove. SMAS sets adhesions with the lateral edge of the orbicular eye muscle (pars orbitalis).
- Inferiorly – clavicular region (mobile point)
- Superiorly - the zygomatic arch on the periost of which joins SMAS (fixed point). From there, it continues with the temporal or superficial temporoparietal fascia and covers the temporal region (temporal aponeurosis and muscle).

SMAS, as well as the superficial fascia, separates the skin's superficial adipose tissue from the deep cellular tissue. For this reason, when it is isolated by dissection, it appears more or less fat.

The soft tissue planes are supported in a normal anatomical position by a series of restraining ligaments coming in from the depths, fixing the facial structures to the superjacent.

SMAS relations

We underline the SMAS connection with the skin of the region but, in particular, its relations with the superficial muscles of the face (the muscles of the facial expressions) with the deep fascia and the neurovascular elements underneath. From a functional point of view, the attachments means of SMAS to viscerocranium are of utmost importance. These gives the firmness of the face skin and plays the role of fixed point in the movements of the mimics muscles. They prevent the appearance of wrinkles and the phenomenon of aging face.

Superficial relations of SMAS

SMAS forms with skin a functional, adipose and neurovascular unit, physiologically inseparable, cutaneous-mucoid-aponevrotic cervicofacial unit. The superficial surface of SMAS is united by the deep face of the dermis through fine, perpendicular or oblique fibrous tracts that isolate adipose lodges that form adipose paniculi. This superficial subcutaneous fat tissue has particular functions (elasticity, retractility). With aging, these tracts relax, the paniculum diminishes, and the skin, which in turn loses its elasticity, becomes too large and hangs.

The function of SMAS is to convey the activity of the mimics muscles to the skin and thereby to adjust the expression of emotional states. In the latero-facial region, the subcutaneous fat, more or less thick,is disposed as follows:

- superior - the zygomatic arch or adipose tissue mentioned above and the jugulopalpebral fold under which the palpebral skin adheres to the orbicular muscle,
- inferior – the superior part of the neck under the basilar edge of the mandible where the platysma muscle adheres to the skin,
- anterior - nasal jugal fold which is determined by the jugal subcutaneous adipose tissue, the adherence of the labial region and by the tonus and contraction of the levator and depressor labial muscles,

- posterior - the ear pavilion and the parotid region where the adipose tissue gradually decreases from anterior to posterior.

As for the zygomatic bone, there is a particular adipose deposit that participates in the projection of the cheekbones and covers the zygomatic muscles and the inferolateral part of the orbicular eye muscle. This adipose deposit adheres to the skin and is united with SMAS.

Deep relations of SMAS

The cutaneous muscular aponeurotic cervicofacial unit is separated from underlying planes, through deep subcutaneous tissue that has the function of a sliding plane. If deep subcutaneous cellular tissue is reduced, SMAS adheres to the underlying planes and the skin loses some of its mobility.

The neurovascular elements in its immediate neighborhood are numerous and complex. From this point of view, we have to emphasize the complexity of the parotid region where the facial nerve is found (it is divided into the terminal branches within the parotid gland), as well as branches of the external carotid artery. Also in this region the external jugular vein is formed. SMAS covers theparotid fascia, coming in close proximity to the above-mentioned elements.

The course of the facial nerve branches is also in the vicinity of the SMAS, as well as branches of the trigeminal nerve. The facial nerve branches are considered the most variable anatomical elements, and the use of landmarks allows them to be located with precision (18, 19).

The vascular supply of the skin through the perforating arteries coming from the underlying muscles allowed the description of the musculocutaneous territories, later known as angiosomes (20,21,22,23, 24, 25)

With age, there is a reduction in vascularization by fragility of terminal capillaries, by diminishing blood flow and elasticity of the vascular wall. This reduction in vascularity is accelerated by arteriosclerosis and tobacco. Sensitive skin innervation is ensured by the auricular branch of the superficial cervical plexus through branches of the trigeminal nerve: the auriculotemporal, the buccal and the mental (26, 27, 28, 29, 30, 31).

CONCLUSIONS

Knowing the individualization and regional distribution of cevicofacial SMAS is indispensable in keeping it as intact as possible in facial surgery to ensure flaps viability and avoid complications.

SMAS is a complex structure that forms with the skin an inseparable functional, adipose and neurovascular unit, physiologically unit.

Figure 1. Overall aspect of cervicofacial SMAS

Figure 2. Parotidian cervicofacial SMAS continues superiorly with parietotemporal fascia. The superficial temporal vessels and their branches are observed

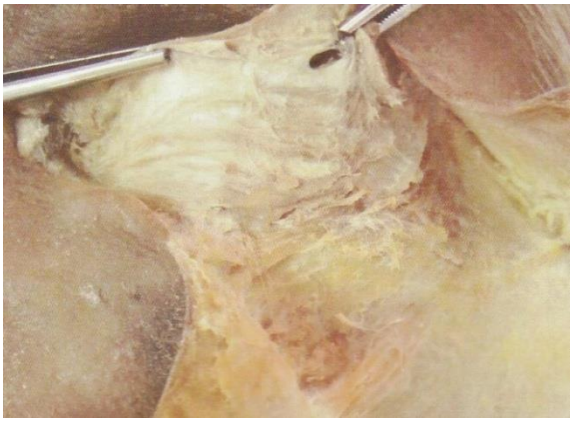

Figure 3. Periorbital SMAS

Figure 4. Cervical superficial fascia and anterior fibers from platysma muscles. In subjacent plane it can be seen sternocleidomastoid muscle

Figure 5 The elevation of cervical SMAS which covers anterior wall of submandibular lodge

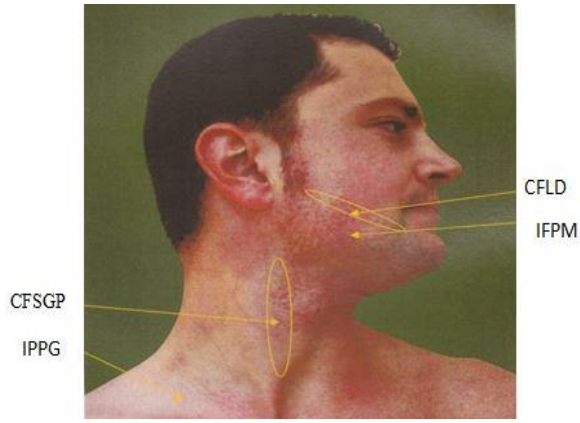

Figure 6 Cervicofacial skin falds due to the insertion of the platysma muscle into the neck skin (IPPG), to the continuity of the superficial cervical fascia with sternocleidomastoid muscle (CFSGP), to the insertion of the platysma fascia on the mandibular body (IFPM) and its continuity to the face without delimiting fold (CFLD), which proves that the platysma's fascia extends facially .

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