tpm taberna pro medicum

HIGH-FREQUENCY ULTRASOUND SKIN IMAGING

presented by: tpm taberna pro medicum GmbH

high frequency ultrasound since 1978

CONTENTS:

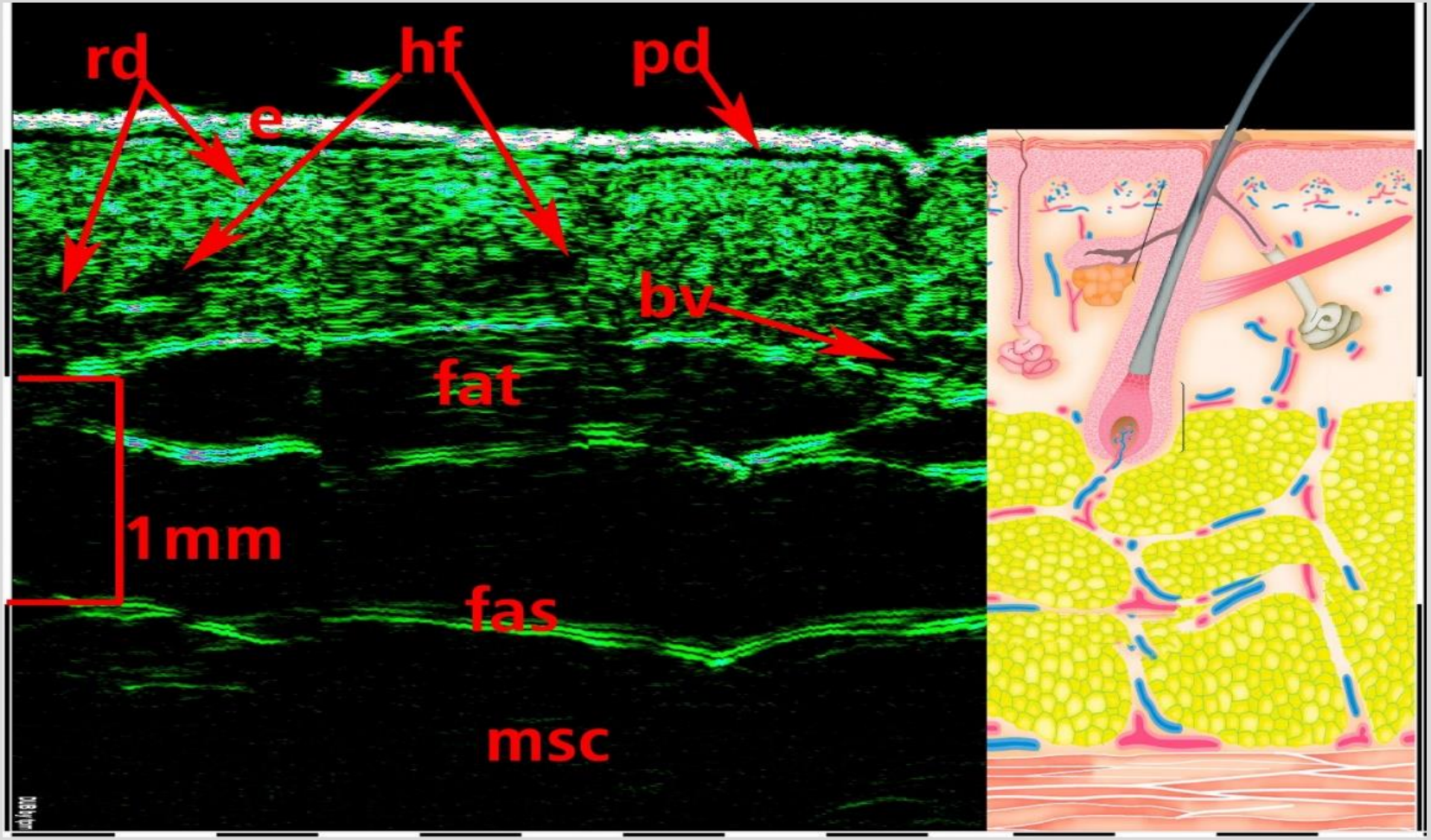
INTRODUCTION
HIGH-FREQUENCY ULTRASOUND (HFUS)

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

-**To diagnose skin changes, probes from 22-28 to 100 MHz are required.** These probes allow seeing the entire skin tissues and accurately examine the epidermis, dermis, and subcutaneous fat.

-High scanning frequencies showing the processes occurring directly **in the "skin vertical section"** (from the epidermis to the subcutaneous fat). **Near-histological resolution up to 21 µm (75 MHz)** helps to assess skin lesions location, structure, and margins with maximum accuracy.

HFUS AND SKIN MICROANATOMY CORRELATION



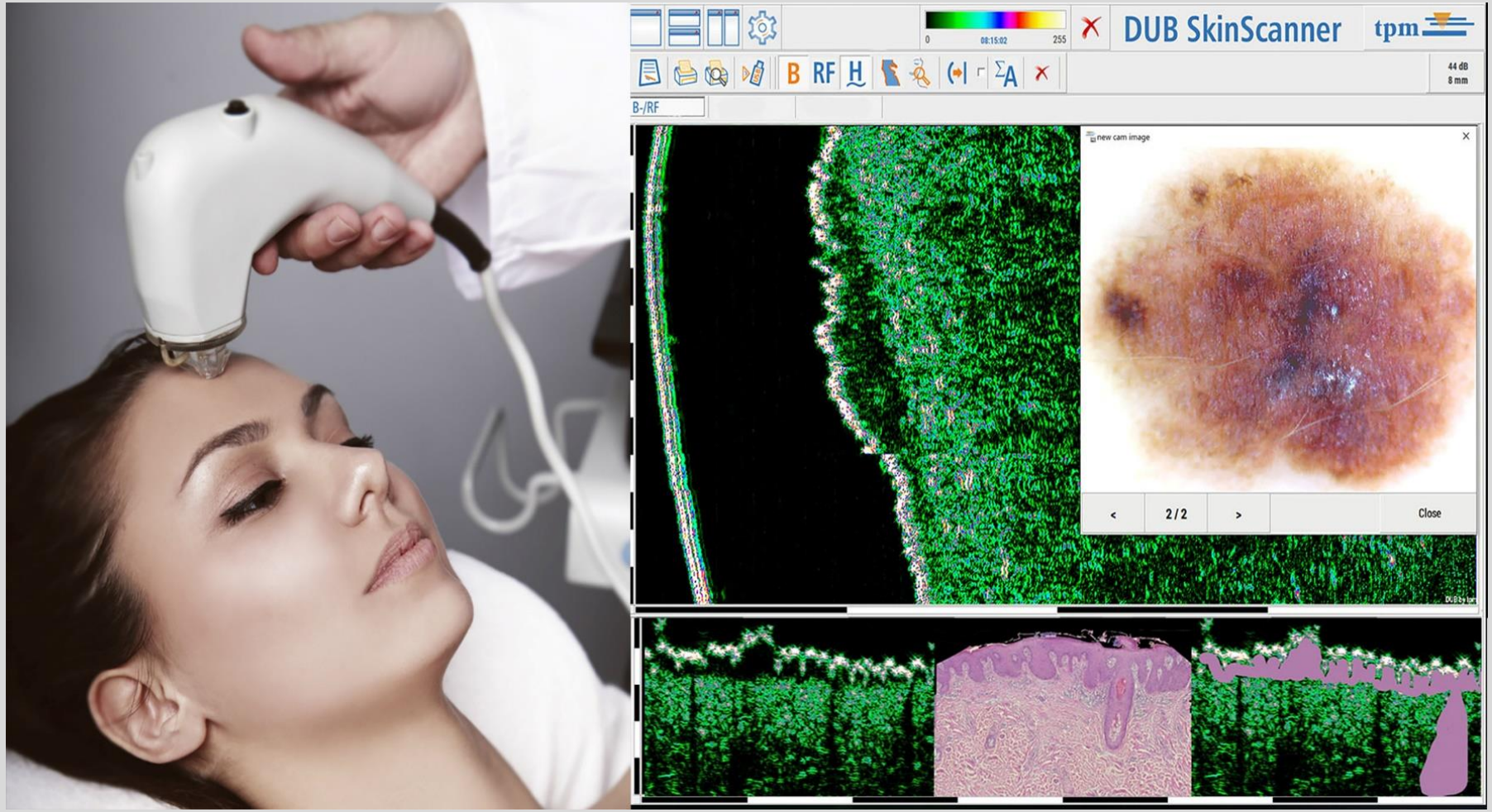
A 75 MHz scan of intact skin (left) and a diagram of the skin microanatomical structure (right). e - epidermis, pd - papillary dermis, rd - reticular dermis, hf - hair follicle, bv - deep dermal plexus blood vessel, fat - adipose tissue, fas - fascia, msc - muscle.

HFUS + VIDEODERMOSCOPY EXAMINATION

-The combination of 22-28 MHz and 75 MHz ultrasound scanning with high-frequency Doppler and the option of cross-polarized video dermoscopy provides a complete tool set for complex diagnosis of the required skin area. This combination allows to visualise all pathological changes beginning from the epidermal surface, and in deeper dermal and subdermal layers.

- High-frequency ultrasound skin examination is a **basic diagnostic method designed specifically for the daily medical practice** of dermatologists, derma-oncologists, aesthetic doctors, and plastic surgeons.

