JPRAS Open 16 (2018) 6–19

Contents lists available at ScienceDirect

JPRAS Open

journal homepage: http://www.journals.elsevier.com/jpras-open

Original Article

Three-dimensional reconstruction of the suborbicularis oculi fat and the infraorbital soft tissue

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ARTICLE INFO

Article history:
Received 6 December 2017
Accepted 14 January 2018
Available online 31 January 2018

Keywords:
Suborbicularis oculi fat
SOOF plastic surgery
Subcutaneous musculoaponeurotic system
SMAS
3D reconstruction
Infraorbital soft tissue

ABSTRACT

The aim of this study was to reveal the histomorphological connections among the suborbicularis oculi fat (SOOF), the orbicularis oculi muscle (OOM), the superficial musculoaponeurotic system (SMAS), the infraorbital fat and the skin.

Full graft tissue blocks of the infraorbital region with the skin, SMAS, OOM and SOOF were collected post mortem from one female and two male formalin-fixed body donors. Serial histological sections were made, stained and digitized. Digitalization and three-dimensional (3D) reconstruction of the histological meshwork were performed.

SOOF was revealed as a fibro-adipose tissue underlying the OOM, which was strictly separated from the intraorbital fat pad by the orbital septum. SOOF, OOM and SMAS were connected by fibrous septa derived from the SOOF, traversing the OOM with division into multiple muscular bundles, continuing above the muscular plane by forming the SMAS and ending with skin insertion. In the infraorbital region, two different types of SMAS bordering the infraorbital fold have been recognized. Muscle cells have been demonstrated in the SMAS fibrous septa of both SMAS types.

Together with the OOM, the SMAS and the skin, SOOF forms an anatomical functional unit. Muscular contraction of the OOM could be transferred by the SMAS to the skin level, producing periorbital

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https://doi.org/10.1016/j.jpra.2018.01.001

mimic expression. The 3D reconstruction facilitates the comprehension of the morphological structure, its connections and space correlations in the infraorbital area. The morphological and topographical peculiarities of the infraorbital structures make it possible to conclude that surgical interventions in this area need to be elaborated and individualized.

Introduction

The suborbicularis oculi fat (SOOF) was defined as a fat pad lying supraperiosteally beneath the orbicularis oculi muscle (OOM) and below the lateral half of the infraorbital rim above the zygoma.[1] The hockey stick-shaped head of SOOF is located at the inferolateral side of the orbit within a range of +15 degrees medial and –87 degrees lateral to a caudal vertical mid-pupillary line.[2] It has an average horizontal length of 48 mm and an average vertical height of 27 mm.[2]

Previous studies described that the midfacial fat compartments (malar and SOOF) are connected to the orbicularis oculi muscle and the facial bone by the superficial musculoaponeurotic system (SMAS).[3] The lack of a clear definition of the SMAS structure allowed the authors to conclude that SMAS inserts in the orbicularis oculi muscle (OOM) connection to the facial bone.[3,4] Recent investigations described the SMAS as a three-dimensional meshwork connecting the mimic musculature to the skin with communicating fibro-muscular compartments enveloping fat pads.[5]

The anatomy of the periorbital fat pads, especially the SOOF, is well described, and the connection of these structures to the periorbital and cheek SMAS raised interest among oculoplastic reconstructive and rejuvenating surgeons.[1,6,7] The term SOOF was coined in clinical practice related to the lower eyelid blepharoplasty, where it was resected to avoid contour defects.[1] However, the SOOF terminology has not yet been implemented in Nomina Anatomica.[8]

The surgical management of chronic facial palsy includes, among other problems, the reposition of the SOOF, which helps elevate the overlying and the lower eyelid tissues because they are connected to each other.[9] SOOF lifting procedures are thus used as additional surgical maneuver in the correction of the cicatricial lower eyelid ectropion, aging mid-face ptosis and chronic facial palsy to achieve adequate corneal protection and improve the aesthetic facial affect.[6,9] Furthermore, SOOF plication and suspension are well-described surgical techniques for midfacial rejuvenation.[1,10] However, these procedures have shown a better long-term effect in congenital cases than in facial palsy, where the subsequent drop is greater due to the heavy tissue.[6]

Nevertheless, the lack of a clear definition of SOOF has allowed controversial opinions and interpretation concerning the anatomical location and morphology of this structure.[2,11]

The aim of this study was to perform histomorphological analysis and three-dimensional (3D) reconstruction of the meshwork of the SOOF structure and its connection to the SMAS, the OOM, the intraorbital fat and the skin. The hypothesis of this investigation was that SOOF is a fat pad with morphological architecture that is similar to that of the SMAS underlying the OOM.

Methods

Full graft tissue blocks of the skin, SMAS, OOM and SOOF of the lateral infraorbital region were collected post mortem from two male (61 and 80 years old) and one female (80 years old) body donors and fixed in 4.5% formaldehyde. The cadavers were provided by the Department of Anatomy II, Friedrich-Alexander-Universität Erlangen-Nürnberg and were official testamentary donations of volunteers to the Department for the anatomical student course for medical and dental students and for medical