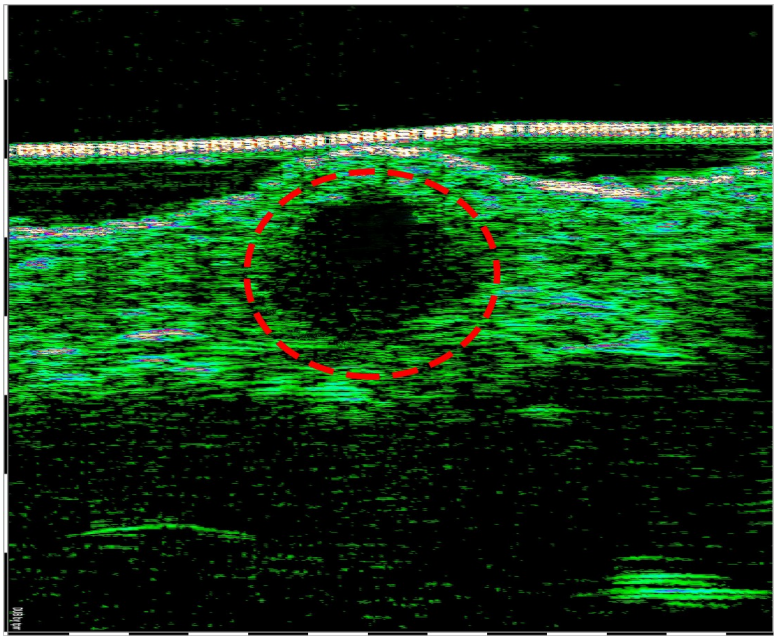
WHY YOU SHOULD USE HIGH-FREQUENCY ULTRASOUND DIAGNOSTICS IN AESTHETIC MEDICINE



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INTRODUCTION

Modern dermatology and aesthetic medicine require objective, reliable and safe diagnostic methods. Considering the difficulties of differential diagnosis in dermatology, high risk of side effects after aesthetic procedures, there is a strict demand for objective diagnostics of skin condition.

Today's diagnostic trends are focused on imaging methods that provide the most understandable and reliable visual information about the pathological object. It is always better to "see" the changed structure and location of the pathological site in order to choose the correct patient management.

Nowadays, the most common non-invasive skin diagnostic methods are video dermoscopy and high-frequency ultrasound (HFUS) skin imaging.

High-frequency ultrasound skin examination is a basic diagnostic method specially designed for the daily practice of dermatologists, derma-oncologists, aesthetic physicians and plastic surgeons. It makes possible any pathological changes detection in the skin and soft tissues.

It is well known that the higher the ultrasound frequency, the higher the resolution. Frequencies of 22 MHz and higher are used to diagnose surface structures such as the dermis, epidermis and subcutaneous tissue.

High-frequency ultrasound has a significant difference from traditional ultrasound with a probe frequency of 14-16 MHz, which is designed to examine deeper structures like liver, kidneys, muscles, etc.

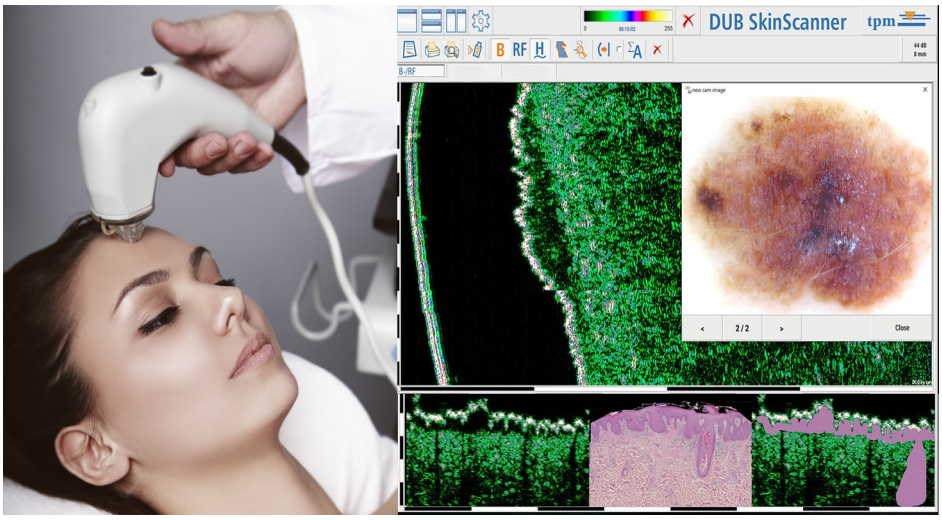
For the skin structure changes visualization probes from 22 to 100 MHz are required. These probes let doctors see the entire skin tissue and precisely examine the epidermis and dermis.