HFUS + VIDEODERMOSCOPY EXAMINATION



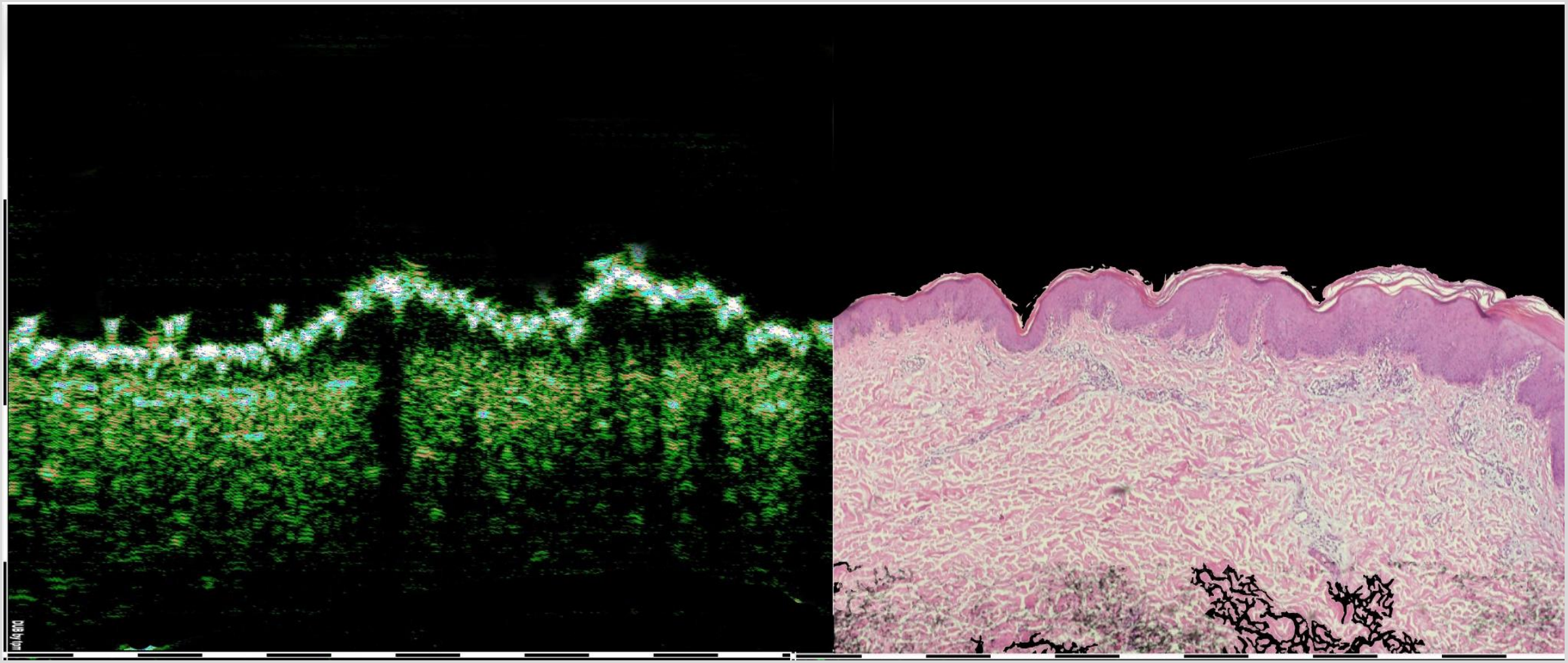
Melanocytic nevus HFU scan + videodermoscopic image

HIGH-FREQUENCY ULTRASOUND AND HISTOLOGY

The HFUS skin image on the scans is visually comparable with the histological picture. HFUS scans have a high resolution and are easily interpreted by specialists. Many scientists refer to high-frequency ultrasound as in vivo biomicroscopy.

It is important that the data from high-frequency measurements of skin micromorphology **have been repeatedly confirmed by studies** that compared the measurement results of high-frequency ultrasound and Histomorphometry.

HIGH-FREQUENCY ULTRASOUND AND HISTOLOGY



Psoriatic papule before biopsy (left)

Same psoriatic papule histological image (right)

DERMATOLOGICAL APPLICATIONS:

DIFFERENT PATHOLOGIES HAVE SPECIFIC ULTRASOUND PATTERNS THAT HELP TO DIFFERENTIATE VARIOUS SKIN DISEASES.

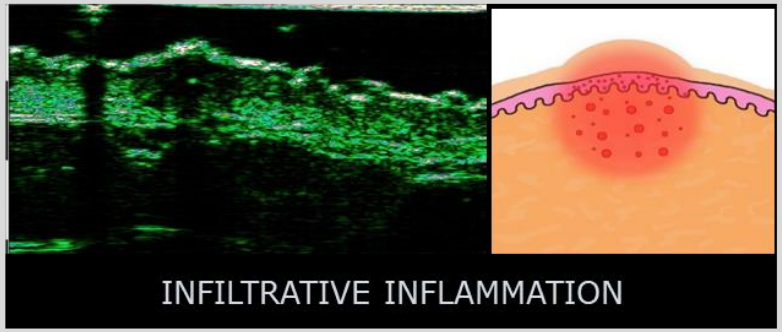
- **Non-invasive skin pathology differentiation** (like infiltrative inflammation, exudative inflammation, purulent inflammation, necrosis, fibrosis, atrophy, cicatricial changes and lipodystrophy etc.) **is essential for proper clinical diagnosis.**

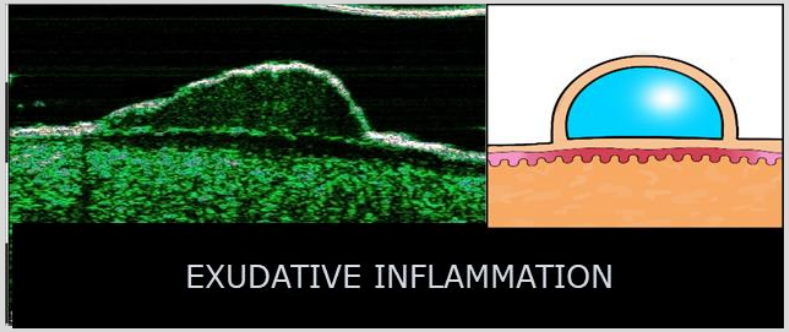
- Objective disease severity assessment, and adequate treatment choice.

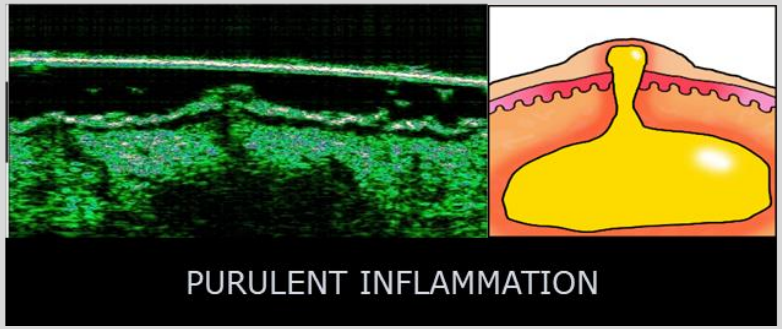
- Treatment effects quantitative monitoring in dynamics.

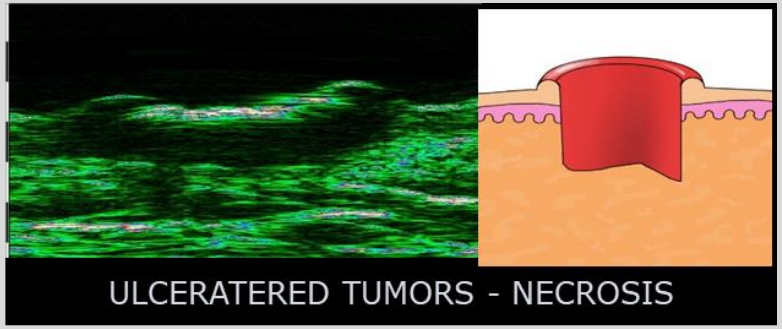
Ultrasound scanning is actively used by dermatologists all over the world, allowing to expand the diagnostic capabilities of visualization not only on the skin surface, as in dermoscopy, but also throughout the depth.

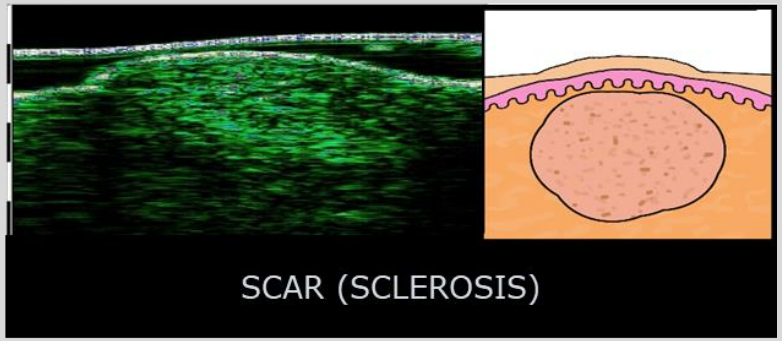
SKIN MAIN PATHOLOGICAL PROCESSES:

