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Facial ultrasound in aesthetic dermatology: A revolutionary approach

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Introduction

Aesthetic dermatology has seen tremendous advancements over the last few decades, with innovations aimed at improving patient outcome and safety. One such groundbreaking technology is facial ultrasound, which has transformed the way aesthetic procedures are performed. In 1979 ultrasound was introduced in dermatology clinical parctice and much later in aesthetic dermatology.[1] Traditionally used in medical imaging, ultrasound is now an indispensable tool in aesthetic dermatology, offering real-time visualization of the skin layers, fat compartments, and vascular structures. This article explores the role, benefits, applications, and future prospects of facial ultrasound in aesthetic dermatology.

Understanding facial ultrasound

Ultrasound is becoming increasingly important in aesthetic dermatology, offering numerous benefits for minimally invasive procedures. It aids in targeted therapies, complication prevention, and management, particularly for dermal fillers.[2] Facial ultrasound employs high-frequency sound waves to create detailed images of skin, subcutaneous tissues, and deeper anatomical structures. Unlike other imaging modalities, such as CT scans or magnetic resonance imaging (MRIs), ultrasound is non-invasive, radiation-free, and provides real-time dynamic imaging.[3] It allows practitioners to identify previously injected fillers, determine optimal injection depths, and monitor treatment efficacy.[4] Beyond injectables, ultrasound enhances other aesthetic techniques like mesotherapy, radiofrequency, and cryolipolysis.[2] This imaging modality supports a holistic approach to aesthetic dermatology, complementing clinical dermatology by addressing both skin health and appearance. As a quick, painless, and relatively inexpensive tool, ultrasound is becoming an essential part of the aesthetic practitioner's diagnostic arsenal.[3,4]

As the ultrasound is a user-dependent device, the injectors needs to to have a broader knowledge of anatomy and ultrasound techniques. They need to be educated and trained in basic physical principles of ultrasound imaging and anatomy.

How Facial Ultrasound works?

Facial ultrasound works by emitting high-frequency sound waves that penetrate the skin and bounce back to the ultrasound transducer, creating detailed images. The depth of penetration and clarity of images depend on the frequency used. Higher frequencies provide greater resolution but less penetration, making them ideal for facial imaging.

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Ultrasound imaging consists of:

- *B-mode imaging:* Produces two-dimensional grayscale images of soft tissues.
- *Doppler ultrasound:* Measures blood flow in vessels, helping avoid complications in vascular regions.
- *Shear wave elastography (SWE):* Assesses tissue stiffness, which is useful in skin aging studies and filler longevity assessment.[5]

The probe of ultrasound is called transducer which is both transmitter and receiver of ultrasound waves. The waves received are then converted into digital images by the processor. The various probes used are linear, convex and phased array. The convex probe by employing deep focusing is used in abdominal ultrasound whereas linear one is used in aesthetic procedures because of its superficial focus. These devices may have variable frequency transducers that operate in their upper range of 15 to 70 MHz and also have color Doppler, which allows for the detection of capillary type and blood flow velocity.[3]

Higher frequency transducer provides more detailed images but has limited penetration so probes with frequency ranging between 10-22 MHz are used in facial examination. The images produced by the device are in different shades of gray. Absence of reflection is seen as black or anechoic, complete reflection as white or hyperechoic and gray or hypoechoic. Isoechoic images are seen when tissues are indistinguishable from neighboring tissues.[1]

Benefits of Facial Ultrasound in Aesthetic Dermatology The integration of ultrasound in aesthetic dermatology has provided several benefits, including the enhanced precision, improved safety, personalized teatment planning and being non-invasive and painless.[1,6]

Applications of Facial Ultrasound in Aesthetic Dermatology In dermal fillers injections the facial ultrasound aids in identifying vascular anatomy and ensuring safe injection points. It also helps in detection of filler placement and migration in cases of asymmetry or lumps. It facilitates the physician in hyaluronidase-assisted filler dissolution in cases of complications.[7]

In case of botulinum toxin injections ultrasound can accurately locate the muscle layers and injection depth. It helps to optimize dosing and targeting of specific muscles, reducing adverse effects such as ptosis or asymmetry.[8]

Facial ultrasound is instrumental in assessing the skin thickness, collagen levels, and overall dermal health. This allows dermatologists to design personalized antiaging regimens, monitor collagen production following treatments such as microneedling, PRP, and laser resurfacing.[5]

Ultrasound plays a pivotal role in diagnosing complications related to aesthetic procedures, including the filler-induced vascular occlusion, vessel compression or embolisms, delayed-onset nodules and granulomas, distinguishing between biofilm infections, inflammatory responses, or incorrect filler placement. It can also detect foreign body reactions and migration of non-hyaluronic fillers.[9]

In case of lasers and energy-based device treatments ultrasound can help evaluate skin thickness and hydration levels, guiding dermatologists in selecting appropriate laser or radiofrequency treatment settings for optimal results.[10]

Future Prospects of Facial Ultrasound in Aesthetic Dermatology With ongoing technological advancements, the future of facial ultrasound in aesthetics appears promising. Some anticipated developments include AI-enhanced ultrasound imaging in which machine learning algorithms can help dermatologists automatically map the facial anatomy and predict procedural outcomes. Handheld and portable ultrasound devices will become a necessary tools for every injector as they are more compact and user-friendly devices. Combining Augmented Reality with ultrasound imaging could provide real-time

guidance for injectors, enhance precision, and reduce risks.

Conclusion

Facial ultrasound revolutionizes aesthetic dermatology by improving safety, precision, and treatment outcomes. As technology advances, its integration into routine practice will continue to expand, ensuring safer and more effective aesthetic interventions. Dermatologists and aesthetic practitioners who embrace this tool will undoubtedly provide superior patient care and achieve better aesthetic results with fewer complications.

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