High scanning frequencies show the processes occurring directly in the vertical "skin slice cut" (from the epidermis to the subcutaneous fat). And resolution down to 21 μm (75 MHz) helps to evaluate these lesions with maximum accuracy.

HFUS is the only way to see any changes in the skin's full thickness, giving a precise diagnosis for lesions. The combination of 22 MHz and 75 MHz HFUS with Doppler and cross-polarized video dermoscopy provides a complete tools set complex diagnosis of the required skin area. You can observe all pathological changes in different skin layers with a resolution of up to 21 microns, determine the characteristics of blood flow, and evaluate these changes on the skin surface using dermoscopy (50x magnification).

Ultrasound scans and dermoscopic changes can be displayed together on one screen, which is important for obtaining a complete picture of the skin lesion.

High-frequency ultrasound skin imaging has indisputable advantages: availability, reliability, high measurement accuracy, non-invasiveness, painlessness, safety and the ability to study the evolution of the same object in dynamics.



HFU scan + videodermoscopic image

High-frequency skin scans are similar in appearance to histologic images and are intuitively understood by dermatologists, aestheticians, oncologists, plastic surgeons, and other specialists involved in the diagnosis and treatment of skin lesions. These professionals have a good understanding of skin anatomy and histology, which simplifies the interpretation of HFUS scans.

The special software developed for HFUS skin images processing helps to study and accurately assess the morphofunctional skin parameters.

HFUS is widely used to examine the skin at various time intervals, documenting all features and changes. The data is digitized and stored in a database. It is easy to perform comparative analysis of images, see skin changes in dynamics and analyze the effectiveness of treatment.
Today, HFUS could improve the service quality of any medical organization, especially those operating in the high-tech sector.

AESTHETIC MEDICINE

The frequent use of injectable fillers, thread lifts, and energy-based skin treatments may cause severe side effects and complications. One of the most likely reasons for this is the significant diversity of individual morphological parameters of the skin, SMAS, and subcutaneous fat, as well as the variability in the location of major arteries and veins.

Incorrect filler injection depth or non-targeted energy delivery may occur due to variations in the thicknesses of the epidermis and dermis or the SMAS depth. Skin individual parameters depend on anatomical localization, age, gender, and personal phenotype. The variations in the skin morphology require a complete diagnostic picture assessment before the treatment planning in the aesthetic clinic. Moreover, the assessment of individual parameters is necessary to improve the procedure quality and safety in plastic surgery and aesthetic dermatology.

Fillers

HFUS is useful for the detection and type determination of the previously injected fillers. Also, HFUS examination is helpful for skin individual anatomical features specification for navigation and targeted filler injections.

HFUS examination provided before filler injection helps to take into account the individual morphological and functional skin parameters, such as the dermis and subcutaneous fat thickness, the depth and relative position of the muscle, fascias, and periosteum, as well as the variability in the blood vessels location.

While dermal fillers have many benefits, there is still a chance of side effects and complications.

Early complications are caused by procedural errors or filler components and manifest as inflammatory and allergic reactions, filler migration, vascular compression, and filler penetration into arterial vessels in the form of abscesses and necrosis.

Late complications appear several months and even years after filler injection in the form of non-absorbed nodular deposits, foreign body granulomas, sclerosis areas, and fibrous capsules around the filler.

