ORIGINAL PAPER

RJME
Romanian Journal of Morphology & Embryology
http://www.rjme.ro/

Anatomical considerations on the masseteric fascia and superficial muscular aponeurotic system

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Abstract

The masseteric region is considered by the most researchers as a subdivision of the parotideomasseteric region. Because of its surgical significance, we emphasize it has distinctive morphofunctional features. The aim of this manuscript is to highlight particular characteristics of the masseteric region and practical applications of this concept. The material used was represented by 12 embalmed cephalic extremities dissected in "Ion Iancu" Institute of Anatomy, "Grigore T. Popa" University of Medicine and Pharmacy, Iaşi, 10 operating specimens from the Clinics of Maxillofacial Surgery and Plastic Surgery of the "St. Spiridon" University Hospital, Iaşi, Romania, and computed tomography (CT) and magnetic resonance (MR) images from the same patients. Our results underline the importance and individual arrangement of the superficial muscular aponeurotic system (SMAS) of the face, at the level of masseteric region. The superficial fascia facilitates adhesion to the dermis of the mimic muscles of the region. This reveals that the masseteric superficial fascia will follow the masticatory movements of the mandible and masseter, but also those of the minor and major zygomaticus muscles. These muscles are the infra-SMAS layer and thus take part in the formation of a unitary complex together with the superficial fascia. The particularities of the SMAS in the masseteric region are especially important in plastic and reconstructive surgery.

Keywords: SMAS, masseteric fascia, cheek anatomy, zygomaticus muscles.

Introduction

Knowing and understanding subcutaneous layers in different regions of the face is important in various surgical specialties. The superficial muscular aponeurotic system (SMAS) of the face is a guiding structure for the plastic surgeon, especially in the masseteric region.

In view of these considerations, a number of clarifications are needed regarding the notion of SMAS of the face, its origin and embryogenesis, eventually systematizing some anatomical conclusions adapted to the new techniques of plastic and repair surgery [1, 2].

There is a great variability in the histological aspect of SMAS in different facial regions in the same individual, but also between the same region in different individuals.

SMAS presents as a distinct fibromuscular layer, consisting of the platysma muscle, the parotid fascia and the fibromuscular layer covering the cheek [3]. A continuous, organized, fibrous mesh, specific to the nasolabial fold and upper lip, frontal, parotid, zygomatic and infraorbital regions, is achieved [4].

The aim of this study is to identify the particular morphofunctional features of the SMAS in masseteric region and to show their practical significance.

Materials and Methods

The study was conducted on 12 embalmed cephalic extremities dissected at the "Ion Iancu" Institute of Anatomy, "Grigore T. Popa" University of Medicine and Pharmacy, Iaşi, and on group of 10 patients, which have been clinically and imagistically explored in the Clinics of Maxillofacial Surgery and Plastic Surgery of the "St. Spiridon" University Hospital, Iaşi, Romania. These patients were admitted for benign tumor of parotid region and for extended facial lifting procedures.

Computed tomography (CT) and magnetic resonance imaging (MRI) explorations have been performed before surgery in order to plan the surgery procedure.

For the qualitative microanatomical study of SMAS in the stratigraphic layers of the face, we sampled all the soft parts of the facieses of the anatomical specimens, from the skin to the bone, in the form of small blocks, with the following topography: premasseteric and masseteric. The dissection was performed perpendicular to the surface of the epidermis in order to be able to follow the correct sequence of the planes.

We also used operatory fragments removed from superficial layers to deep fascia, during facial lifting and other interventions on this region and compared these with CT and MRI aspects.

The collected specimens were processed by paraffin technique and stained with special techniques for muscular and connective tissue (Verhoeff and Szekely).

Stereology was used with the standard Weibel parallel grid to quantify the percentage volumes of the main structural parietal components in the studied vessels.

Results

SMAS can be macroscopically seen in the masseteric region, otherwise it can be observed with the microscope; laterally forms the anterior sheet of the parotid fascia. Although SMAS is intimately applied to the superficial surface of the parotid, a distinct parotid fascia is identified between the gland and SMAS, which extends to the masseteric region (Figure 1).

The cervicofacial cutaneous muscular aponeurotic unit is separated from underlying, musculo-aponeurotic or periostic planes by deep adipose tissue that functions as a sliding plane. If deep subcutaneous adipose tissue is reduced, SMAS adheres to the underlying planes and the skin loses part of its mobility.

