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Cosmetic

Ultrasound as an Educational Tool in Facial Aesthetic Injections

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Summary: Injection therapies for cosmetic enhancement, particularly antiaging treatments, are increasingly popular. However, once the needle has penetrated the skin, the injector is "blind" to the depth and exact location of the needle tip. Duplex ultrasound use before and after treatment can allow the injector to visualize in real time the individual anatomy, thereby improving and confirming the accuracy of the injections through visualization of both the target layer and the vital structures to be avoided. Previously injected permanent filler treatments can also be visualized. In this way, ultrasound use becomes an important educational tool in promoting "safer" facial injection therapy. It shifts static anatomy to mobile real-time facial anatomy, thereby establishing itself as an invaluable learning tool through follow-up imaging, with subsequent optimization in techniques and patient outcomes. *(Plast Reconstr Surg Glob Open 2022; 10:e4639; doi: 10.1097/GOX.0000000000004639; Published online 12 December 2022.)*

INTRODUCTION

Facial injections of fillers are a well-established and popular procedure in the cosmetic arena, with a high success rate due to a better understanding of the aging process and the specific areas to target. However, once the needle disappears under the skin, injectors are essentially blind to the location of the needle tip from which the product flows, regardless of a detailed knowledge of facial anatomy and its reported variations.

In the last decade, there have been a growing number of articles published regarding fillers and the use of ultrasound. All of them focus on the visibility of different fillers and/or describe ultrasound as a first-imaging technique for dealing with potential filler complications including vascular adverse events.[1,2] For research purposes, ultrasound examination adds more detailed and new information as the course of vessels and the mobility of tissue can be seen in real time.[3] Besides improving safety and complication management, we would like to highlight the educational aspect of using ultrasound to better understand injection anatomy and the correct placement of filler.

HOW ULTRASOUND WORKS

The ultrasound device allows for a visualization of the cross section of the facial layers, as shown in Figure 1. Simply stated, ultrasound waves penetrate the skin and, depending on the underlying structures, will be transmitted through fluid-containing elements or reflected by hard components. As ultrasound waves cannot penetrate through bone, the high degree of reflection gives the bone the distinctive appearance of a white line (hyperechoic). Blood vessels contain fluid, so with the ultrasound transducer rotated in the longitudinal direction they can be identified as black (anechoic) tubular structures. Color Doppler imaging can determine direction and intensity of blood flow, and thus is recommended where possible. Every structure, including all fillers, has its own echogenicity, and injectors need to train their eyes in pattern recognition of the different facial layers and filler composition.[1] In contrast to performing common full-body ultrasound examination techniques, the authors have found the learning curve of ultrasound tissue recognition as rapid (steep).

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EDUCATION: ULTRASOUND INJECTION ANATOMY

When performing filler injections, knowledge of facial anatomy is of the utmost importance to avoid (serious) complications and ensure optimal long-term treatment outcomes. Even when the injector is well versed in surgical facial anatomy, ultrasound adds valuable information. Incorporating ultrasound into the treatment plan gives insight into the patient's individual anatomy in real time. Variations, multiple classifications, and their discordant percentages have been reported in the literature.[4] Most injectors have limited understanding of the individual differences in facial layers and how all the different structures relate to each other.[5] Improper placement of fillers is an underestimated problem that can cause not only suboptimal aesthetic outcomes but also significant adverse events.[6] Ultrasound allows for the delineation of differences in subcutaneous thickness (Fig. 2). Filler injections into the superficial fat compartments are relatively routine, but a thinner tissue layer will have an intendant higher probability of targeting the appropriate depth. Instead of injecting filler material into the subcutaneous tissue, it may inadvertently be injected into the fascia surrounding the superficial fat compartments, into the underlying muscle, or into the parotid gland (Fig. 3) causing migration of product, late-onset nodules, and inflammatory responses.[7] Scanning the area before injection may lead to a better experience and outcomes for each individual patient (Figs. 2, 3).[6,8]

For nonseasoned injectors, the use of ultrasound during injection provides an extra means to appreciating how the right plane "feels" during injection on a real-time basis.