High-frequency ultrasound enables visualization of the biodegradation stages of the filler, the migration of the filler, and the side effects and complications of the filler.

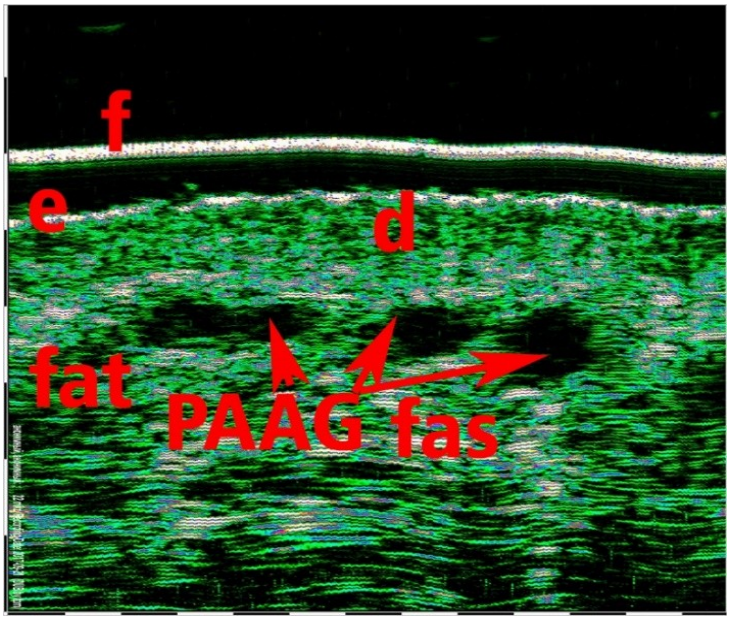
Nowadays difficult to find “virgin skin” in aesthetic patients. The majority of them underwent numerous filler injections and energy-based procedures, which altered their skin structure. Especially important to consider is the emergence of a large group of patients with unclear medical

anamnesis. Regrettably, they frequently cannot disclose the type of filler previously injected or may conceal this information.

Therefore, a preliminary HFUS examination in order to identify the previously injected filler, its resorption degree, and the surrounding tissues' condition has become a necessity. This diagnostic information is vital to decide on the possibility and tactics of re-injection in the examined area.

In many cases, the incomplete resorption of the previously injected filler leads to morphological changes in the surrounding tissues, such as fibrosis, encapsulation, filler migration, and filler non-resorbable deposit. Under such conditions the normal distribution of the newly injected filler is unlikely and re-injection of the filler should be avoided.

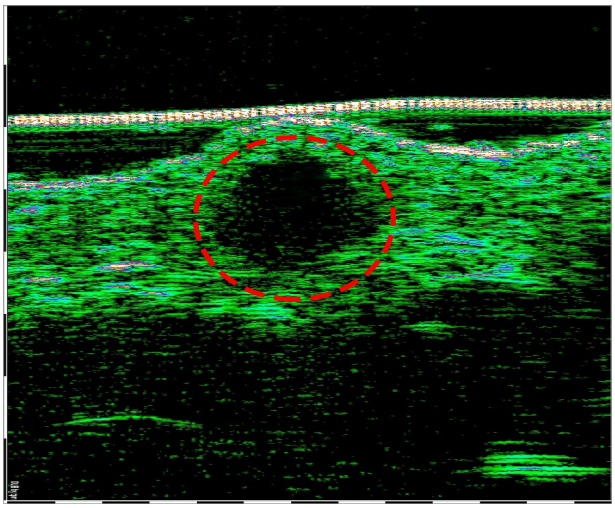
The compatibility of various filler types has not been practically studied. Therefore, filler injection into area where already existing filler deposits with different chemical compositions, increases the complications risks many times. An objective assessment of the filler localization, biodegradation, and pathological changes in the surrounding tissues cannot be carried out using physical examination. To solve this issue, we need to examine the skin's morphology in vivo. **HFUS skin examination remains only one diagnostic tool to determine the presence or remnants of previously injected fillers and to identify their type.** Different filler types have specific ultrasound patterns at HFUS images due to their physicochemical properties. These patterns analysis helps to define the filler type for the main filler groups.



