

# High-frequency ultrasonography (HFUS) as a useful tool in differentiating between plaque morphea and extragenital lichen sclerosus lesions

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Adv Dermatol Allergol 2017; XXXIV (5): 485–489

DOI: <https://doi.org/10.5114/ada.2017.71118>

## Abstract

**Introduction:** Morphea and lichen sclerosus (LS) are chronic inflammatory diseases that may pose a diagnostic challenge for a physician. High-frequency ultrasonography (HFUS) is a versatile diagnostic method utilized in dermatologic practice, allowing monitoring the course of the disease, treatment response and differentiation between certain skin disorders.

**Aim:** To prove the usefulness of HFUS in differentiating between plaque morphea and extragenital LS lesions.

**Material and methods:** We examined 16 patients with plaque morphea and 4 patients with extragenital LS using 20 MHz *taberna pro medicum*<sup>TM</sup> (Germany) device.

**Results:** Investigations revealed hyperechogenic entrance echo in both morphea and LS lesions, whereas a distinct polycyclic surface of the entrance echo was detected exclusively in LS.

**Conclusions:** High-frequency ultrasonography is a current diagnostic modality that may prove useful in differentiating between morphea and LS lesions.

**Key words:** high-frequency ultrasonography, plaque morphea, extragenital lichen sclerosus, differentiation.

## Introduction

Morphea (localized scleroderma) is a rare, chronic inflammatory disease of the skin and subcutaneous tissues that progresses to sclerosis. Typical plaque lesions are oval or round and indurated. The inflammatory stage (Figure 1) is characterised by an erythematous halo (lilac ring) [1]. The sclerotic stage (Figure 2) presents with an ivory coloured centre of the lesion. After months to years the skin becomes atrophic and soft, with areas of hypo- or hyperpigmentation (Figure 3). Involvement of deeper structures (fascia, muscles, bones, nerves) may result in disability.

Lichen sclerosus (LS) is an inflammatory disease as well, affecting superficial dermis or submucosa, leading to hypopigmentation, induration and atrophy. Anogenital lesions are typical, whereas extragenital localization is less frequent, usually including the upper trunk, axillae, buttocks and lateral thighs [2]. The lesions appear as porcelain-white plaques, occasionally presenting follicular dells and ecchymoses. Pruritus, often of severe intensity, may accompany the lesions.

Morphea and LS lesions are typically distinguishable from each other basing on clinical and histological examination although occasionally diagnostic difficulties may occur [3]. Both disorders may coexist in an affected individual. Up to 38% of patients diagnosed with morphea suffer from genital LS as well [4], whereas extragenital LS was present in approximately 1.7% of patients with morphea [5].

The association between morphea and LS remains controversial. Peterson *et al.* [1] defined LS as a subtype of plaque morphea. Uitto *et al.* [3] observed clinical and histologic features of LS and morphea in the same lesions in 7 of 10 evaluated patients concluding that clinical spectrum may reflect similar etiologic events or closely related pathologic processes. Although etiopathogenesis of these two entities is not completely understood, autoimmune processes, *Borrelia burgdorferi* infection or previous trauma have been proposed as common causative factors [2, 6]. Other investigators also reported coexistence of extragenital LS and morphea [7–10]. On the other hand, Patterson and Ackermann [11] deemed LS and morphea as separate clinical entities

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**Received:** 25.06.2016, **accepted:** 30.08.2016.



**Figure 1.** Inflammatory stage of morphea. Erythematous halo is prominent ("lilac ring")



**Figure 2.** Sclerotic stage of morphea. Whitish plaques are firm upon palpation



**Figure 3.** Atrophic stage of morphea. The skin is thin, hypopigmentation and hyperpigmentation areas are also visible

due to the observation that deeper structures (reticular dermis, subcutaneous tissue) were affected exclusively in morphea. Ensuing studies provided additional data concerning differentiation between LS and morphea [12–16].

Ultrasonography is a versatile diagnostic imaging technique aiding diagnosis in numerous medical specialties. As to dermatology, frequencies of 7.5–15 MHz are used in evaluation of lymph nodes and subcutaneous lesions. 20 MHz and higher frequencies (high-frequency ultrasonography – HFUS) provide physicians with an opportunity to visualize upper layers of the skin in better resolution [17]. High-frequency ultrasonography has proven useful in real time visualization of healthy and lesional skin areas without performing the biopsy. The method is rapid, non-invasive and safe but requires

special training of the physician. High-frequency ultrasonography may be utilized in evaluating the progress of several skin disorders and their response to treatment [18, 19]. Additionally, sonographic imaging may aid differential diagnosis in certain dermatoses.

#### Aim

Our study attempted to establish usefulness of HFUS in differentiating between plaque morphea and extragenital LS lesions.

