Midcheek endoscopic anatomy

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ABSTRACT: *Background.* Surgical approaches to the midcheek area are challenging. Recent clinical reports have proposed minimally endoscopic approach again, in order to obtain to obtain a correct balance between the operation's safety and the cosmetic and minimally invasive outcome, but none of them provides a careful anatomic description of the midcheek area. The purpose of this study was to provide a new anatomic perception of the midcheek area through a detailed anatomic endoscopic-assisted dissection.

Methods. Four freshly injected cadaver heads were dissected to illustrate the endoscopic anatomy of the midcheek region.

Results. An endoscope provided an excellent surgical window that achieved greater exposure for dissection and at the same time improved magnification of the noble key anatomic elements.

Conclusion. This study emphasizes the critical role of the transverse facial artery and the facial retaining ligaments as a fundamental endoscopic landmark that allows the identification of key anatomic structures and the creation of safe surgical corridors. *Head Neck* **38**: E268–E273, 2016

KEY WORDS: midcheek mass, midcheek anatomy, endoscopic approach, retaining ligaments, accessory parotid gland

INTRODUCTION

The term "midcheek" refers to the anatomic district included between the lower eyelid above and the upper lip below. Because of its particular location, the midcheek is considered as one of the most important anatomic structures involved in facial communication and mimical expression.[1]

The peculiar anatomic location and the presence of such different structures in limited spaces make this region a formidable challenge for surgeons (Figure 1).

Lesions occurring in this district are infrequent and barely evaluable for the clinician and they can develop from every tissue included in the midcheek structure (cutaneous, lymphatic, adnexal, neurogenic, and salivary structures).[2–5]

Thus, a great number of surgical approaches have been described in the literature for the management of midcheek lesions.

Most common approaches are intraoral, external (modified Blair's incision, facelift-type incision), and direct skin incision surgeries.[6–8] None of the surgical approaches previously described can be considered reliable for the complete excision of tumor masses from the midcheek associated with low morbidity. None of these approaches is best in order to obtain the maneuvering space required for the preservation of noble structures, such as vessels and nerves, ensuring at the same time an acceptable scarring.

Because of the particular features of this district, the best surgical management should consider both aesthetic and clinical outcomes. Thus, the endoscopic procedure can be considered as a good approach to conciliate to both needs.

Recent clinical reports have proposed this approach again, with direct visualization of the surgical field through the aid of endoscopic surgery, but none of them provides a careful anatomic description of the midcheek area.[9,10]

In our opinion, an endoscopic-oriented review of the surgical anatomy is mandatory: visualizing fundamental landmarks is the preliminary step to a surgical procedure that might be complicated by the obvious distortion of the midcheek because of the tumor's presence.

On the basis of such considerations, the purpose of this study was to provide a new anatomic perception of the midcheek area through a detailed endoscopic-assisted dissection and to describe its relevant anatomic details in order to achieve guidance for a further surgical procedure design.

MATERIALS AND METHODS

Four cadavers prepared with intravascular injection of colored silicone were dissected bilaterally: the study has been performed at the Anatomy Laboratory of the University of Tubingen Medical Center, after approval of the local ethical institutional board was obtained.

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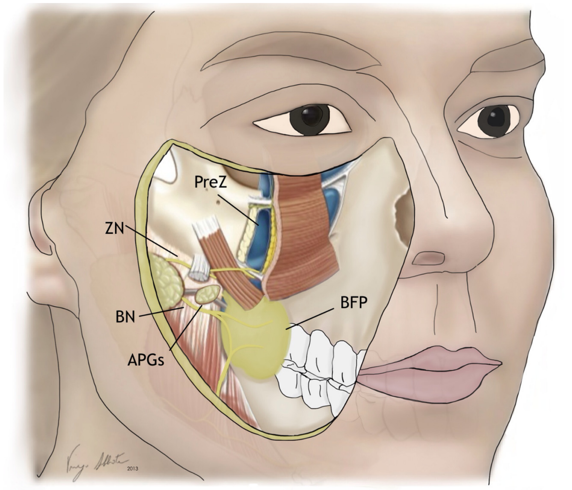

FIGURE 1. The midcheek has a trapezoidal shape, narrowing below because of the roundness of the cheek. Laterally, the midcheek region is bounded by an anterior concavity line extending from the lateral canthus to the labial commissure. This line passes over the body of the zygomatic bone, the upper and anterior boundary of the masseter muscle, and the anterior portion of the buccinator muscle. PreZ, prezygomatic space; ZN, zygomatic nerve; BN, buccal nerve; APGs, accessory parotid glands; BFP, buccal fat pad.