Takeaways

Question: Does ultrasound have a use in facial aesthetic injections?

Findings: Ultrasound can improve the accuracy and safety of cosmetic-enhancement injections.

Meaning: Ultrasound has a key role in facial aesthetic injections and should be used routinely to guide injections and as an educational tool.

Furthermore, posttreatment visualization of the deposited filler provides insight into filler dispersion within tissue planes and adds an educational evaluation element to assessing injector skills (Table 1).

The face is dynamic and the mobility of the midfacial structures influences the location and projection of injected fillers. Visualization of the change in shape and form of the injected filler as well as the subcutaneous tissue due to the underlying facial musculature leads to a better understanding of how facial animation during both verbal and nonverbal communication can be taken into account when injecting fillers, leading to more predictable and natural outcomes through the range of facial expressions.[9] Facial ultrasound is invaluable in shifting an understanding of static anatomy to one of mobile anatomy.

In addition, pretreatment scanning is invaluable in cases of previous filler treatments, the exact composition of which is commonly unknown to the patient, since each deposit is recognizable by the type of filler and its location, depth, size, and placement.[1] For hydrophilic

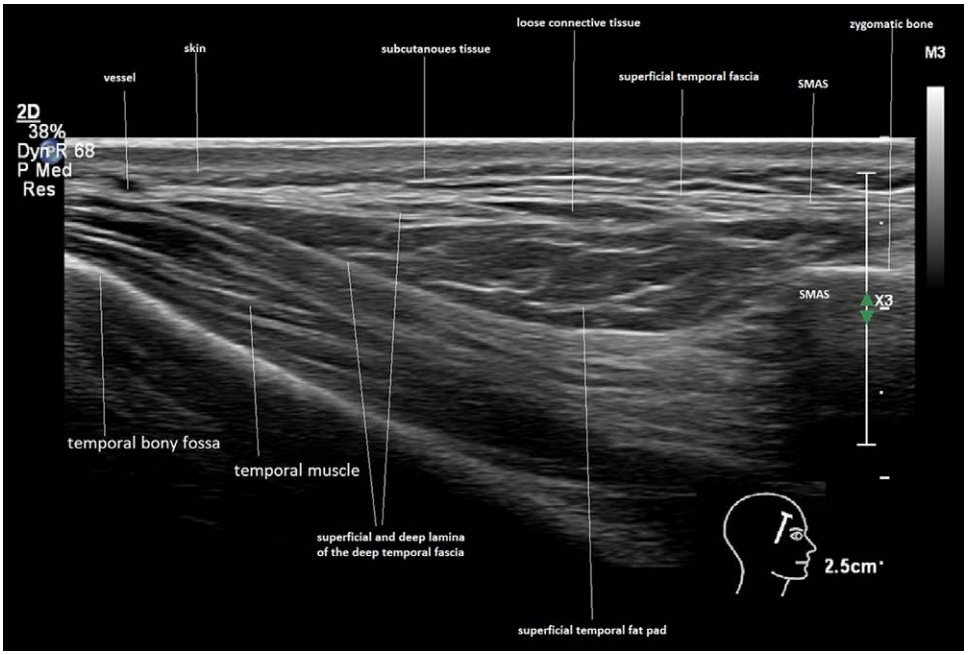

Fig. 1. Duplex ultrasound of the facial layers (ultrasound device: affinity 70 linear 18-MHz probe, Philps BV, The Netherlands).