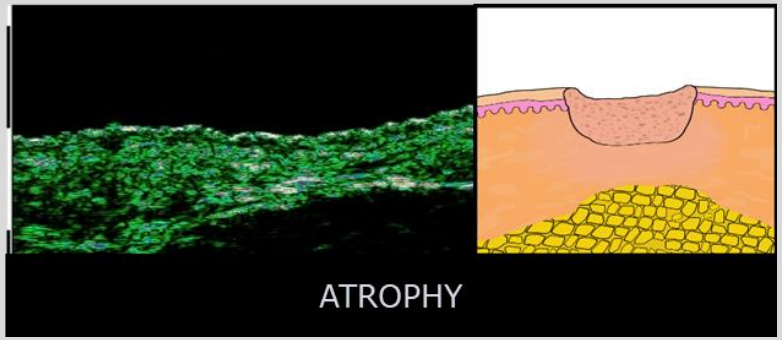












AESTHETIC MEDICINE

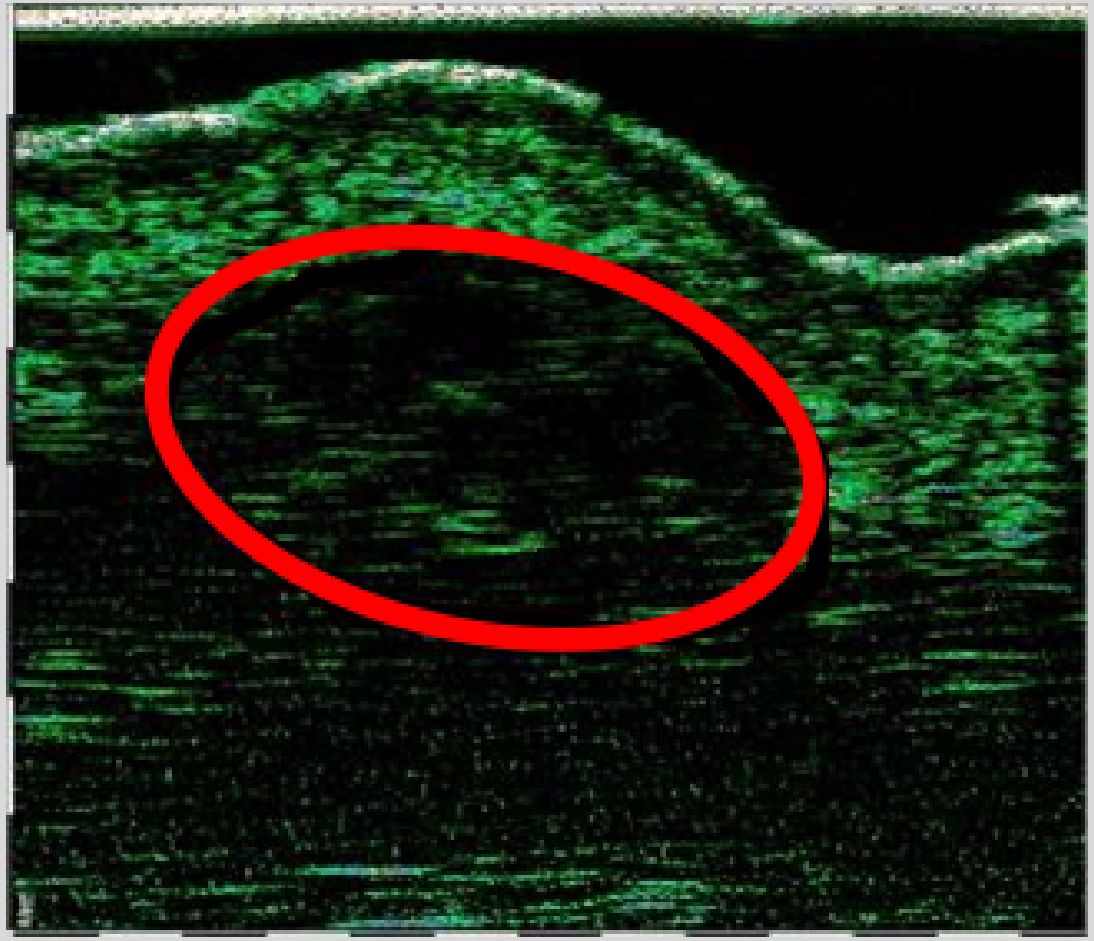
FILLER DETECTION AND FILLER TYPE DETERMINATION

Unclear anamnesis is a common problem for aesthetic patients. **Information about previously injected fillers very often is unavailable.**

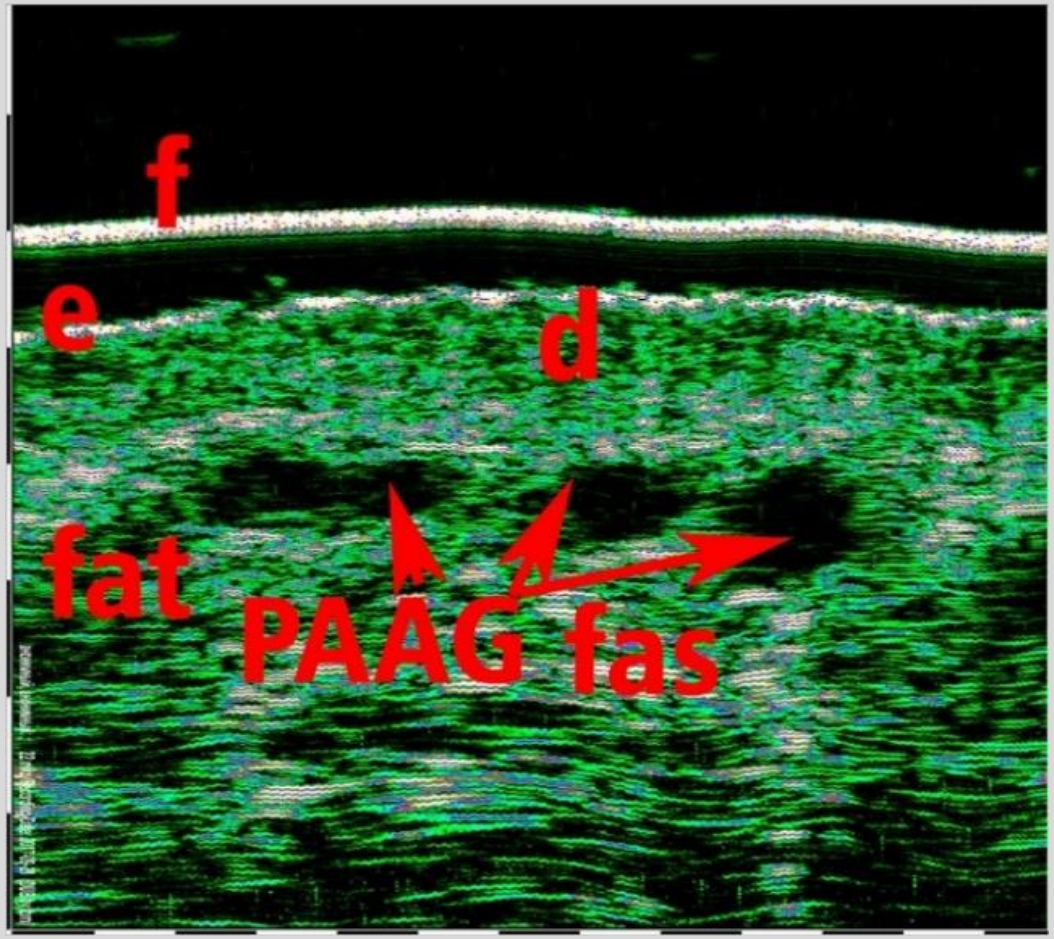
Preliminary **HFUS examination** in order to identify the previously injected filler type, its resorption degree, and the surrounding tissues' condition **has become a necessity.**

This diagnostic information is vital to decide on the possibility and tactics of re-injection in the examined area.

FILLER LOCATION DETECTION AND DETERMINATION OF THE PREVIOUSLY INJECTED FILLERS TYPE

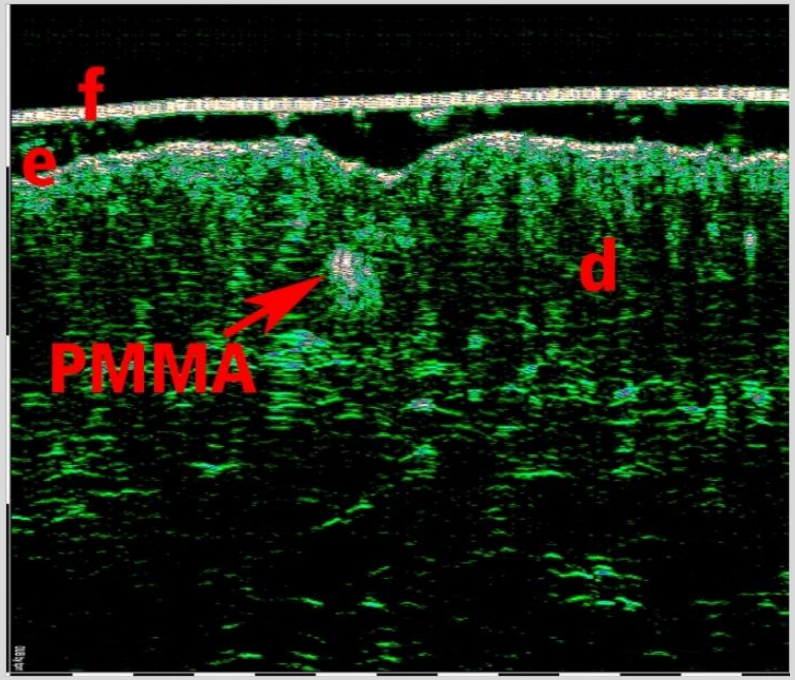


Hyaluronic acid in the upper lip columns

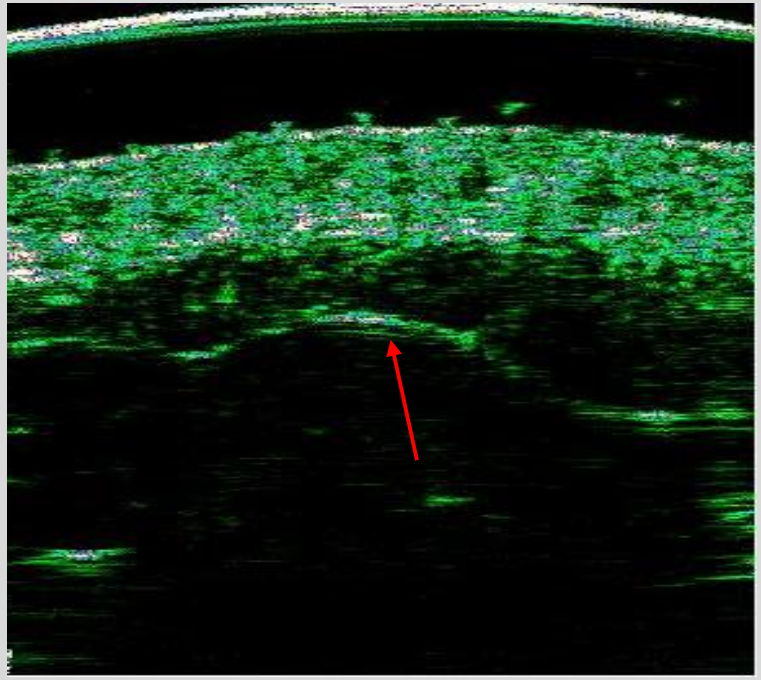


Polyacrylamide gel injected into the nasolabial fold

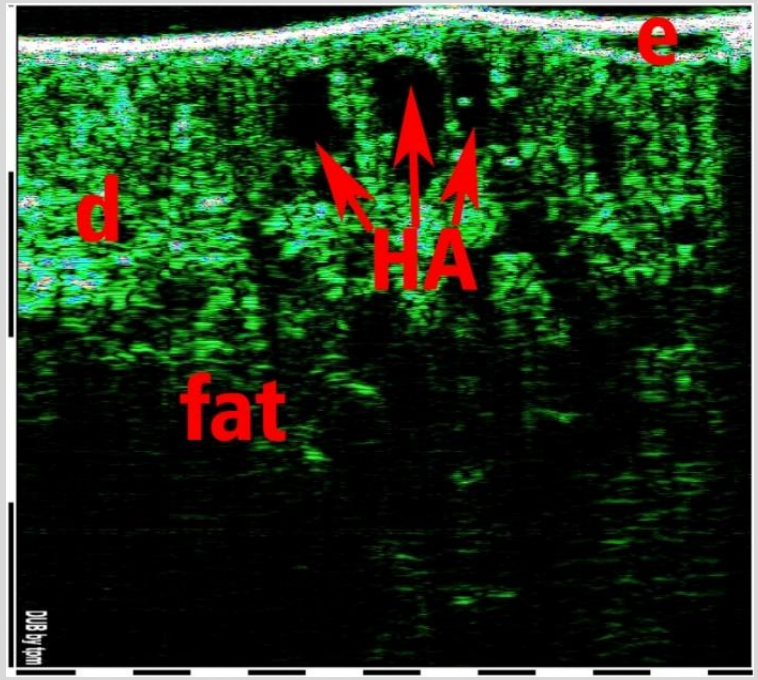
FILLER LOCATION DETECTION AND DETERMINATION OF THE PREVIOUSLY INJECTED FILLERS TYPE