Cadavers included in the study design complied with the following criteria: all small vessels were injected with silicone, and the age of death not over 80 years old for the age-related changes occurring in the midcheek area. A total of 3 male cadavers and 1 female cadaver, age range between 64 and 76 years old (mean age, 71) were used for this study.

Eight procedures have been performed, one for each cadaver' side. Two surgeons were admitted for each cadaver. One surgeon performed endoscopic aided dissection by using a "two hands operation mode," whereas the other surgeon was holding the endoscope and detaching tissues during the dissection procedures.

Four millimeter diameter, 18 cm length rigid, rod lens endoscopes were used with a 30° piece, angulation coupled to a high definition camera and monitors (Karl Storz, Tuttlingen Germany). Optical dissector (50200 ES), with distal spatula, fenestrated, large, sharp, to be used with HOPKINS II telescope; RHINOFORCE II nasal scissors (449201), and BLAKESLAY nasal Forceps (456000) were adopted to perform all the procedures (Karl Storz). All dissections were documented by high definition camera and AIDA recording system (Karl Storz).

Anatomic report

For each side, the head was placed in lateral rotation. Three incisions were performed: one with a length of 1.5 to 2.0 cm made at the margin of the tragus, whereas 2 additional incisions were made along the postauricular crease and on the temporal scalp above the hairline (see Figure 2).

Incisions were made across tissues to the upper face of the superficial musculoaponeurotic system (SMAS) and its continuation, the superficial temporal fascia, in the temporal region, preserving the latter. Each incision was dissected using Metzenbaum scissors for about 1 cm along the SMAS toward the front. This small initial dissection allows the insertion of the optical dissector with the distal spatula. Under 30° endoscopic view, through the tragal incision, the first structure encountered were the parotid cutaneous ligaments. These ligaments appeared lax and easily undergo a blunt dissection by endoscopic scissors (Figure 3A). Operative instruments reached the endoscopic field of view through the temporal and postauricular incisions.

Dissecting along a line led from the tragus to the ala nasi, and then the superior branch of the transverse facial artery (TFA) was highlighted at about 3.5 to 4 cm from the access. This artery comes out of the parenchyma and through the endoscopic field of the view, vertically. Smooth dissection led cranially to this anatomic landmark, letting the operators visualize the zygomatic retaining ligaments and the zygomatic branch of the facial nerve. This is the emerging point of the nerve from the parotid gland that gets closer to the muscular layer near the zygomatic retaining ligaments. Once the zygomatic nerve and ligament were released, it was easy to enter the prezygomatic space safely until reaching the root of the

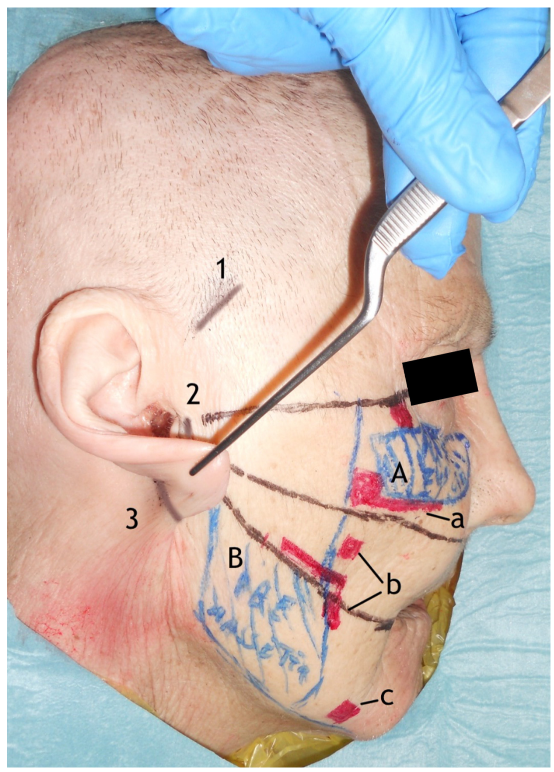

FIGURE 2. Fresh cadaver study, 1 = 1-cm long incision in the temporal scalp above the hairline; 2 = 1.5–2.0-cm long incision at the margin of the tragus; 3 = 1-cm long incision along the postauricular crease. A = Prezygomatic space and B = premasseteric space cutaneous projection; a = zygomatic; b = upper masseteric; and c = mandibular retaining ligament's cutaneous projection.