Polyacrylamide gel injected into the nasolabial fold

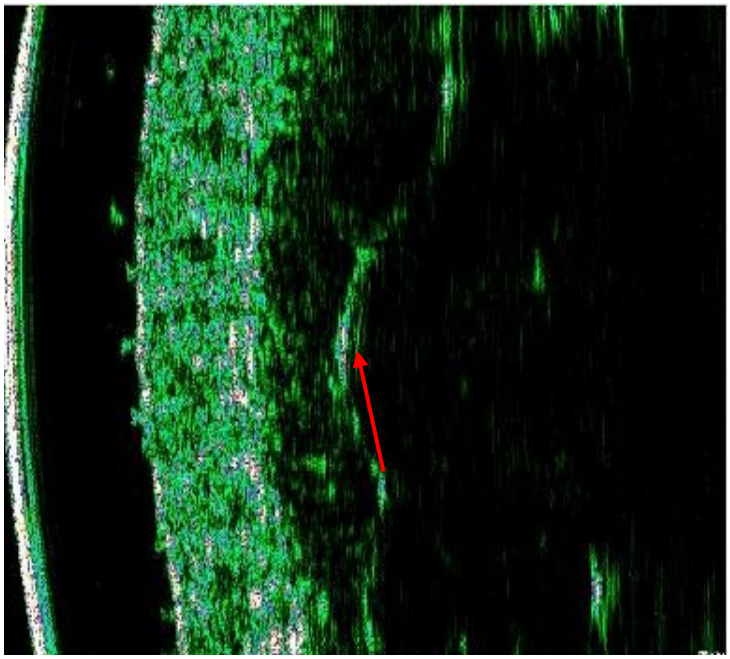
The modern algorithm for managing aesthetic patients includes dynamic control after injection. HFUS examination should be provided at certain intervals to check probable filler migration, complications appearance, biodegradation stage, etc.

HFUS dynamical control after the procedure is necessary for side effects early identification.



Complication after filler injection. Foreign body granuloma.

It is also often required to assess the skin structure during thread-lifting procedures. HFUS allows to evaluate the parameters, condition, and possible pathological changes of the dermis and subcutaneous fat in the areas of the threads' proposed location, and correctly select the appropriate type of threads.



Aptos Nanovitis, scan after 6 months

When prescribing high energy-based treatment methods (lasers, RF, HIFU, etc.) HFUS skin scanning is mandatory for accurate target-tissue determination.

The energy-based treatments can target various skin layers, such as the epidermis, papillary dermis, reticular dermis, SMAS, and subcutaneous adipose tissue.

Precise energy delivery to the target tissue, with adequate power, significantly increases the treatment effectiveness and safety.

For example, **HIFU** treatment results are directly related both to the properties of the used physical factor and to the morphological and functional features of target tissues. HIFU devices are usually equipped with transducers set, and every transducer has a fixed penetration depth, of 1,5 mm, 3,0 mm, 4,5 mm, or others.

The target for HIFU – is SMAS. The SMAS depth and thickness are very variable depending on anatomical location, patient age, gender, and constitution. The use of fixed in depth HIFU transducers could result in ineffective treatment and complications.

For example, if the dermis thickness in the treated area is about 2.0 mm, but the transducer is focused on 1.5 mm, the energy is released in the dermis with the dermal burn as a result. Another example – is if the SMAS lower border is located at 2 mm depts, but transducer with a fixed 3.5 mm is used, the energy is released in the muscle, with burn and pain syndrome as a result.

To increase the HIFU treatment efficacy and avoid complications we can simply measure the SMAS depth and thickness with High-frequency ultrasound and choose the necessary HIFU applicator.

