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ORIGINAL ARTICLE

Periorbital venous stasis may be involved with filler induced malar edema—A duplex ultrasound-imaging-based case series

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Abstract

Introduction: Filler injections in the periocular region are regarded as a challenging and advanced maneuver in a high-risk area. Adverse events as malar edema due to filler treatment may occur. To evaluate the possible reasons, the ultrasound images, and medical data of patients that were prospectively referred with malar edema were evaluated.

Materials and Methods: A total of 17 patients (26 eyes) with malar edema after hyaluronic acid filler treatment were included. All cases were assessed with an 18 MHz linear ultrasound device. Exact location of the filler material was noted. Relations with clinical data were analyzed using chi-square tests.

Results: Onset of malar edema after treatment showed a wide range from immediate (0 days) to 3 years. Most patients had an early onset $N = 13$ (76%), a minority showed late onset $N = 4$ (24%). In 23 eyes, the filler material was found to be located inside the SMAS. In 3 cases filler material was located on the periosteum of the orbital rim. After duplex-ultrasound guided filler removal, restored venous flow could be seen in the superficial and/or deep fatty layer often accompanied by flow piercing through the SMAS. Minutes after treatment, clinical improvement of malar edema was observed.

Conclusion: Malar edema after by filler treatments in the periocular region may be caused by veno-lymphatic compression by filler deposits.

1 | INTRODUCTION

The tear trough deformity is common complaint both as an anatomical variety and as a sign of aging.[1,2] Volumizing the area with pre-periosteal filler in particular hyaluronic acid (HA) is a well-established therapy. Although dermal fillers are considered safe, filler injections in the periocular region are regarded as a challenging and advanced maneuver.[3] Adverse events do occur, notably filler persistence, blue-gray dyschromia, filler migration, contour abnormalities, and persistent edema are short and long term filler related issues for patients in the periocular area.[4–6]

The development of lower eyelid edema extending into the malar area has been described to occur in 11%–42.3% of patients treated with filler in the periocular area[3,5,7–9] The time of onset may range from directly after treatment to weeks or even years.[5,7,10] Malar edema can last from days to months. One of the recommended treatment options for these patients is to dissolve the HA filler with use of hyaluronidase.[6,7,10] However, one injection with hyaluronidase may not be enough and additional treatments may be required and repeated treatments are frequently needed.[2,3,6] Malar edema may be long lasting and, in case of other fillers, responds poorly to treatment. The therapeutic strategies

may include cold compresses, manual compression multiple times daily, lymphatic drainage, systemic use of prednisolone,[6] and intralesional use of triamcinolone.[11]

Our hospital runs an outpatient clinic for filler complications for more than 12 years. Difficult and persistent cases are being referred. To diagnose and manage complications, facial ultrasound imaging is considered the primary complementary technique[12–15] and is incorporated in our patient care. For years, we treated malar edema by locating the filler and in case of HA, to dissolve the filler ultrasound guided. Recently, we are more focused on the vascular changes associated with malar edema and the anatomically location of the injected filler. In this prospective case series, we evaluated the duplex–ultrasound images and medical data of 17 consecutive patients with in total 26 under eye lids with malar edema due to HA filler.

2 | METHODS

Consecutive patients with malar edema after HA filler injections as a primary complaint referred between September 2021 and September 2022, were included in this study. Patients with potential signs of inflammation (erythema, pain) were excluded. Medical data noted age, gender, primary complaint, time of onset, location and type of clinical symptoms, type of filler used, as well as timespan between injection and occurrence of symptom. Duplex ultrasound imaging was performed using an 18 MHz linear probe (Philips Affinity 70).

All patients included in this study provided written informed consent for accessing their data for the purposes of this study. All treatments were performed in accordance with the standards of good clinical care following local guidelines and regulations. Ethics committee approval to gather data concerning soft tissue filler complications was obtained (MEC-2016-0660), however ultrasound imaging is considered the standard of care for the management of adverse events according to The Medical Research Involving Human Subjects Act.

Ultrasound images of the affected area were stored and later assessed independently by two physicians experienced in reading US images (LS, PV). Descriptions of foreign materials present (presumed to be fillers) was based on earlier proposed nomenclature.[16] The layer in which the filler was located was determined to be one of the following: (1) superficial fatty layer, (2) fibrous layer (fascia/SMAS), (3) deep fatty layer, (4) periosteum, (5) muscle or (6) another layer. Filler deposit in the SMAS was defined as filler mass confined between continuous hyperechogenic linear structures (fibrous tissue) both superficial and deep to the filler (Figure 1). For standardization, the probe position was marked on the skin prior to hyaluronidase injection to obtain the same ultrasound anatomy images before and after dissolving.