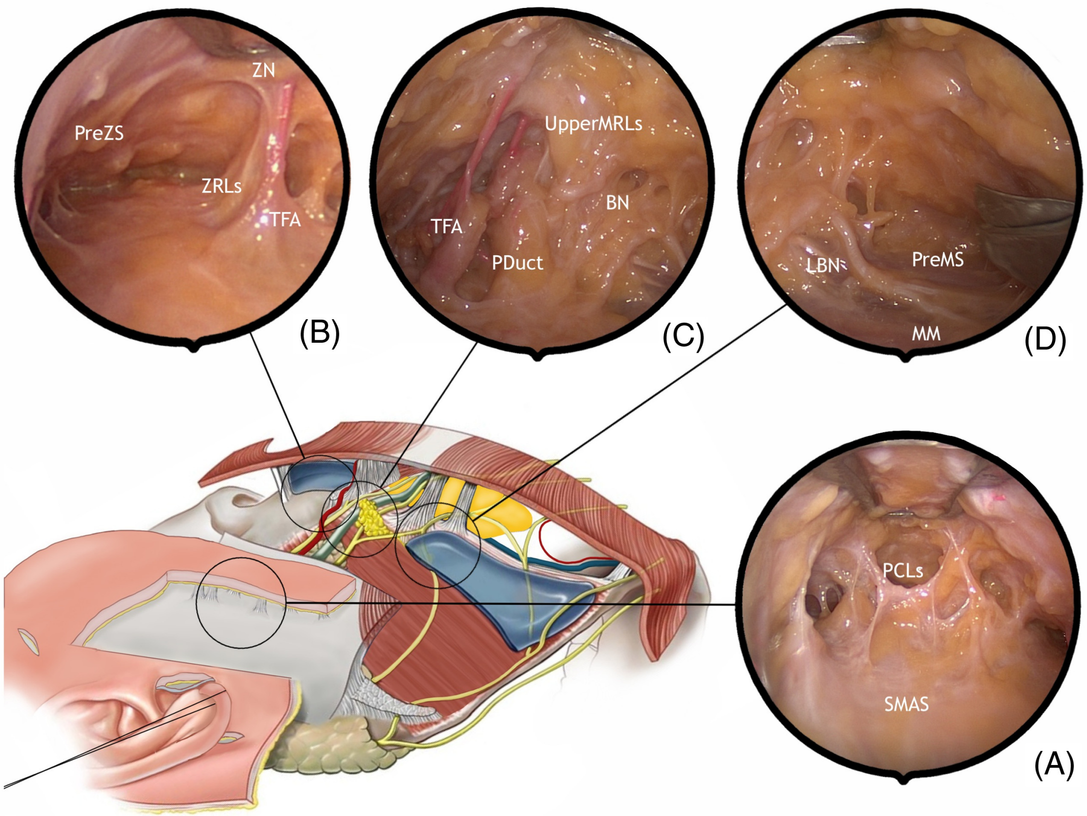

FIGURE 3. Anatomic reconstruction and cadaver dissection showing the main anatomic structures visualized through the endoscopic view. (A) First steps of dissection. (B) Upper limit of midcheek dissection. (C) Dangerous zone. (D) Lower limit of midcheek dissection. PCLs, parotid-cutaneous ligaments; SMAS, superficial musculoaponeurotic system; PreZS, prezygomatic space; ZRLs, zygomatic retaining ligaments; ZN, zygomatic nerve; TFA, transverse facial artery; PDuct, parotid duct; UpperMRLs, upper masseteric retaining ligaments; BN, buccal nerve; LBN, lower branch of buccal nerve; PreMS, premasseteric space; MM, masseter muscle.

nose medially and the orbital septum superiorly (Figure 3B).

Then, keeping the TFA as an endoscopic landmark, dissection was led below and through the premasseter space. This cleavage plane lies immediately superficial to the masseter fascia and underlies the SMAS, which here incorporates the platysma.

Through this safe areolar plane the anterior border of the masseter muscle was easily visualized. A few facial nerve branches were clearly visible coursing under the floor on the surface of the masseter, where they remained "protected" beneath the masseter fascia (Figure 3D).

The space under the transverse facial artery along the anterior border of masseter muscle contains key anatomic structures, which, from above to below, are the parotid duct, the accessory parotid glands (APGs; inconstant), the upper masseteric ligaments and the upper buccal trunk of the facial nerve (Figure 3C).