PMMA - permanent filler. Hyperechoic areas are visualized intradermally, located along the wrinkle

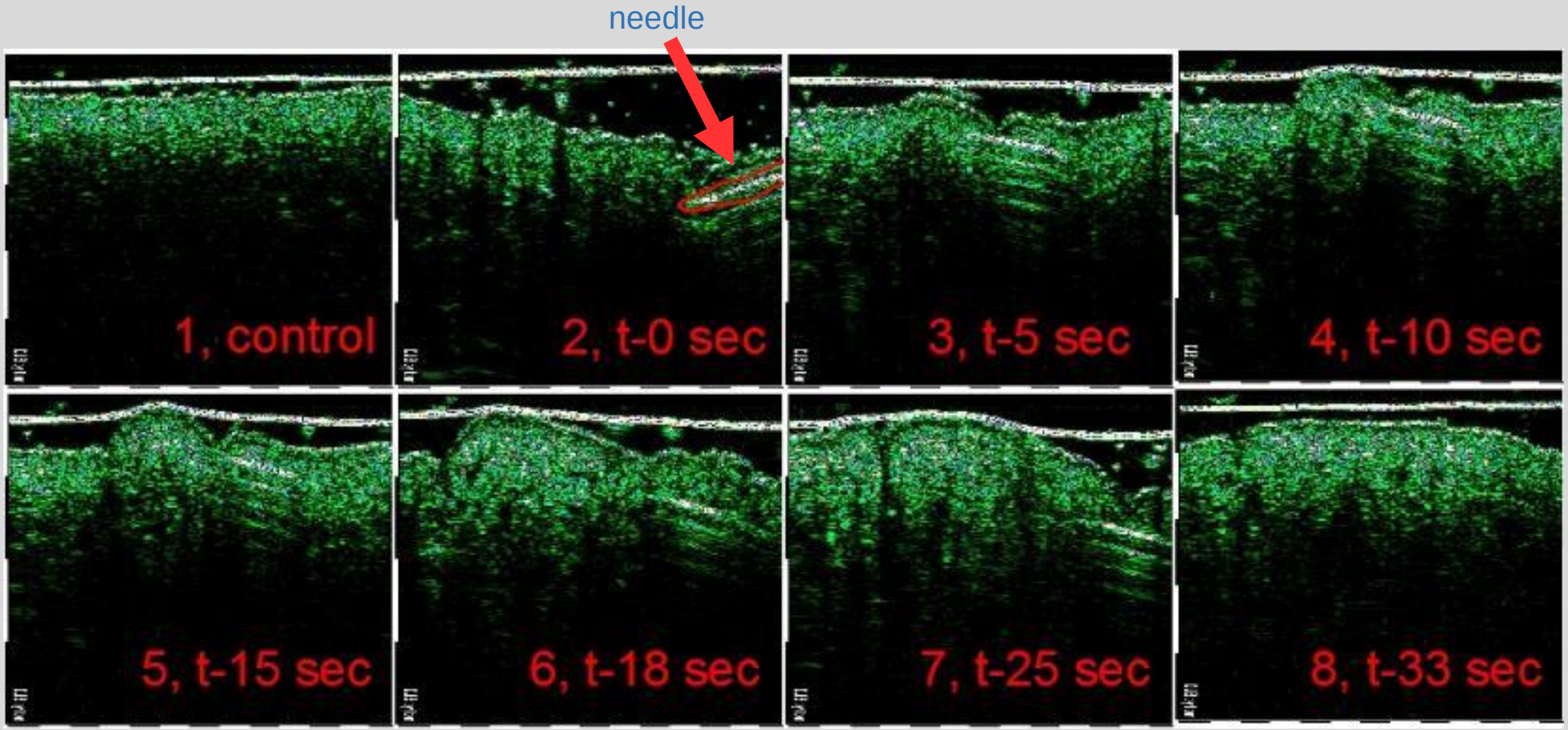


Aptos Nanovitis, scan after 6 months



Intradermal location of hialuronic acid

ULTRASONIC SCANOGRAM OF FILLER INJECTION



FILLER COMPLICATIONS

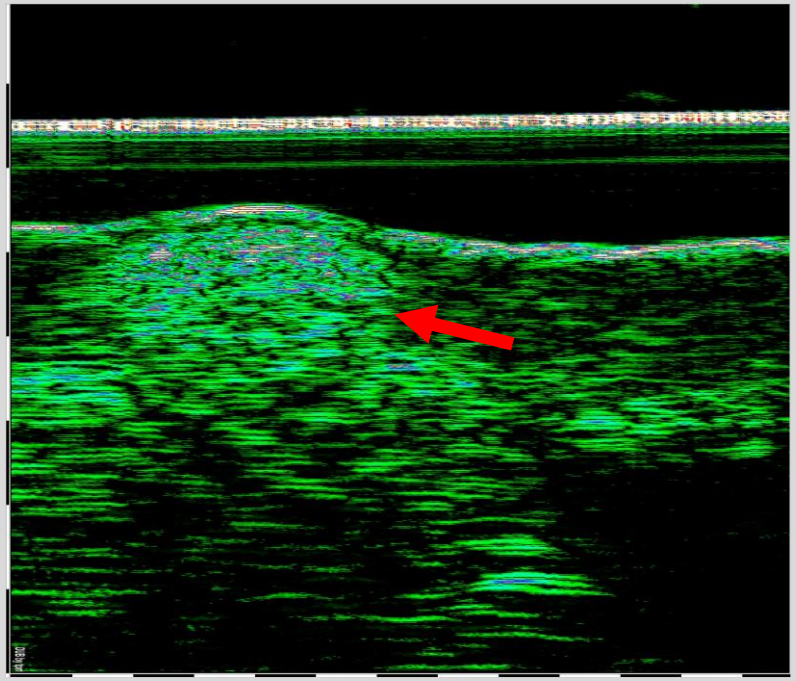
At the same time with all the benefits of dermal fillers, there is always the possibility for side effects and complications.

Early complications appear in the form of inflammatory and allergic reactions, filler migration, blood vessel compression, and penetration of the filler into arterial vessels, in the form of abscesses and necrosis.

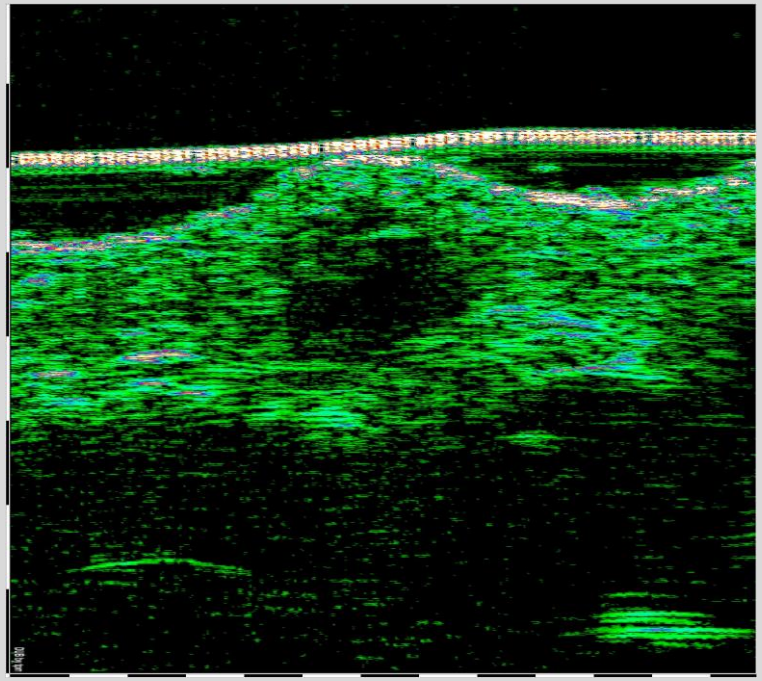
Late complications appear several months and even years after the filler injection in the form of non-absorbed nodular deposits, foreign body granulomas, sclerosis areas, and fibrous capsules around the filler.

High-frequency ultrasound imaging allows to see the filler biodegradation stages, filler migrations, and filler side effects and complications.