#### Material and methods

We examined 16 consecutive patients admitted to our Department of Dermatology due to plaque morphea (16 females; mean age: 35.9 ±14.3 years) and 4 consecutive patients presenting extragenital LS (4 females; mean age: 55 ±9 years). Each diagnosis had been previously confirmed by histological examination of skin biopsy specimens. Ultrasonographic imaging was performed utilizing 20 MHz *taberna pro medicum*<sup>TM</sup> (Germany) device. The data were collected and saved using DUB *micro*<sup>®</sup> *tpm* and DUB 6100 v 1.0 software. The parameters of axial and lateral resolution were approximately 80 µm and 200 µm, respectively. The length and the depth of investigation reached 12.8 mm and 8 mm, respectively. Measurements and echogenicity of the structures were assessed in both A-mode and B-mode. The densitometry value was defined as the mean height of reflection amplitude, measured in a standardized colour scale of 255 amplitude levels. In B-mode images dark colours were associated with hypoechogenic structures, bright colours with hyperechogenic structures. Each subject was evaluated in lesional and corresponding contralateral healthy skin areas as well, providing a point of reference. The study was approved by the local ethics committee.

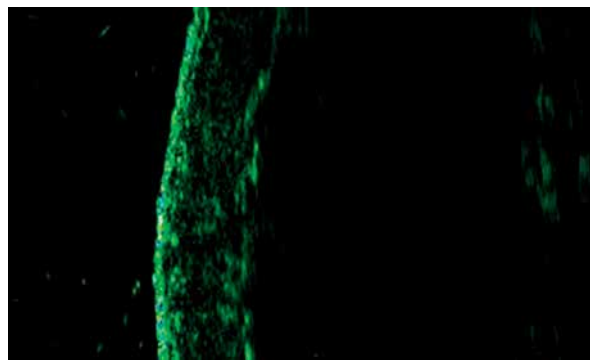
## Results

Healthy areas of the skin examined with HFUS revealed a hyperechogenic entrance echo, a normoechogenic area below (representing dermis) and a hypoechogenic or anechogenic zone associated with subcutaneous tissues (Figure 4). The border between dermis and subcutaneous tissues was linear. Linear hyperechogenic structures below represented muscle fascia.

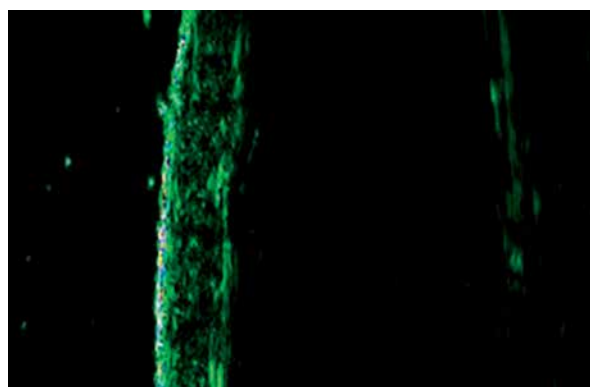
Each patient suffering from plaque morphea (in every stage: inflammatory, sclerotic and atrophic) demonstrated a hyperechogenic entrance echo in HFUS. Examinations revealed a widened, normo- and hypoechogenic areas below in 4 cases. Upon clinical examination, lesions were indurated during palpation. Eleven patients presented a narrow hypoechogenic area depicting the fibrosing process in dermis (Figure 5). Subjects with extragenital LS presented a hyperechogenic entrance echo along with the distinct polycyclic surface. Below, a narrow hypoechogenic area was detected. The dermis area was markedly widened and hypoechogenic as well (Figure 6). Clinical details regarding each patient are summarized in Tables 1 and 2.

## Discussion

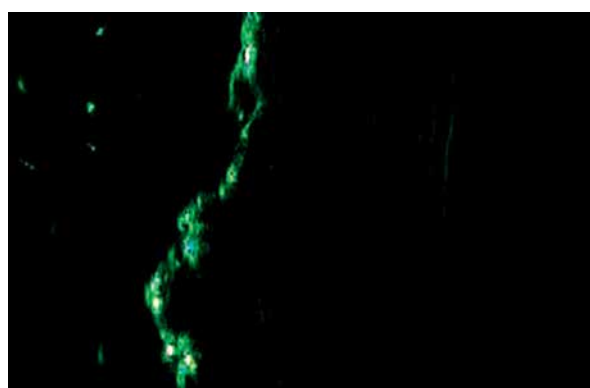
High-frequency ultrasonography is a useful diagnostic modality in dermatology, which complements the diagnosis and monitoring of various disorders. Hoffmann *et al.* [20] and Kreuter *et al.* [5] reported HFUS usefulness in monitoring the course and treatment of morphea. Similar conclusions were reached by Szymanska *et al.* [21] who analysed both morphea and LS lesions. Chen *et al.* [22] described a case of a 54-year-old woman with an abdominal LS lesion resembling morphea. The HFUS implied the diagnosis of LS, further confirmed by a skin biopsy. However, the authors did not describe new ultrasonographic phenomena supporting the differential diagnosis. To our knowledge, our study is the first to report that hyperechogenic, polycyclic entrance echo is a characteristic ultrasonographic feature of LS. In clinical practice, the differential diagnosis between plaque morphea and extragenital LS lesions may occasionally pose a challenge to a dermatologist. Should doubts concerning the diagnosis arise, histological evaluation of the skin biopsy specimen is the proceeding of choice. Several authors compared histological features of morphea and LS. Rahbari [12] reported decreased or absent elastic fibers in upper dermis of LS subjects as opposed to morphea lesions. The specimens were stained with hematoxylin and eosin as well as Pinkus acid orcein. Nishioka [13] observed that collagen fibers in reticular dermis in morphea and LS are green in polarized microscopy following Picrosirius Red staining. In early stages of LS, collagen fibers in papillary dermis were orange, whereas late-stage lesions appeared green. Differences in colour were also evident in morphea: collagen fibers just below the epidermis