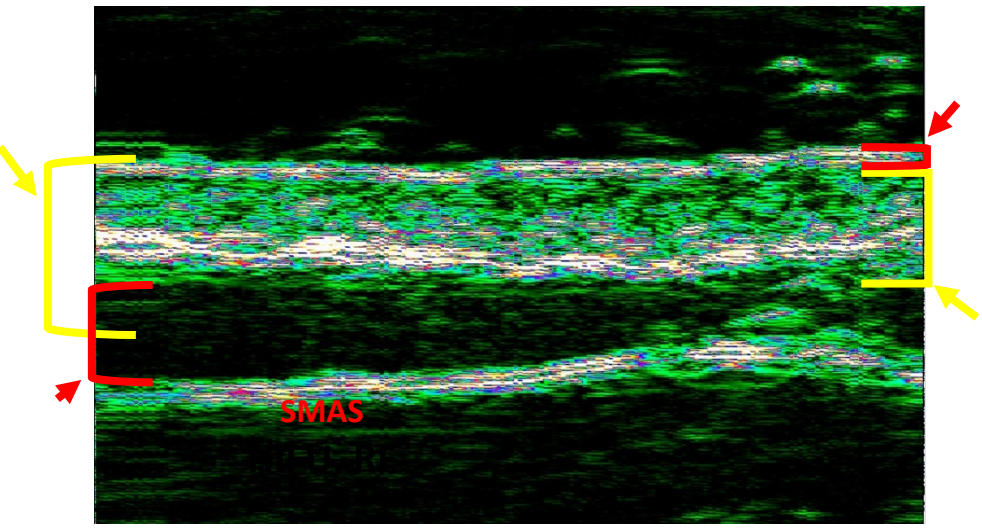
The presence of foreign objects in the tissues (fillers, implants, lifting threads), and fibrotic changes located along the propagation of ultrasonic waves can lead to uneven distribution of thermal energy, overheating or insufficient heating of the tissue, which can lead to complications after the HIFU procedure.

Preliminary measurement of dermal thickness is a necessary component in the patient diagnosis before **HIFU**.

Skin (dermis) thickness decrease is often the result of a decrease in cell activity (synthesis of collagen, elastin, etc.), which may be associated with a system violation of the body's regulatory function (genetic, age-related, hormonal disorders.

HFUS dermis thickness measurement and skin condition assessment are necessary to choose the patient's management tactics with adequate targeted treatment. HFUS measurement results show the target tissue depths and thickness, what is necessary for the optimal treatment parameters choice (penetration depth and intensity).