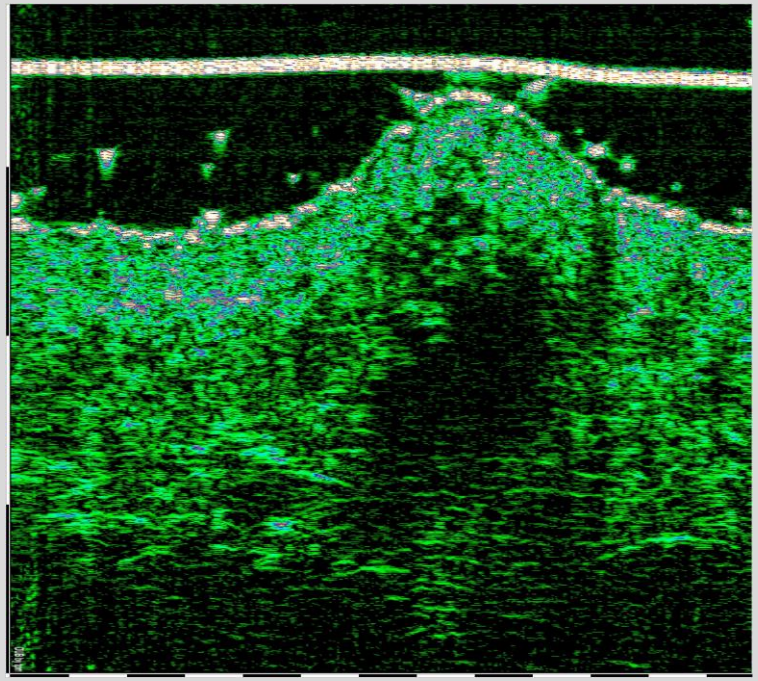
FILLER COMPLICATIONS



Complication, HA hypercorrection of nasolabial folds. Hyperechoic area in the dermis is the sclerotic changes



Complication after filler injection Granuloma



Complication - stabilized HA migration in the nasolabial fold

HIGH-ENERGY BASED PROCEDURES

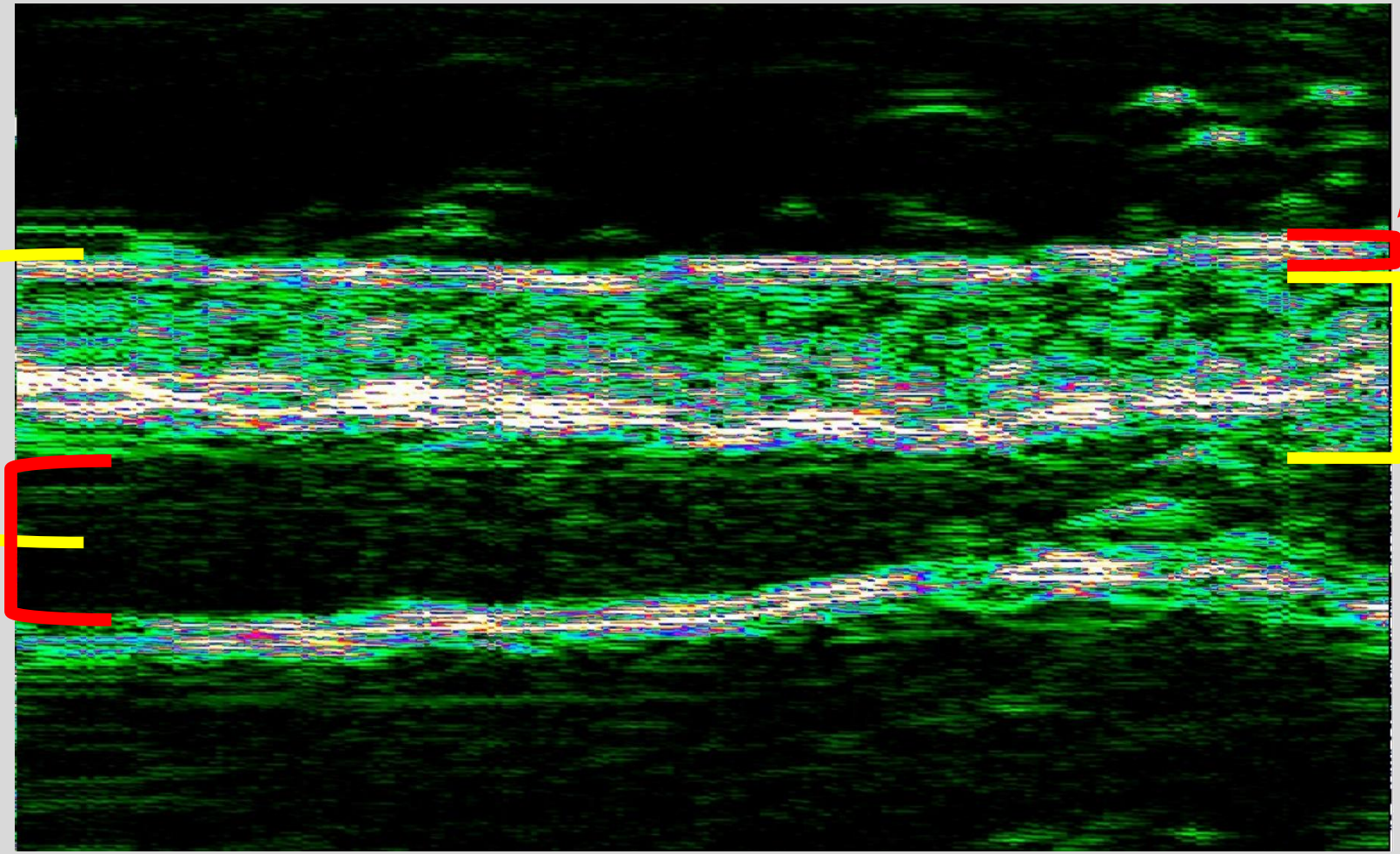
The target for the energy-based treatments could be located in different skin layers, such as the epidermis, papillary dermis, reticular dermis, SMAS, and subcutaneous fat tissue.

Epidermal, dermal, and fat thickness is very variable, depending on anatomical location, age, sex, and phenotype. These individual parameters could be easily determined with HFUS for precise energy delivery to the target tissue.

HFUS evaluation allows to choose an adequate depth and power settings for laser systems, RF, and HIFU. That leads to treatment safety and efficacy improvement.

HIGH-ENERGY BASED PROCEDURES

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

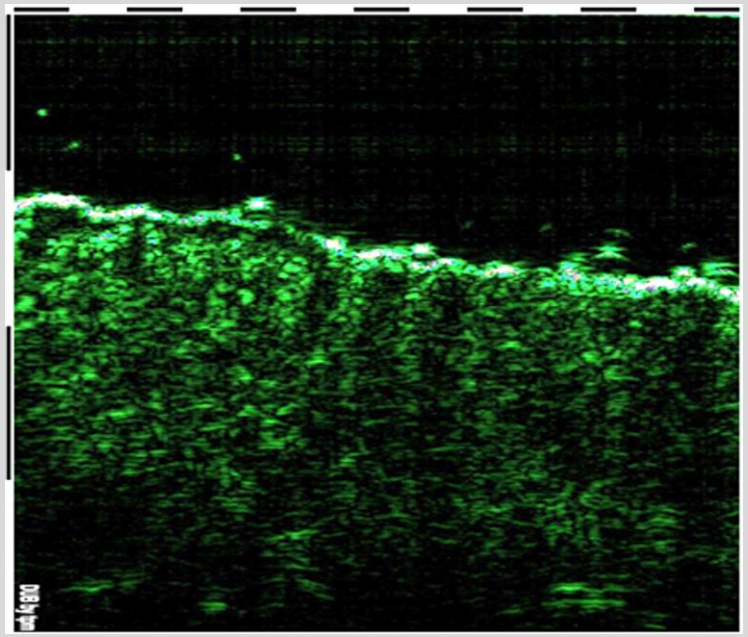


Epidermis, thickness 0.16 mm.
Lasers: KTP, PDL, Erbium

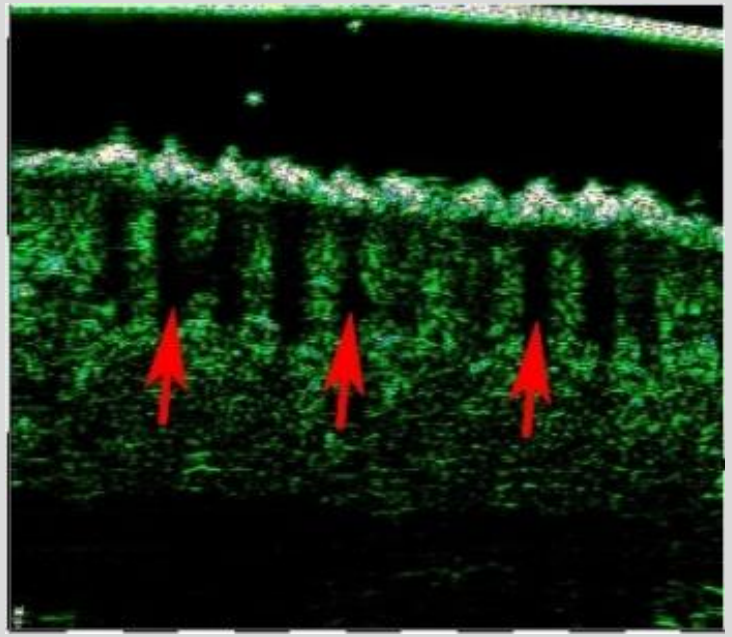
Dermis, thickness 1.3 mm.
RF
Lasers: CO2, Nd:YAG, Diode 800 nm, Alexandrite, Ruby.