The neurovascular elements in its immediate neighborhood are numerous and complex. From this point of view, the complexity of the parotid region where the facial nerve is found, as well as branches of the external carotid artery, has to be emphasized. Lesser (superficial) masseteric nerve, together with superficial masseteric artery and vein are running between SMAS and the masseteric fascia.

The branches of the facial nerve are also in the vicinity of the SMAS of massteric region, as well as branches of the trigeminal nerve. The facial nerve branches are considered the most variable anatomical elements, but the use of landmarks allows us to locate them accurately (Figure 2). These nerve threads are accompanied by branches of the external carotid artery. When removing skin flaps or performing pretragal incision for facial lifting, surgeons must consider these relations of the superficial masseteric fascia (Figure 3).

The masseteric region makes the transition to the zygomatic and temporal regions. The morphological, macro and microscopic differences between these regions are very concise. Superficial thick masseteric fascia continues anterior and superior with the zygomatic fascia, and posterior and superior with the temporal one.

Inferior and posterior, at the level of the parotid gland, the superficial fascia gives rise to the anterior capsule of the gland.

Anterior and medially, it is continued by the superficial fascia of the cheek and it forms fibrous tunnels through which it passes branches of the facial nerve (Figure 4).

Figure 1 – ***Parotid cervicofacial SMAS continues to be superior with parietotemporal fascia. Vessels are observed superficial and their branches. Dissection specimen. SMAS: Superficial muscular aponeurotic system.***

Figure 2 – ***Branches of facial nerve related to SMAS. Dissection specimen. SMAS: Superficial muscular aponeurotic system.***

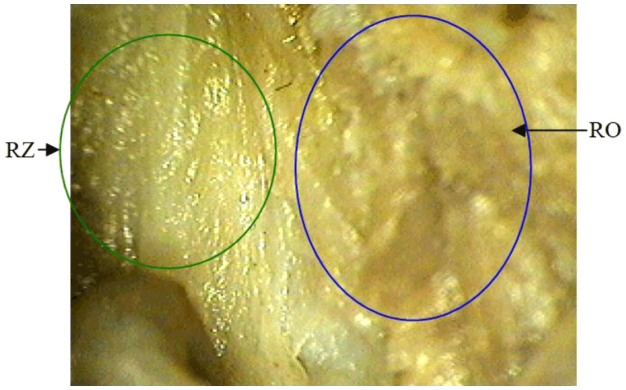

Figure 3 – ***The limit zone between the zygomatic region (RZ) and an image (RO). Mesoscopic images.***

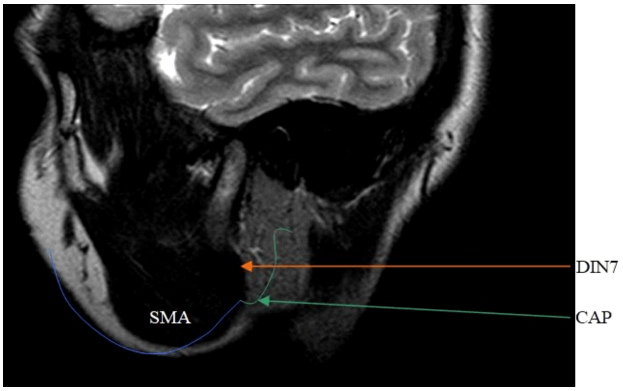

Figure 4 – ***Anterior parotid capsule (CAP); intraparotid division of the facial nerve (DIN7).***

Superficial masseteric fascia is continued downwards by superficial parotid and cervical fasciae, where it originates from (Figure 5).

The most important features of soft tissues stratigraphy at this level are:

(*1*) The superficial fascia (SMAS) is best represented here, consisting of dense connective tissue;

(*2*) The superficial fascia is connected to surrounding fasciae and works as one great muscular aponeurotic complex;

(*3*) Subcutaneous adipose tissue is predominantly prefascial but its consistency and form is different from zygomatic, temporal and parotid regions;

(*4*) The superficial fascia gives rise to the zygomatic and inferior temporal ligament;

(*5*) The superficial fascia is crossed by vascular-nervous elements;

(*6*) Superficial layers have very low mobility in the center of the region.