A gentle smooth dissection was performed from the bottom to the top to visualize all the midcheek key anatomic structures. The buccal branch of the facial nerve emerges from the masseter fascia, closely to the upper masseteric ligament, lying outside the premasseter space; some branches cross the parotid duct to join with the zygomatic ones. APGs are inconstant, but, when present, surround the duct along its way over the masseter muscle before crossing the buccinator muscle approximately at 1.5 to 2 cm from its origin. This glandular lobule seems completely separate from the parotid gland and is connected to the main duct by 1 or more accessory ducts (Figure 4).

Further to the anterior border of the masseter muscle, in the space between masseteric ligaments and oral commissure, there are the structures overlying the fascia on the buccinator muscle, inside the masticator space. Below the fat pad, in the recess extended from the anterior border of the masseter muscle to the insertion of the buccinator, it was possible to display the facial artery and the vertical segment of the facial vein running over the most anterior fibers of masseter muscle, between the jowl recess of the premasseter space and the mandibular ligament (Figure 5).

RESULTS

The procedure was successfully accomplished in all dissected specimens. The use of the Optical Dissector (Karl Storz) with a 30° endoscope provided an excellent surgical window that guaranteed a greater exposure for

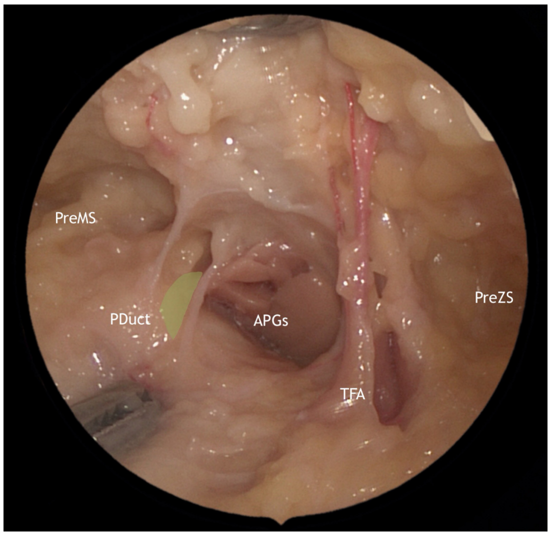

FIGURE 4. Left side endoscopic accessory parotid glands (APGs) visualization. PreZS, prezygomatic space; TFA, transverse facial artery; PDuct, parotid duct (green labeled); PreMS, premasseteric space.

dissection and at the same time improved magnification of the noble key anatomic elements.

The 3 initial incisions supplied a triangulation and various working angles for the endoscope and the surgical instruments, which made the additional dissection and the manipulation easier. The rigid endoscope could be set in across every incision as needed, while the other 2 incisions were available for the instruments.

On all cadavers' sides studied, the following key anatomic structures were visualized and preserved through endoscopic vision: the superior branch of the TFA; the zygomatic retaining ligament; the zygomatic branch of facial nerve; the parotid duct; the upper masseteric ligaments and the upper buccal trunk of the facial nerve; the prezygomatic and premasseter spaces, and the buccal fat pad.

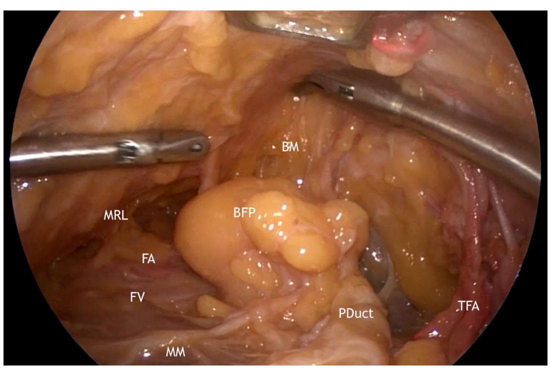

FIGURE 5. Left masticator space endoscopic visualization. MRL, mandibular retaining ligament; FA, facial artery; FV, facial vein; MM, masseter muscle; BFP, buccal fat pad; BM, buccinator muscle; PDuct, parotid duct; TFA, transverse facial artery.