3 | RESULTS

Summary of the result is given in Table 1. A total of 17 patients was assessed (all female) with in total 26 eyes displaying malar edema.

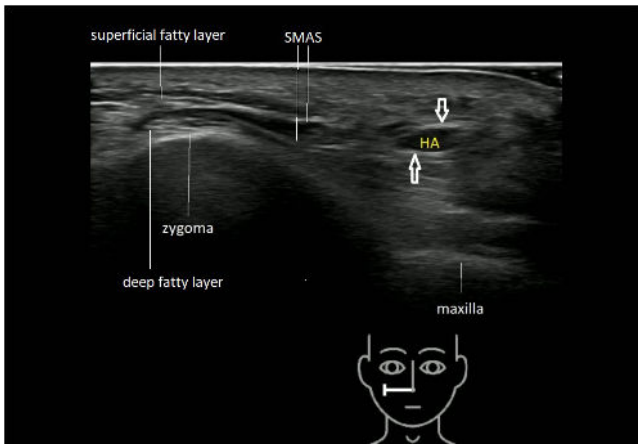

FIGURE 1 Hyaluronic acid filler deposit in the SMAS. The SMAS layer is expanded by filler.

Their mean age was 47,9 years (Table 1). All patients were injected with HA filler.

3.1 | Clinical findings

Onset of malar edema after treatment showed a wide range from immediate (0 days) to 3 years. Most patients had an early onset $N = 13$ (76%), a minority showed late onset $N = 4$ (24%).

3.2 | Duplex ultrasound findings

On ultrasound, HA filler is seen as anechoic to hypoechoic well-defined oval shaped deposit(s), sometimes with posterior enhancement. Fatty layers are seen as lobulated hypoechoic tissue separated by hyperechoic linear fibrous septa. The SMAS is characterized as a hyperechoic linear sheet of variable thickness with a clear fibrillar pattern. Facial dynamic muscles are hypoechoic band-like structures. Glandular tissue (salivary glands) is depicted a homogeneous structure with increased echogenicity compared to nearby tissue. The bone is a hyperechoic linear structure.[17] Vessels are anechoic and depending on the probe position, visible as round to oval shaped structures or as tube-like structures. With duplex mode, the velocity and direction of blood flow in the vessel can be evaluated and the vessels can be seen in red or blue. Veins and arteries can be distinguished: veins have a floating apperance and are compressible. Arteries have a pulsatile behavior. Veins and arteries can also be characterized by their waveform pulsation features.[18,19]

The HA filler deposits in the periocular region could be identified in all patients. With ultrasound imaging the filler material was found in the superficial and deep fatty layers, on the periosteum of the orbital rim and between fibrils of the SMAS. Signs of edema were detected in patients with severe malar edema with ultrasound imaging (Figures 2, 3). With duplex modus on, the vessel activity around the

TABLE 1 Patient data. Consecutive numbering based on date of admission. Age in years.

Patients/area's	17, 26
Mean age	47, 9
Initial diagnosis	16×edema
	1×inflammation
Location of filler injection	10×tear through
	4×midface
	3×zygoma
Needle, canula, unknown	13, 3, 1
Date of onset	13×immediately
	4×>4 months
Treatment team	31 US guided injections
Mean dose hyaluronidase	91 units
Locations US findings	
SMAS	2
SMAS med SOOF	2
SMAS midface + migr zyg	1
SMAS midface	6
SMAS zygoma + migr midf	3
SMAS zygoma	2
SMAS midface tt	3
SMAS midface tt + periost	4
Orbital rim	3
Duplex findings after treatment	
Improved venous flow	21
Improved flow vein through SMAS and compression on periost	2
Improved flow artery on foramen	1