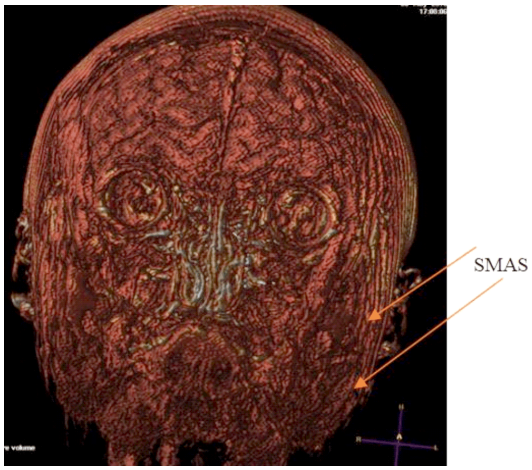

Figure 5 – ***Three-dimensional (3D) coronal reconstruction that highlights the topographical plan of SMAS from tragus to gonion. SMAS: Superficial muscular aponeurotic system.***

In conclusion, we can systematize that the lateral region of the face has as layers:

(*a*) cutaneous, dermoepidermic;

(*b*) subcutaneous fat;

(*c*) superficial fascia;

(*d*) the branches of the facial nerve;

(*e*) deep, masseteric fascia;

(*f*) the muscular layer, represented by the masseter muscle.

Microscopically, SMAS is well represented, with condensed colagene thick fibers, orderly disposed, mostly longitudinal, with diminished interstitial spaces. Blood vessels meet only at the periphery of the lamina and have very small dimensions.

The distance to the deep fascia is increased, the infra-SMAS fat layer being well represented with oblique orientation; the elastic fibers are completely missing.

The superficial connective layer is well represented, with many fat lobes separated by connective tracts with almost vertical or slightly oblique direction. There are predominantly medium-sized collagen fibers, rare elastic fibers, almost similar with the arrangement into parotid region.

Our observations support the quantitative data obtained on CT images. In the masseteric region, the superficial fibroadipose layer has an average thickness of 4.32± 2.9 mm, and the deep fat layer is very thin, 0.33±0.48 mm. SMAS appears as a hyperdense line intimate to the gland, with a thickness of 0.76±0.43 mm (Figures 6–8).

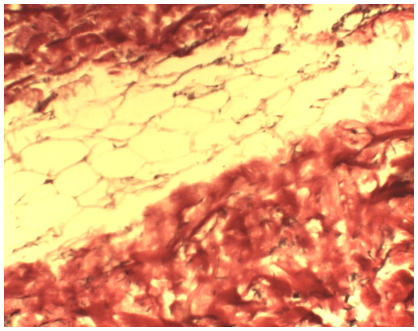

Figure 6 – ***Succession of superficial layers in the parotid region, top-down: SMAS, adipose tissue infra-SMAS and parotid fascia. Verhoeff's staining, ×400. SMAS: Superficial muscular aponeurotic system.***

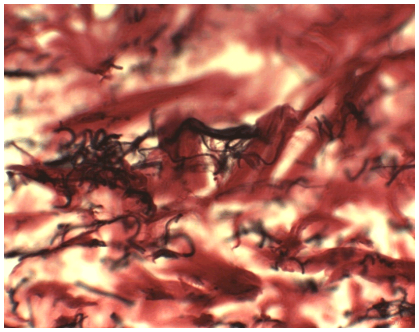

Figure 7 – ***Parotid dense structure, with many collagen fibers thick and thin, fragmented elastic fibers. Verhoeff's staining, ×600.***

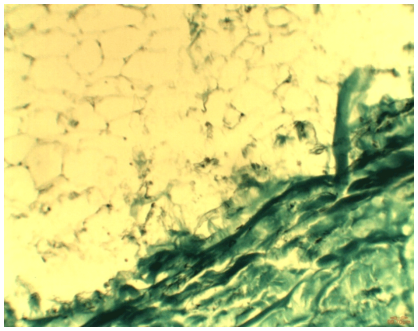

Figure 8 – ***SupraSMAS fibro-adipose tissue, well-represented, in the parotid region. Szekely staining, ×200. SMAS: Superficial muscular aponeurotic system.***

Discussions

Parotid masseteric SMAS is well personalized and may contain some muscular fibers and nerves fibrous tunnels [5]. It covers parotid gland and masseter muscle [6]. Riolan, in "Le Double", signaled "*portio musculi cutanei supra parotidem ad aurem ascendentis*" [7], a part of the platysma muscles that ascends to the ear, passing over the parotid. It is fixed to the auricular cartilage and establishes deep adhesions with the parotid capsule. In the area located inferior to mandibular angle and in mastoid region, SMAS adheres to the superficial cervical aponeurosis that covers the sternocleidomastoideus muscle.