SMAS
HIFU, RF

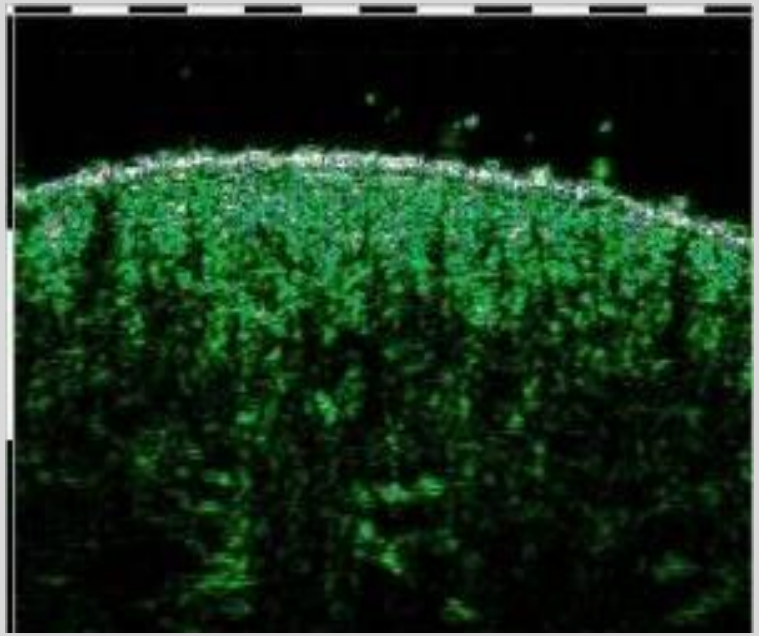
TREATMENT EFFICACY CONTROL



Skin state before treatment



Microthermal columns, several seconds after applying fractional CO2 laser



Skin state 12 months after applying fractional CO2 laser

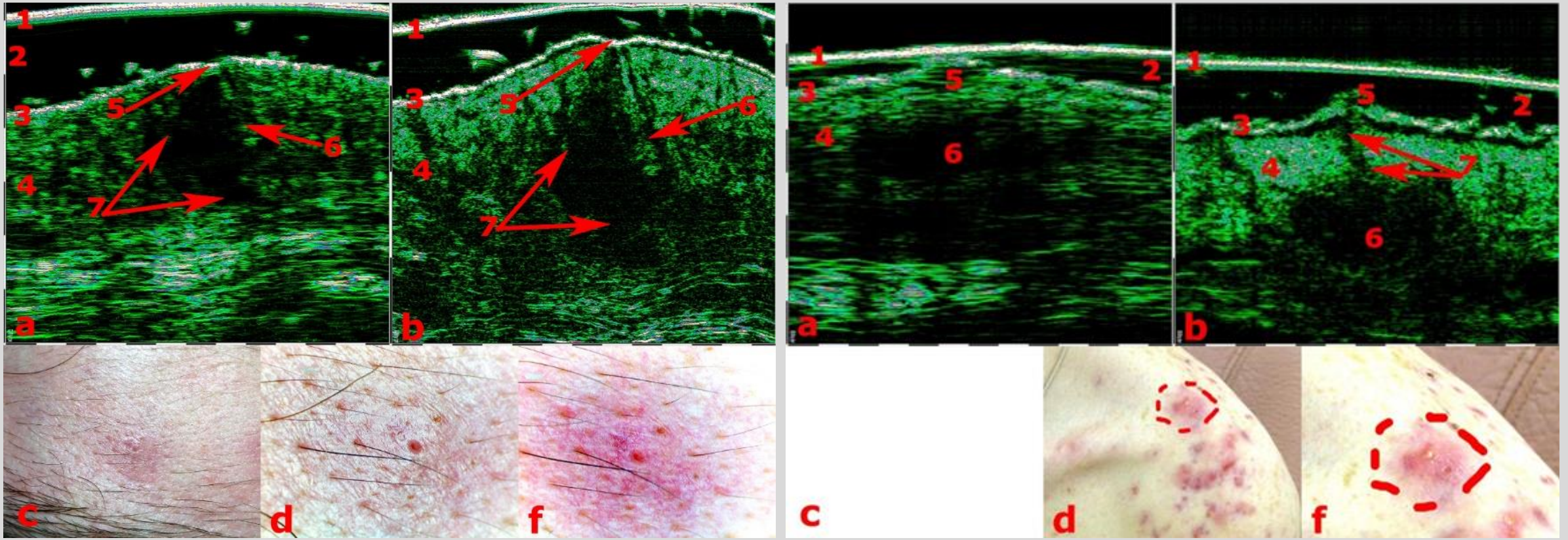
EVALUATION OF ACNE SEVERITY

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 and lower 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.

EVALUATION OF ACNE SEVERITY

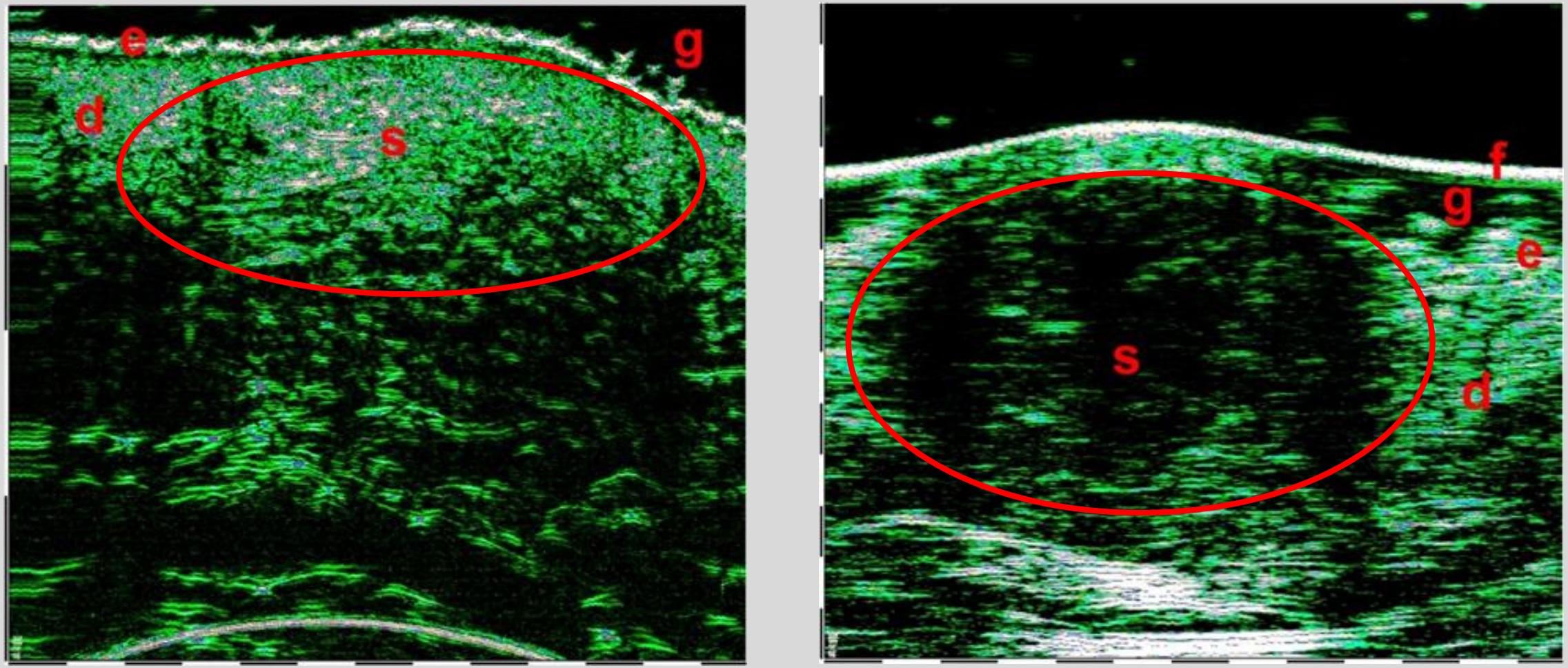


HYPERTROPHIC AND KELOID SCARS DIFFERENTIATION

Skin scarring is one of the valuable subjects in dermatology and aesthetic medicine. According to some recent studies, the HFUS data for the different scar types differentiation were obtained.

HFUS scar measurements 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.

HYPERTROPHIC AND KELOID SCARS DIFFERENTIATION



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

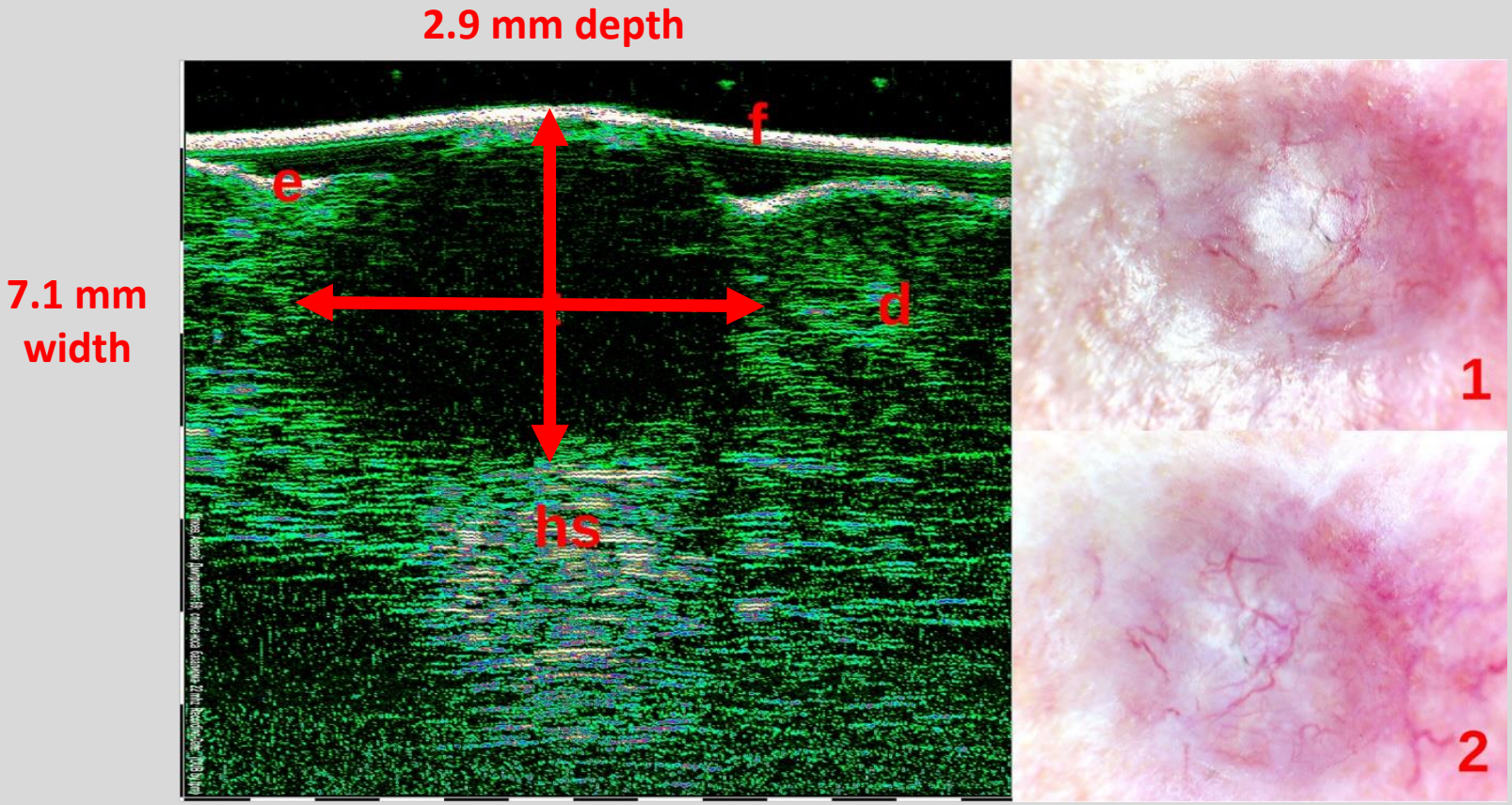
ONCOLOGY

DETERMINATION OF TUMOR'S DEPTH, INTERNAL BORDERS, AND BLOODFLOW

HFUS is the only available method for in vivo determination of tumor size, invasion depth, margins character, and tissues involved in the neoplasm process.