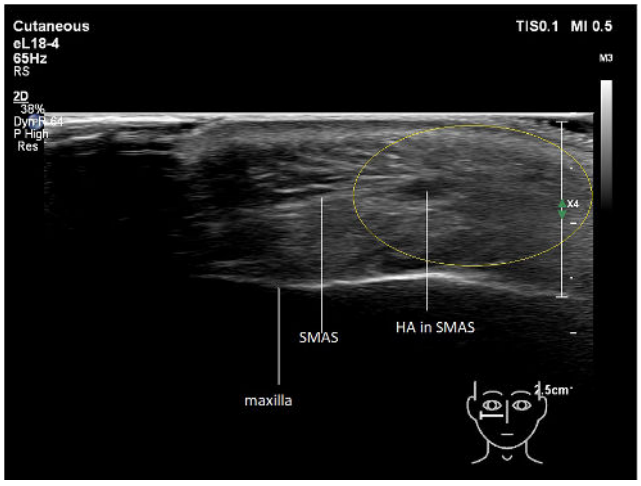

FIGURE 2 Edema on the right side of the image: abnormal echogenicity and increased thickness of the dermis with indistinct "haziness" and increased echogenicity of the subcutaneous tissue (in yellow circle). HA, hyaluronic acid filler.

HA filler deposits before treatment were observed. This was compared to the vessel activity after removal of the HA filler deposit(s).

4 | TREATMENT RESULTS

Seventeen patients and in total 26 periorbital areas underwent ultrasound guided injections into the filler deposits leading to decrease or clearance of filler deposits. Twenty-three filler deposits injected with hyaluronidase were located in the SMAS in the region of the medial SOOF. In three cases, the filler deposits were visible on the periosteum of the orbital rim and dissolved with hyaluronidase. Ranges of 50–125 units of hyaluronidase (Hyason®) were used per treatment with an average of 100 units. Minutes after treatment, clinical improvement of malar edema was observed (Figure 4). Two patients returned for a second treatment session, two other patients with severe edema (Figure 3) needed three treatment sessions. No other medication was given.

With duplex-ultrasound, restored venous flow could be seen in the superficial and/or deep fatty layer often accompanied by flow piercing through the SMAS (Video 1). The treatments were sufficient to keep the edema away. The restored vessels were most of the times veins (objectified with pulse wave mode) and sometimes a combination of small veins and arteries in the superficial fatty layer. In case of injection on the periosteum of the orbital rim, an artery and vein piercing through a foramen were blocked by a HA filler deposit (Video 2).

5 | DISCUSSION

Lower eyelid edema extending into the malar area is an interstitial fluid accumulation over the malar eminence and may be caused by periorbital dermal filler injections.[20,21] Several theories on the development of edema have been considered. It may represent a low-grade inflammatory reaction; however, there is no convincing signs of inflammation (i.e., erythema).[7] A hypersensitivity reaction to the HA filler has been suggested, and the edema may be a result of this.[22] Patients with allergies, rosacea, an underlying tendency for fluid retention (sometimes only in the first hours after waking

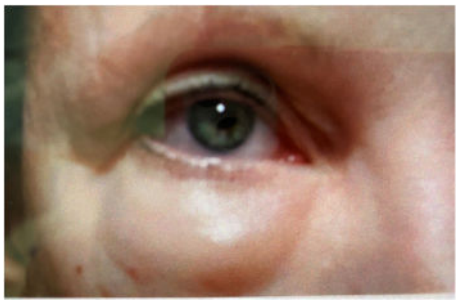

FIGURE 3 Severe edema.

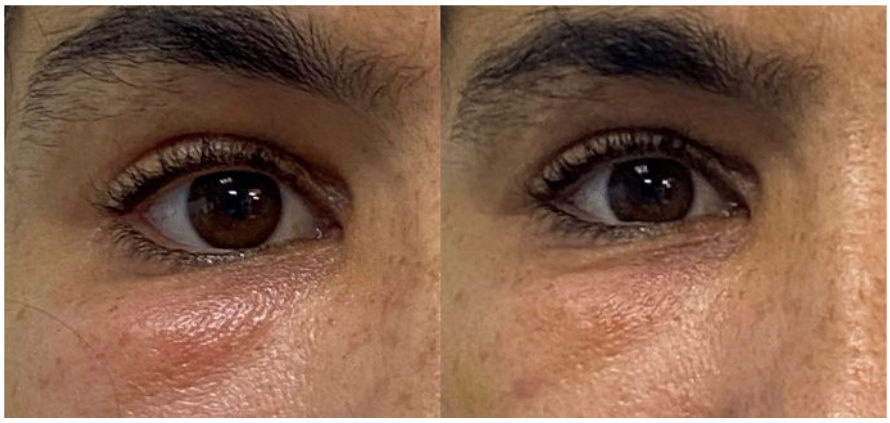

FIGURE 4 Left: before hyaluronidase treatment. Right: 10 min after hyaluronidase treatment. Direct clinical improvement is noted.