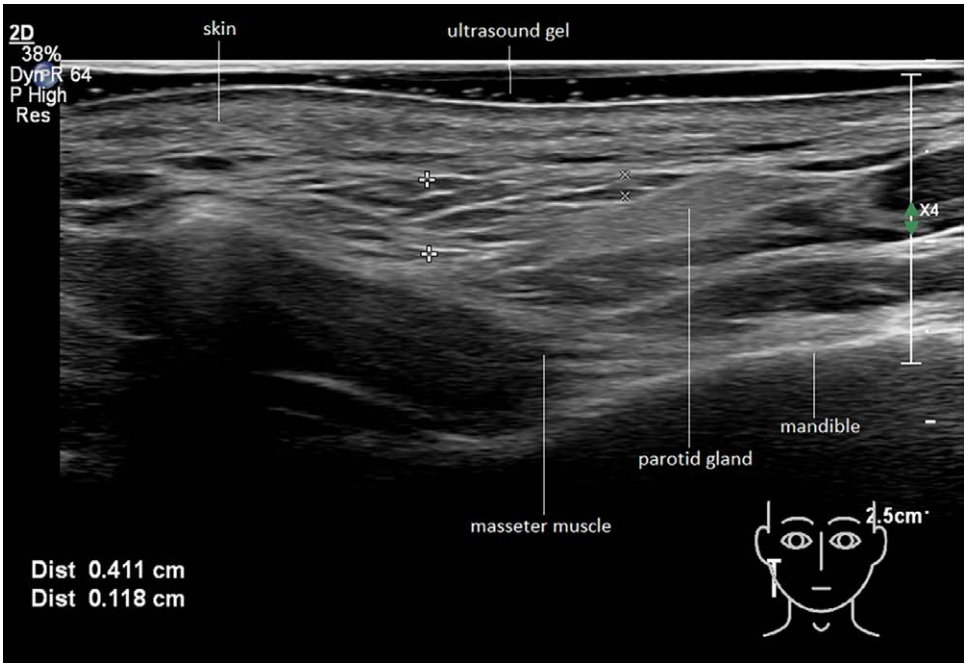

Fig. 2. Differences in subcutaneous thickness. Superficial fatty layer between markers. Markers (ultrasound device: affinity 70 linear 18-MHz probe, Philips BV, The Netherlands).

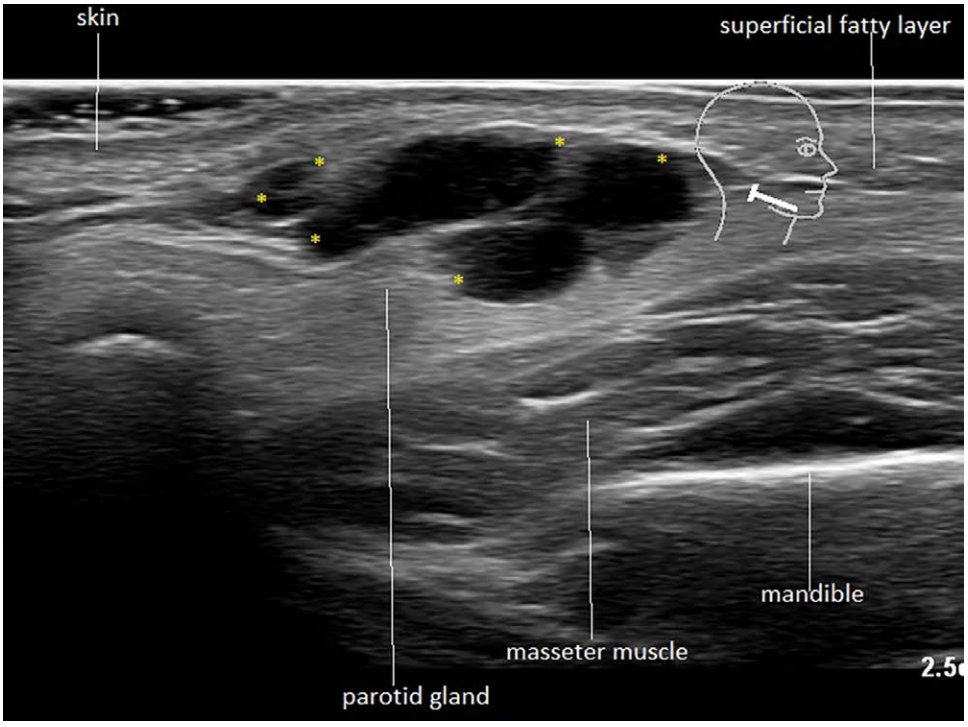

Fig. 3. Filler into the parotid gland HA filler between yellow markers (ultrasound device: affinity 70 linear 18-MHz probe, Philips BV, The Netherlands).