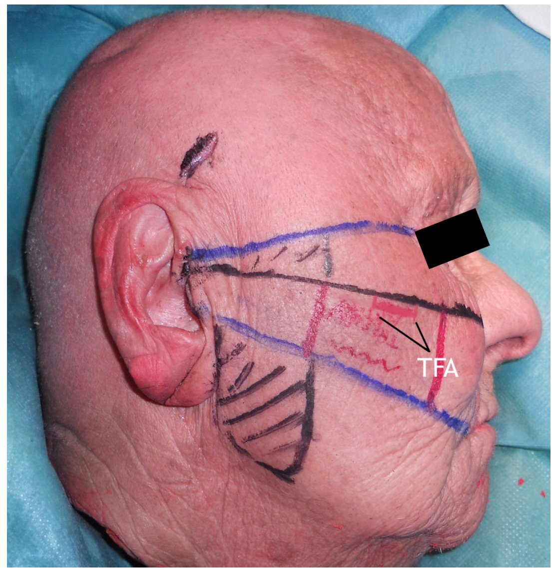

FIGURE 6. The superior branch of the transverse facial artery (TFA) was displayed at the emerging point from the parotid gland at about 3.5 to 4 cm from the tragus. The cutaneous landmark was identified approximately at the intersection between a line that led from the tragus to the ala nasi and a line drawn from the lateral canthus to the oral commissure. TFA, transverse facial artery range point of emergence.

The superior branch of the TFA was displayed at the emerging point from the parotid gland at about 3.5 to 4 cm from the tragus. The cutaneous landmark was identified approximately at the intersection between a line that led from the tragus to the ala nasi and a line drawn from the lateral canthus to the oral commissure (see Figure 6).

In 2 different specimens (25%), the APG and the related accessory duct were found.

DISCUSSION

Midcheek has a trapezoidal shape, narrow below, following the roundness of the cheek. Laterally, the midcheek region is limited by a line extending from the lateral canthus to the labial commissure. This line passes over the body of the zygomatic bone, the upper and anterior border of the masseter muscle, and the anterior portion of the buccinator muscle.

The central position in the face makes this area topical for individual appearance and subsequently primarily responsible for the loss of attractiveness that occurs with aging.[1,11]

Beyond aesthetics, the midcheek area contains key anatomic structures that may be interested by benign or malignant neoplasms. Incidentally, lesions occurring in this district are infrequent and often benign.[6,12,13]

After differential diagnosis, surgical approach to the midcheek region is another important issue.

Many surgical approaches to the midcheek area have been described, but none of them completely fulfills the purposes of a complete tumor removal with low morbidity, minimal or no scars, and the preservation of the surrounding key anatomic structure.

Most common approaches are intraoral, external (modified Blair's incision, facelift-type incision), and direct skin incision surgeries.[6–8]

The intraoral approach, first described in 1979, was soon rejected because it provided inadequate exposure for the control of bleeding and preservation of facial nerves. In 2007, Schmutzhard et al[14] reevaluated this method introducing active monitored nerve stimulation and bipolar cautery, but unsatisfying bleeding control and Stensen's duct injuries still remained problems related to the procedure.

Direct skin incision over the mass was an ill-advised procedure. Johnson and Spiro[7] reported an incidence of 40% of facial nerve injuries for tumors approached via a direct skin incision over the mass.

Most of the authors believe that the surgical approaches of choice for APG pathology are the standard parotidectomy incisions (Blair's incision or facelift-like incision).[15–19]

An incision of 10 to 15 cm long, a large wound, and visible scars on the visible facial areas are common disadvantages of these parotidectomy approaches.

In their retrospective chart review, Aversana Orabona et al[5] provide the reader with an overview of the pathology of this complex anatomic area focusing the attention on the differential diagnosis and the recent surgical strategies. They found a significant rate (55.5%) of temporary complications in all the performed procedures (external, intraoral, and direct skin approach). These authors are the first who emphasize the role of endoscope-assisted surgery as a possible alternative to the traditional approaches for the management of well-selected benign midcheek masses.

Recent clinical reports have proposed minimally endoscopic approaches again, with the aim to obtain a correct balance between the procedure's safety and the cosmetic and minimally invasive aspects, but none of them has provided an optimal anatomic description of the midcheek area.[9,10]

This anatomic report emphasizes the role of the retaining ligaments as a fundamental anatomic landmark to lead the midcheek endoscopic dissection. These structures fasten facial soft tissue in normal anatomic position, resisting the gravitational forces.