This clinical information is vital for preoperative planning full tumor excision with clear borders and avoiding relapses after the operation.

DETERMINATION OF TUMOR'S DEPTH, AND INTERNAL BORDERS



Nodular BCC. High frequency ultrasound scan with tumor sizes, and videodermoscopy

MELANOMA BRESLOW AND CLARK INDEXES HFUS DETERMINATION

HFUS Breslow and Clark in vivo determination:

-Determines the need for additional diagnostic procedures such as remote metastasis search, regional lymph node biopsy, etc., which is very important for patients 10-year survival rate.

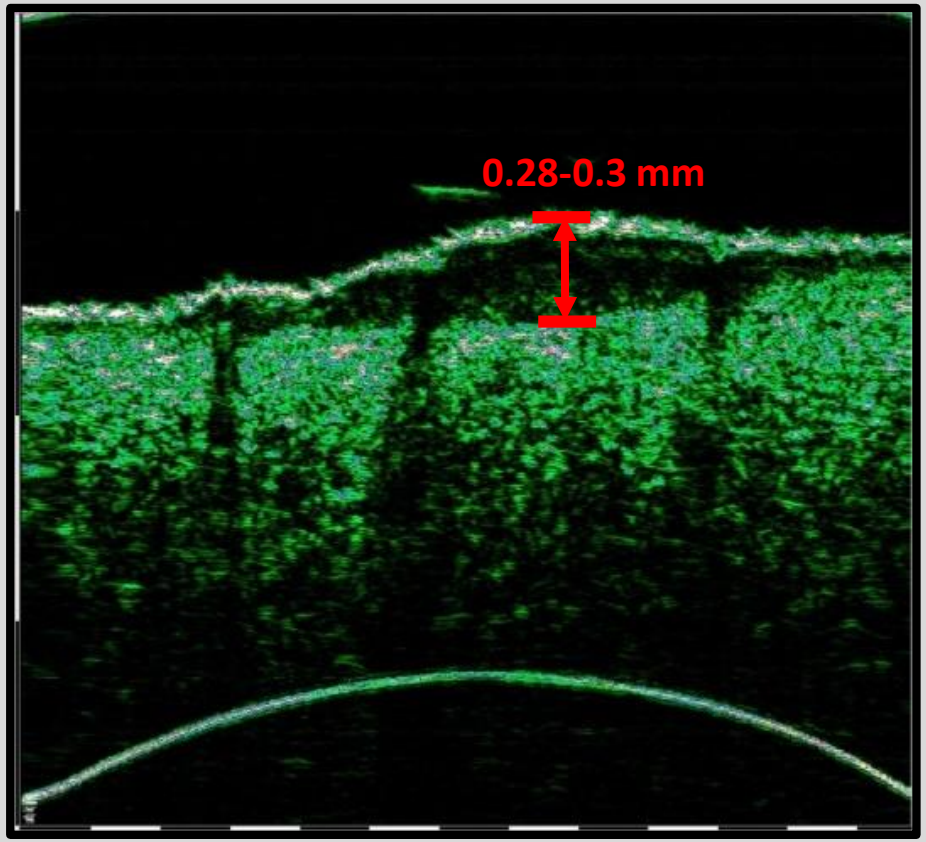
-Allow to **choose an adequate surgery volume**, and **plan the adjuvant therapy (chemotherapy, immunotherapy, or radiotherapy).**

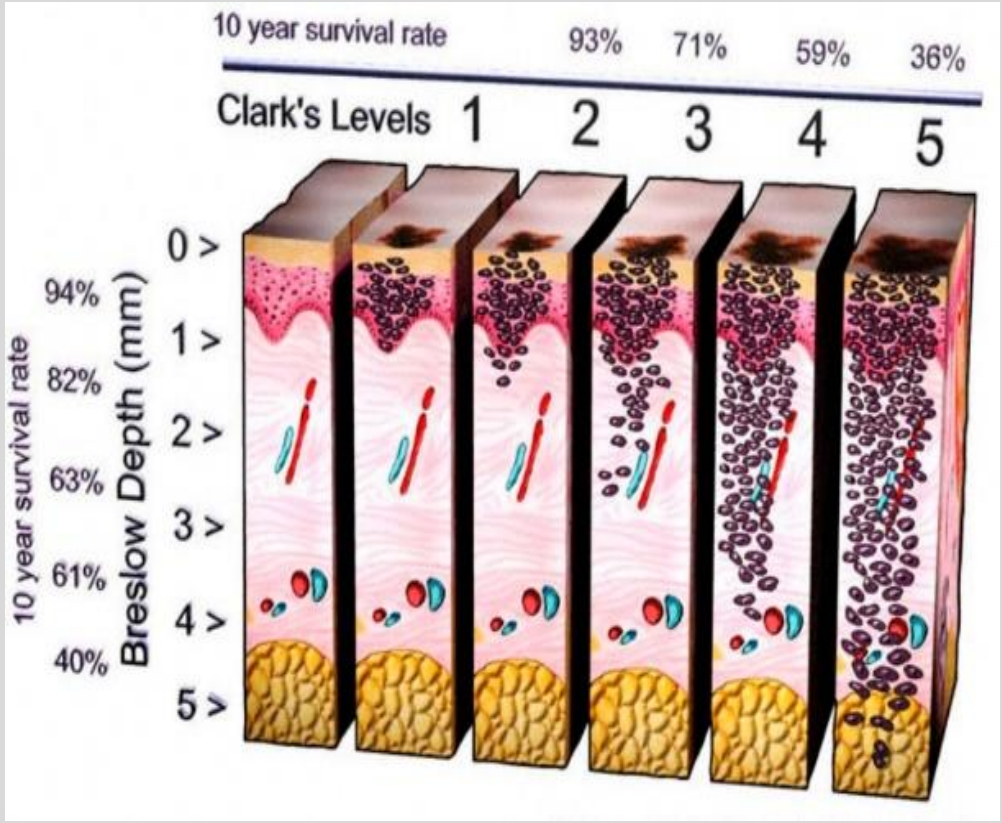
MELANOMA BRESLOW AND CLARK INDEXES HFUS DETERMINATION

Melanoma scan 75 MHz, hypoanechoic tumor 11 mm x 300 µ, depth 140-190 µ from the skin surface

BRESLOW INDEX - 0 (melanoma thickness 0.28-0.3 mm)

CLARK LEVEL - 2 (penetration into the papillary dermis layer)



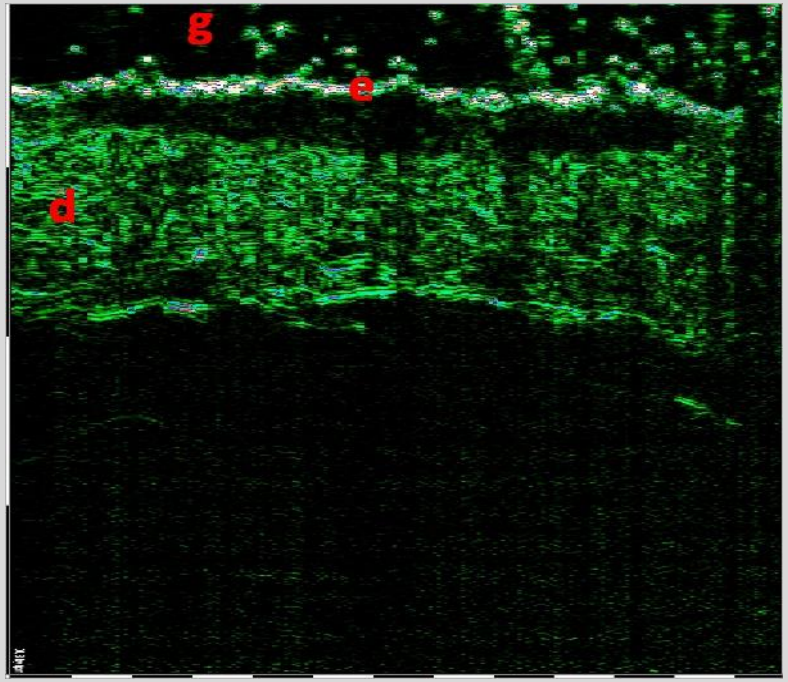


BASAL CELL CARCINOMA CLINICAL FORMS DIFFERENTIATION

The various BCC forms (superficial, nodular, scleroderma-like, and micronodular) should be treated in different ways.

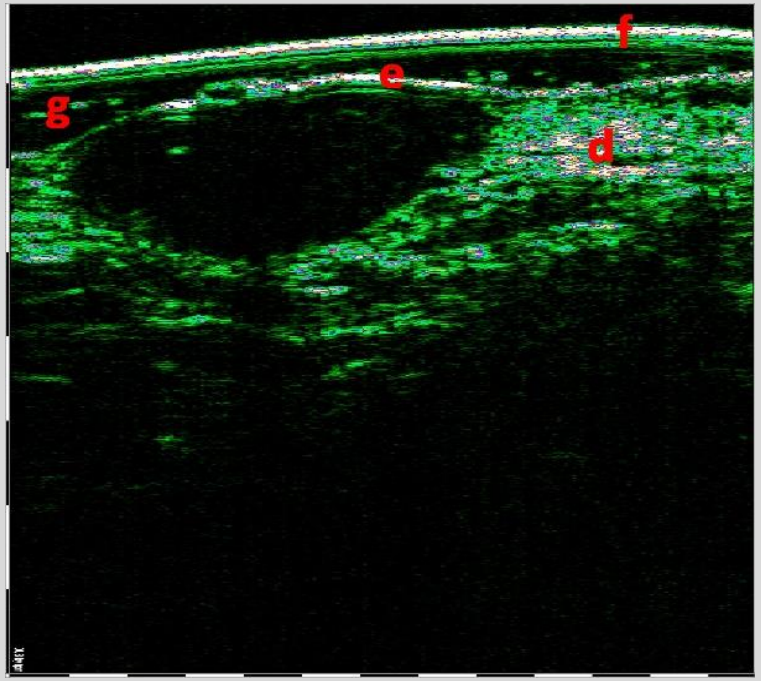
At present time HFUS patterns for the different BCCs are well-described in multiple studies and clinicians are using this diagnostic information for the proper treatment method choice.