(water-binding) fillers such as hydrogel polymers and hyaluronic acids, the ultrasound waves travel through the fluid with little or no reflection so the image on ultrasound appears black, often with posterior enhancement (anechoic–hypoechoic). Whereas hyaluronic acid depots appear oval-shaped, permanent hydrogels more

Table 1. Pretreatment Key Structures to Visualize with Ultrasound[6,8]

Anatomical Area	Pretreatment Key Structures to Visualize with Ultrasound	Key Notes
Zygoma	Deviant superficial course of the transverse facial artery Zygomaticofacial foramen SMAS	For injections in the deep fat or on the periost, the needle or cannula has to be underneath the SMAS
Temples	Location of deep temporal arteries Thickness of the subcutaneous layer	The subcutaneous tissue might be very thin and product may be injected into the superficial temporal fascia
Midface	Location of the infraorbital notch Dominant infraorbital artery Mobility of the dynamic muscles	The biodynamics of the midface may be taken into account to determine the amount and location of injected product
Tear trough	Deep or superficial plane of the angular vein	A deep coursing vein may lead to a hematoma and less room to inject the product on the periost
Eye	Dominance and course of infraorbital and angular artery can be visualized	Infraorbital dominance may lead to different vascular patterns Adding filler on top of earlier injected filler may overfill this delicate aera and lead to malar edema
Nose	Presence of (para) central arteries Deep or superficial plane of the nasal veins and arteries	Arteries may course in the deep plane
Lips	Labial arteries coursing above, in, or under the orbicularis oris muscle	Superficial course of the labial artery may increase the risk of a vascular adverse event
Chin	Deviant course of the inferior labial artery coursing from the mental protuberance Location of the mental foramen Thickness of the subcutaneous tissue above the depressor anguli oris	A thin subcutaneous layer may lead to product injections into the dynamic musculature (especially the depressor anguli oris)
Jawline	Thickness of the subcutaneous tissue above the parotid gland Mobility of the masseter muscle	A thin superficial fatty layer may lead to a different product choice to avoid visibility of filler
	Locate the facial artery and facial vein	Avoid injections into the parotid gland (special care should be taken in case of thin superficial fatty layer)
Forehead	Superficial course of the arteries—coursing subdermal instead of in the subcutaneous plane Unexpected anastomoses between the supratrochlear and supraorbital arteries Thickness of the forehead	A forehead may be 2–5 mm in thickness. A thin forehead may required a different product choice
All areas	Presents of (the amount) of filler	Injections into permanent fillers should be avoided, and overfilling of an area due to earlier resorbable fillers may cause vascular problems

often appear bulky-shaped with multiple internal echoes.[4] For hydrophobic fillers (such as polymethyl methacrylate or silicon oil), the ultrasound waves striking the fibrotic tissue around the particles are fully reflected, creating a hyperechoic band with no visible anatomic structures underneath (posterior shadowing). Biostimulatory fillers (eg, calcium hydroxyapatite) show as hyperechoic deposits with slight posterior shadowing, whereas subcutaneous threads appear as hyperechoic bands.[2,10] As injections into previously placed permanent fillers may lead to inflammatory responses in the latter, their visualization and avoidance before treatment can prevent complications. Furthermore, it is difficult to interpret remaining product of resorbable fillers without ultrasound, especially in watershed areas of restricted vascular supply. For instance, adding further filler in an already overfilled nasal tip with limited safety window may lead to compression of end arterioles and subsequent inflammation or vascular compromise of the overlying skin.

CONCLUSION

The use of duplex ultrasound in facial filler treatment provides additional essential information permitting the normally "blinded" injector to visualize both the targeted tissue and vital structures under the skin.

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