up) and those on the sleep apnea spectrum are supposed to be particularly at risk.[7,23]

However, the most accepted hypothesis of malar edema is a compromised lymphatic drainage system. Filler deposits may cause edema by either obstruction of the lymphatic drainage or by direct pressure on the lymphatics when injection volumes are too large.[6,10]

With duplex ultrasound examination of the periocular region in patients with lower eye lid edema, we observed a difference in blood flow before and after removal of HA filler deposits. As we are not familiar with the individual vascular anatomy of the patient before the adverse event, we could only register the flow pattern presented after filler injection. We compared this with the blood flow after hyaluronidase injections into the HA filler deposit. Vessels that were not visible before dissolvement were noticed with duplex ultrasound. These vessels are mainly veins. Comparing the before and after images, it looks like during the adverse event leading to malar edema, there is reduced flow is in the micro vascularization of the superficial layers and in the SMAS. The quick recovery of blood flow is accompanied by clinical visible diminished malar edema in minutes (Figure 4). After that, the edema disappears further in a couple of days. The fast restoration of visible blood flow and the clinical accompanying improvement may indicate a veno-lymphatic cause of malar edema in case of filler treatment.

In contrast to veins elsewhere in the body, orbital veins, including those of the eyelids, generally do not accompany the arteries. Venous drainage occurs via the pre- and post-tarsal veins. In front of the tarsus on the lateral side, blood drains into the superficial temporal vein and the lacrimal vein; medially, blood drains to the angular and ophthalmic veins. Behind the tarsal plates, blood drains into the orbital veins and the deeper branches of the anterior facial vein and pterygoid plexus.[24]

A compromised lymphatic drainage system cannot be ruled out as the drainage of the medial portion of the upper and lower eyelids drain in the submandibular nodes by channels that follow the angular and facial vessels[25] The lymphatic system is not visible with a 18 MHz probe.

Filler material may accidentally end up in the SMAS in different ways. By aiming to inject sub-SMAS, the tip of the needle or cannula may wind up inside this layer. The tip of the needle is touching the bone, but at the same time the SMAS is being pushed down and filler product is injected in one of the layers of the SMAS instead of sub-SMAS. Furthermore, in order to reach the deep fatty layer, the SMAS has to be passed with needle or canula and a tract is created by which backflow of filler may happen. When aiming for the superficial fatty layer, the tip of the needle or cannula may go too deep and filler material may be injected inside the SMAS.[26] Adjustment of the current injections technique to avoid these injector related adverse events is something to look into. Recognizing these patterns is probably the first step.

Malar edema may appear immediately after filler treatment but may also take months to years to develop (5,7 and personal observations). In a subsequent study, it might be of interest to search for a difference in the severity of the vascular obstruction between those early and later onset complications. Filler migration has been described and may take years to manifest. This delayed migration /redistribution of fillers is visible on ultrasound as a stratified dispersion pattern within the SMAS[26,27] accompanied with SMAS expansion, and may also explain the late time of onset of malar edema.[28–31] The musculocutaneous perforators supplied by the facial artery run through the SMAS.[32] The perforators combine with the intraseptal vene of the SMAS. These intraseptal vene are the anastomoses between the subcutaneous and the sub-SMAS irrigating system.[33,34] It has been suggested that muscle cell contraction compresses the intraseptal veins and acts as a muscular pump to accelerate the drainage within the venous system.[35] Filler deposits located in the SMAS may compromise this venous system and may explain why, after filler removal, restored flow in the superficial layers and in the SMAS is visible. In three patients, the filler deposit was located on the periosteum. We assume that these deposits accidently compress a vein coursing underneath, leading to restored flow and diminished edema after filler removal.

The limitations of this study were the open, noncontrolled design and the small numbers. We will continue to collect ongoing data.

6 | CONCLUSION

Malar edema after by filler treatments in the periocular region may be caused by veno-lymphatic compression by filler deposits.

AUTHOR CONTRIBUTIONS

LS and OL performed the research, LS, SC and PV designed the research study, PV analyzed the data, LS SC an SSD wrote the paper.

CONFLICT OF INTEREST STATEMENT

Dr Schelke and Dr Velthuis are shareholders in Cutaneous BV, a company that provides educational courses and materials in the realm of facial ultrasound imaging.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available in [repository name] at [DOI/URL]. These data were derived from the following resources available in the public domain: [list resources and URLs]

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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