In the masseteric region, the superficial fascia features numerous lobules. They are superimposed by vertical fibrous tracts and infra-SMAS these tracts have a horizontal disposition. In the posterior part of the parotid gland, the superficial fascia exhibits a condensation that forms a true hill for the gland. At this level, the facial nerve, the facial artery and the external jugular vein enter the parotid gland [8].

Jugal SMAS is thin, discontinuous and difficult to be dissected; it becomes gradually thinner from the posterior to the nasolabial above and does not go beyond the groove. It contains the risorius muscle that moves paracomisurally and pulls it back in the smile. This muscle develops in SMAS thickness, before masseter aponeurosis, but without inserting it [9].

SMAS forms together with skin a functional, tegumentary, adipose and neurovascular unit, physiologically inseparable, cervicofacial cutaneous muscular aponeurotic unit [10].

On axial CT, SMAS appears as a relative hypertension, tortuous line between superficial fibrous tissue and deep adipose tissue that are hypodense. Quantitative measurements performed on CT by researchers [11, 12] showed regional differences in thickness of the superficial layers of the face. We have also used MRI and CT images for determination of morphological aspects of other muscles [13].

Quantitative measurements were made on the representative microscopic sections and were taken from the

microscope using an image acquisition system (a video camera connected to a PC), after which the PRODIT 5.2 professional program was applied. This interactive digital program has enabled many measurements to be made by choosing the desired quantitative method from the menu, automatically calculating the results.

In the parotid region, the superficial fibroadipose layer has an average thickness of 4.32±2.9 mm and the deep fat layer is very thin, 0.33±0.48 mm. SMAS appears as a hyperdense line intimate to the gland, with a thickness of 0.76±0.43 mm. At the cheek level, the superficial fibro-adipose layer is very well represented (5.57±1.17 mm), the thicker layer is thinner, 2.94±0.62 mm, and SMAS recognizable slightly (2.94±0.62 mm). At the level of the nasolabial groove, the superficial fibroadipose layer is poorly represented (0.37±0.06 mm), the deep fat layer has an average thickness of 2.15±0.63 mm, while SMAS continues with muscles of facial expression, also with average thickness (2.41±0.05 mm).

On MRI images, SMAS appears as a continuous hypotensive line in T1 and T2 weights, from the parietal region to the nasolabial sulcus. It includes the muscles of facial expressions in the cheek regions and in the nasolabial sulcus.

Our anatomo-imaging study confirms the architectural composition of the face from multiple layers of tissue that connects the facial muscles to the dermis. Aspects encountered on MRI images at various incidences support microanatomical observations, obtained on sections at various levels, according to which, the arrangement of SMAS suggests a gradual centrifugal thinning to the adjacent regions.

Also, here are important force vectors represented by masticatory movements which are highly affected in lesions of the facial nerve, when reconstruction techniques are required [14].

Conclusions

Musculofascial superficial aponeurotic segment in masseteric region is distinguished in the subcutaneous fat layer, only in the posterolateral areas of the face, where there is a deep fascial support, well tensioned functional. Collagen fibers have ordered disposition on successive longitudinal and transverse planes, or they perceive their individual structure, forming layers of varied shapes and sizes, most obviously at the level of the modiolus. Muscle fibers belong to the superficial layer of the skin that form SMAS in some areas, leave it or cross to the deep surface or the osteoperostic plane. Masseteric SMAS is a dense lamina, particularly with collagen fibers, with rare muscle fibers. SMAS layer has a mixed structure, with very small quantitative differences between connective tissue and muscles. The masseteric fascia is a surgical entity because it is has an important function in facial reconstructions.

Conflict of interests

The authors declare that they have no conflict of interests.

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Received: October 5, 2017 *Accepted: July 24, 2018*