Optimal depth of impact, for this patient, and in that location is 1.4-1.7 mm

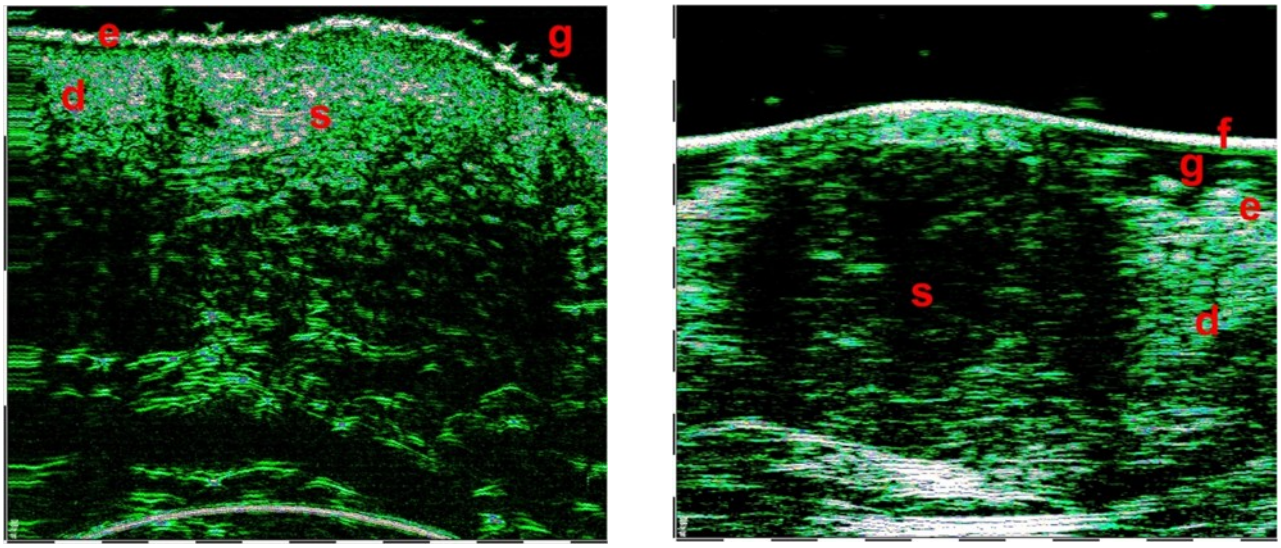


Epidermis, thickness 0.16 mm.
Lasers: KTP, PDL, Erbium

Dermis, width 1.3 mm.
RF
Lasers: CO2, Nd:YAG, Diode 800 nm, Alexandrite, Ruby.

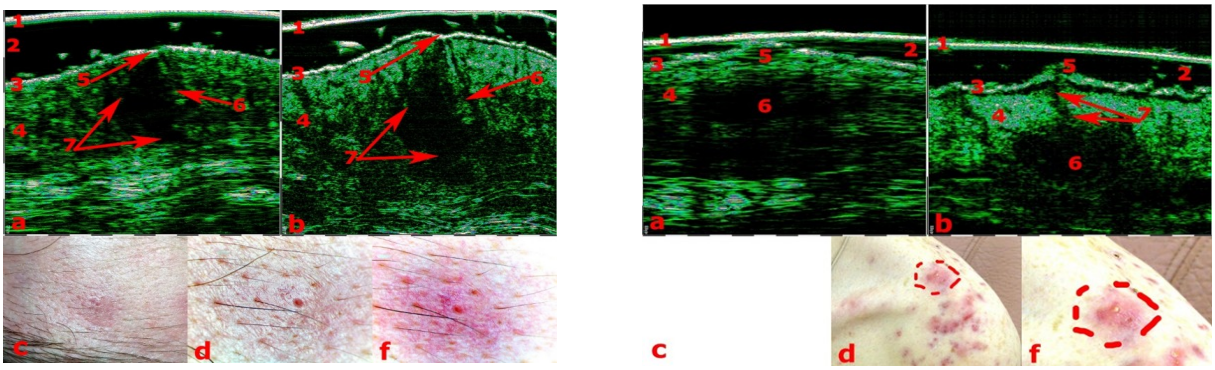
Dermis and hypodermis thickness HFUS evaluation allows to choose the most effective settings for laser systems, and RF procedures.

Skin scarring is one of the valuable subjects in aesthetic medicine. According to some recent studies, the HFUS data for the different scar types differentiation were obtained. **HFUS scars measurement and patterns analysis were successfully used for the normotrophic, hypertrophic, keloid, and atrophic scars differentiation.** This clinical information is vital for the scars proper treatment and rehabilitation.



The HFUS hypertrophic(left) and keloid(right) scars differentiation.

HFUS acne examination is helpful for the precise acne form diagnosis (inflammatory/noninflammatory, pustules, conglobates, etc.). For example, acne severity is very often underestimated, because internal changes in the dermis are invisible. HFUS examination allows to see the signs of infiltration, exudation, and fibrosis, which allows to diagnose acne type and follow proper treatment, with HFUS treatment efficacy control.



Pustules' (left) and Conglobate(right) acne, the most pronounced changes are located in the dermis thickness. HFUS scans and videodermoscopic images

HFUS evaluates all morphological changes located in the skin at different levels: epidermis, dermis, and hypodermis. That is why this method is indispensable and mandatory for medical institutions, it improves the quality of medical treatment, and the institution's status and expands the possibilities of providing high-tech medical care. HFUS is a useful tool for the right treatment method and the choice of its parameters, assess the lesion before treatment and monitor the treated area state after a certain time.

Thus, summarizing the information above, it should be noted that the purchase of a device for high-frequency ultrasound skin scanning is necessary for the daily practice of aesthetic doctors, and will provide high-quality and high technical medical services.