BASAL CELL CARCINOMA CLINICAL FORMS DIFFERENTIATION



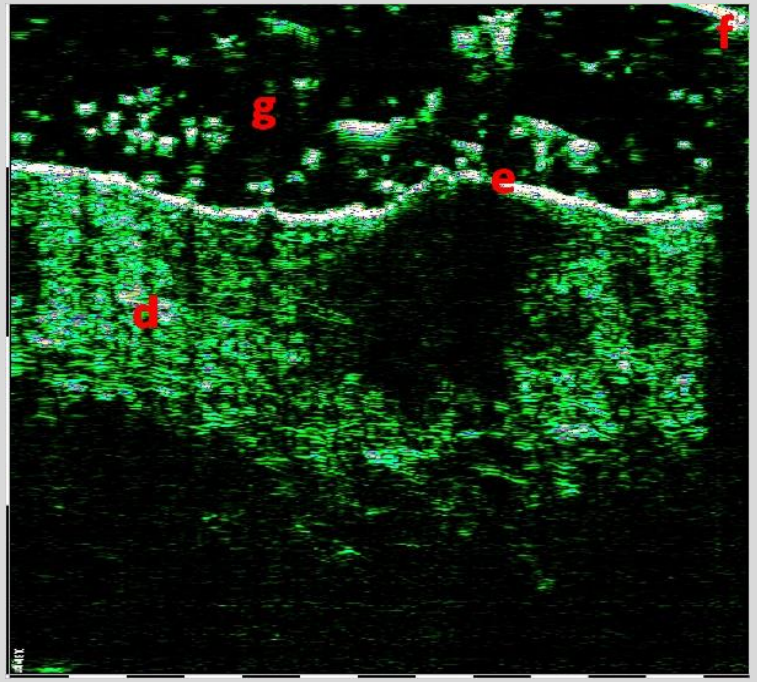
SUPERFICIAL BCC

- IMIQUIMODE
- PHOTODYNAMIC THERAPY
- CRYODESTRUTION
- SURGICAL EXCISION



NODULAR BCC

- SURGICAL EXCISION
- RADIOTHERAPY
- BRACYTHERAPY



SCLERODERMA-LIKE BCC

- MOHS SURGERY
- SURGICAL EXCISION

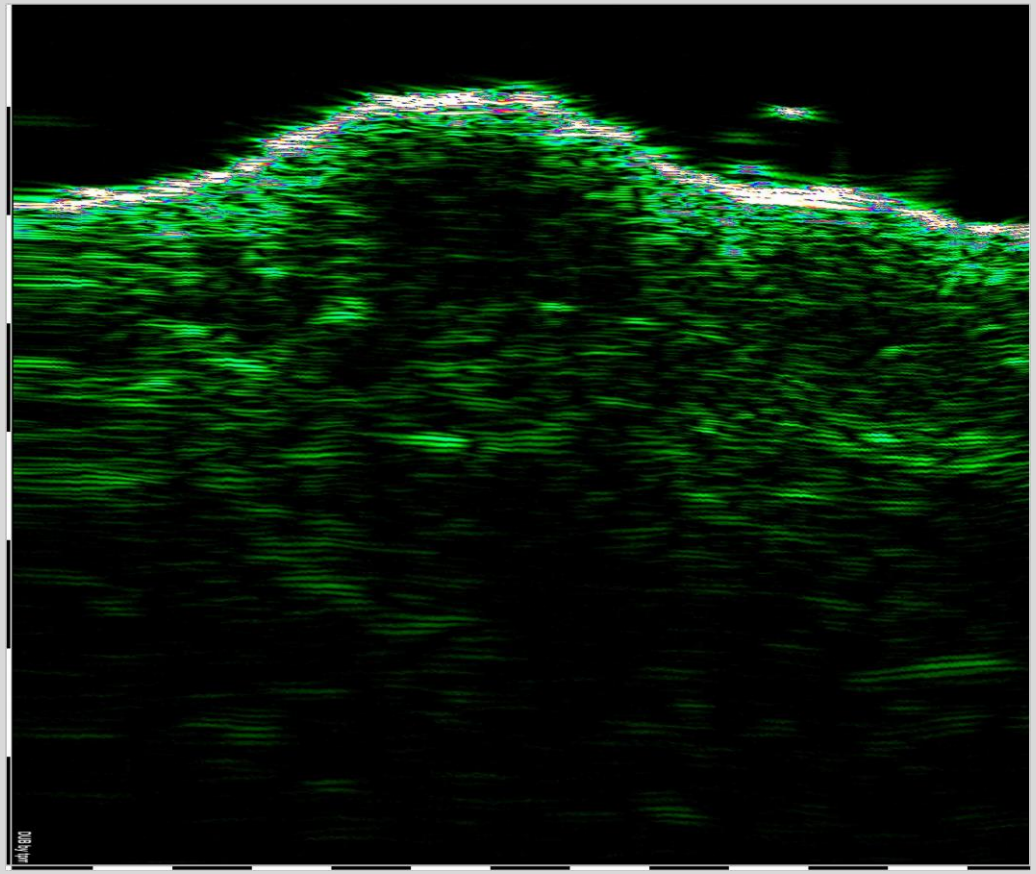
HFUS MALIGNANCY CRITERIA

High-frequency scanning provides the simple malignancy criteria for skin tumor diagnosis.

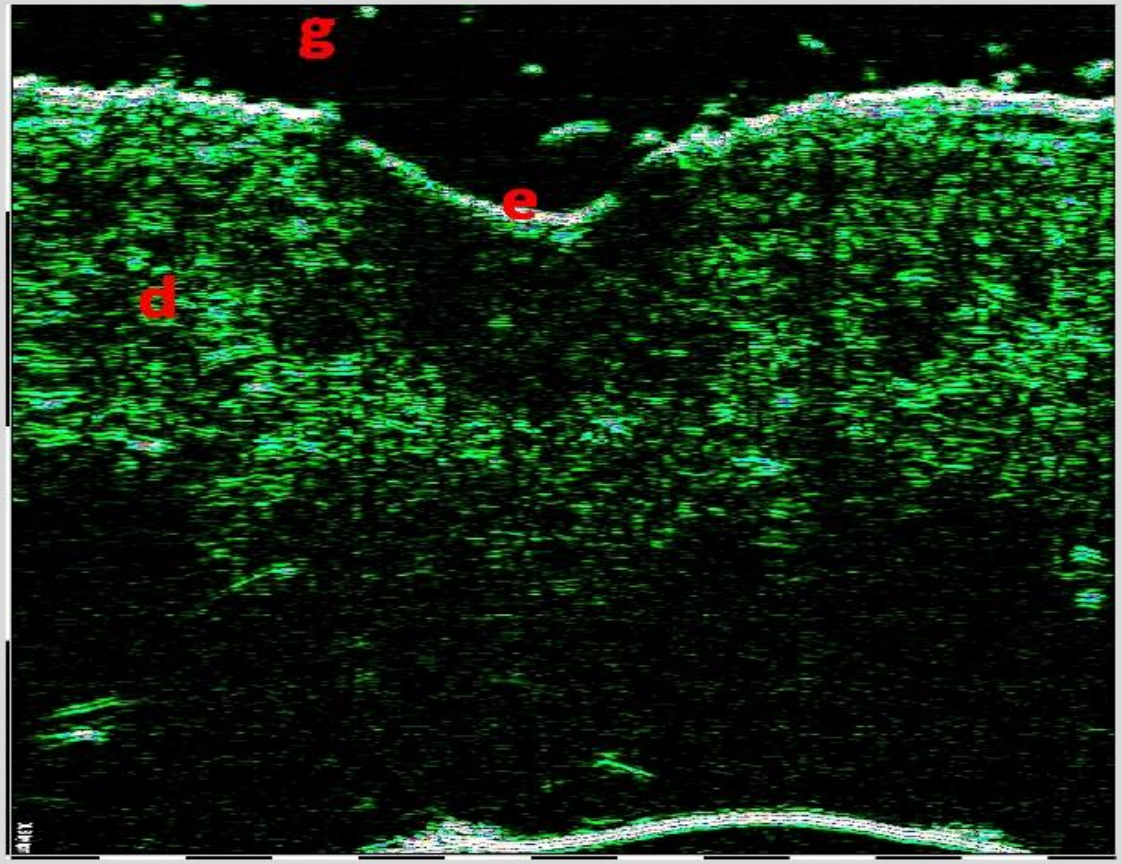
- The most informative malignant signs are: the tendency of constant growth, uneven irregular margins, vertical growth orientation of the tumor, and increased vascularization during Doppler imaging.

- If one or more malignant signs are found, the tumor can be preliminarily classified as malignant.

HFUS MALIGNANCY CRITERIA



Benign cavernous hemangioma.



Malignant BCC Scleroderma-like form.

SUMMARY ONCOLOGY APPLICATION FIELDS

- Quick and accurate quantitative examination of the tumor structure, tumor invasion depth(epidermis, papillary dermis, reticular dermis, subcutaneous fat, etc.), tumor margins, and its characteristics.
- Determining the blood supply of tumors located in the skin.
- Choosing the optimal site for targeted biopsy.
- Measuring of the tumor size and surrounding tissue volume to be removed.
- Metastasis identification in the skin and subcutaneous tissue.
- For patients with suspected melanoma noninvasive defining of the BRESLOW index, CLARK stage, and TNM classification in vivo.
- Post-operative monitoring for the early relapse detection.

COMPREHENSIVE SYSTEM FOR COMPLETE SKIN EXAMINATION

The universality of the system is that:

1. It allows to visualize the skin from above using dermatoscopy and examine all changes in the thickness, in all layers.

2. When examining the skin in all layers, there is such a high resolution of up to 24 microns that minimal changes in individual layers can be assessed.

3. The system has special software designed specifically for the skin.

Thus, a very detailed examination of minimal changes in the thickness of the skin, even in the epidermis, is carried out separately in the papillary and reticular dermis, the hypodermis.

CONCLUSION

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

Thank you for your attention!