Two types of retaining ligaments, as defined by their origin, were described. First, there are the osteocutaneous ligaments, which are a series of fibrous bands that run from the periosteum to the dermis. Zygomatic and upper masseteric ligaments are examples of these structures. A second system of supporting ligaments is made up of a coalescence that occurs between the superficial and deep facial fascia in regions of the face, such as parotid cutaneous ligaments and masseteric cutaneous ligaments.[20,21]

McGregor[22] reported for the first time, in 1959, the close anatomic relationship between the osteocutaneous ligaments (zygomatic and upper masseteric) and the buccal and zygomatic branches of the facial nerve.

In his anatomic studies, Mendelson and Jacobson[1] defined that facial soft tissues are arranged in 5 concentric layers: (1) skin; (2) subcutaneous layer; (3) musculoaponeurotic layer; (4) loose areolar tissue (ie, spaces and retaining ligaments); and (5) fixed periosteum and deep fascia (see Figure 5).

When the same generic 5-layer model is applied to the midcheek, the musculoaponeurotic layer (layer 3) is the one described as the SMAS. The fourth layer is composed by the areolar spaces (premasseteric and prezygomatic) delimited by the retaining ligament that fixes the composite flap (from layers 1–3) to the deep one, allowing movements in response to contraction of the facial muscles (layer 3).

An appropriate knowledge of the fourth layer is the key to perform a safe midcheek dissection. Because these spaces are anatomically predissected, dissection within a space is led quickly without bleeding and with facial nerve preservation as they remain "outside" the spaces in the walls.[23,24]

Accordingly, in our dissections, we found that the facial nerve branches (buccal and zygomatic) were located in the soft tissue immediately outside the prezygomatic space, in the interval between it and the premasseter space, and closely related to the retaining ligaments.

Thus, during the dissections, we first approached the prezygomatic space and then we looked for and dissected the premasseteric space.

The dissection of these 2 spaces provided us the anterior depth limit of our dissection and allowed us to define the limits of the dangerous area, which resulted between them. From this point, dissection was led from the bottom to the top, in order to identify all the midcheek key anatomic structures.

Actually, we believe that a direct front dissection of this subtle region, without providing the lateral depth limits, might imply the serious risk of damage to the structures through an endoscopic 2D vision.

The TFA was our main endoscopic landmark for the identification of the upper limit of the dangerous key anatomic area. The TFA originates from the superficial temporal artery at or above the level of crossing by the temporofacial trunk of the facial nerve in the parotid gland. This artery divides into the superior and inferior trunks in the gland, and continues as an emerging branch. The superior emerging branch emerges from the gland above to the parotid duct, closely related to the zygomatic nerve and ligament.[25] Through endoscopic view, this artery is much more visible than other structures. Once the TFA is identified, the dissection can occur above it safety inside the prezygomatic space keeping noble structures below.

Another important issue is how and where endoscopic-aided dissection drops down from the SMAS plane (layer 3) to the areolar space (layer 4). The answer may have been provided by Ghassemi et al[26] in 2003, who first set the region-specific anatomy of the SMAS. The SMAS is one continuous organized fibrous network, but different facial regions show specific morphological and biomechanical characteristics. Two different types of SMAS morphology were demonstrated: type 1 SMAS architecture is located over the parotid gland with quite small fibrous septa enclosing tall lobules of fat cells, whereas type 2 architecture is located more medially in the midcheek area, where the SMAS consists of a dense collagen-muscle fiber meshwork that reaches directly to the dermis of the skin.

According to Ghassemi et al,[26] we found that the midcheek area is anatomically characterized by the abrupt change between type 1 and type 2 of the SMAS architecture with the nasolabial fold as an approximate juncture line of 2 skin territories. In the midcheek region, the deep adhesion between the muscle and the dermis does not allow the dissection of the SMAS type 2 easily by the subcutaneous overlying layer. Thus, this could explain the shift in the areolar spaces, which we observed when the SMAS dissection was carried out in the midcheek area.

CONCLUSIONS

The purpose of this study was to provide a more accurate surgical-guided anatomic description of the midcheek, with the additional purpose of encouraging a more extensive use of a minimally invasive approach for this district.

Our anatomic experience suggests that the minimally invasive approach provides an excellent surgical window that achieves greater exposure for dissection of the midcheek area. We believe that this procedure might avoid the potential morbidity associated with classical external approaches, improving the magnification of the noble key anatomic elements (buccal and zygomatic branches of facial nerve, APGs, parotid duct, and TFA) and their mutual relationship.

According to our encouraging findings, further clinical applications are required in order to assess advantages and/or limitations of this procedure.

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