**Figure 4.** Typical HFUS image of healthy skin regions. On the left side of the figure, hyperechogenic entrance echo is present, followed by a normoechogenic area representing dermis (1670  $\mu\text{m}$  of thickness) and a hypoechogenic or anechogenic zone associated with subcutaneous tissues



**Figure 5.** High-frequency ultrasonography image of a morphea lesion. Hyperechogenic entrance echo. Thin area of dermis (1200  $\mu\text{m}$  vs. 1450  $\mu\text{m}$  in the clinically unchanged skin)



**Figure 6.** High-frequency ultrasonography image of an extragenital lichen sclerosis lesion. Widened, hyperechogenic and polycyclic entrance echo

were orange yellow and in the papillary dermis – green. Shono *et al.* [14] reported different epidermal lectin binding profiles in LS and morphea. Kowalewski *et al.* [15] applied histochemical staining to basement membrane

**Table 1.** Clinical details of patients with plaque morphea

Patient no.	Age	Localization	Clinical features	Ultrasonographic examination
1	24	Thigh	Inflammatory stage	Hyperechogenic entrance echo. Widened area of dermis (1500 $\mu\text{m}$ in the lesional skin vs. 1350 $\mu\text{m}$ in the healthy skin)
2	27	Thigh	Inflammatory stage	Hyperechogenic entrance echo. Widened area of dermis (1750 vs. 1250 $\mu\text{m}$ )
3	25	Thigh	Advanced sclerotic stage	Hyperechogenic entrance echo. Widened, hypoechoogenic area of dermis (2600 vs. 1200 $\mu\text{m}$ )
4	37	Thigh	Sclerotic stage	Hyperechogenic entrance echo. Thin, hypoechoogenic area of dermis (860 vs. 1500 $\mu\text{m}$ )
5	36	Thigh	Sclerotic stage	Hyperechogenic entrance echo. Thin, hyperechogenic area of dermis (850 vs. 1100 $\mu\text{m}$ )
6	28	Thigh	Sclerotic stage	Hyperechogenic entrance echo. Thin, hyperechogenic area of dermis (850 vs. 1100 $\mu\text{m}$ )
7	44	Thigh	Atrophic stage	Hyperechogenic entrance echo. Thin area of dermis (1250 vs. 1800 $\mu\text{m}$ )
8	27	Arm	Atrophic stage	Hyperechogenic entrance echo. Thin area of dermis (700 vs. 1000 $\mu\text{m}$ )
9	11	Thigh	Atrophic stage	Hyperechogenic entrance echo. Thin area of dermis (1200 $\mu\text{m}$ vs. 1450 $\mu\text{m}$ ) (Figure 1)
10	14	Thigh	Atrophic stage	Hyperechogenic entrance echo. Thin area of dermis (1200 vs. 1670 $\mu\text{m}$ )
11	58	Forearm	Atrophic stage	Hyperechogenic entrance echo. Thin area of dermis (580 vs. 800 $\mu\text{m}$ )
12	42	Back	Sclerotic stage	Hyperechogenic entrance echo. Thin, hyperechogenic area of dermis (1000 vs. 2300 $\mu\text{m}$ )
13	56	Shoulder	Deep morphea	Hyperechogenic entrance echo. Hypoechoogenic, widened area of dermis (1570 vs. 1370 $\mu\text{m}$ )
14	53	Shoulder	Deep morphea	Hyperechogenic entrance echo. Hypoechoogenic, widened area of dermis (2344 vs. 1534 $\mu\text{m}$ )
15	48	Shoulder	Deep morphea	Hyperechogenic entrance echo. Hypoechoogenic, widened area of dermis (3400 vs. 1300 $\mu\text{m}$ )
16	44	Wrist	Deep morphea	Hyperechogenic entrance echo. Hypoechoogenic, widened area of dermis (2300 vs. 1000 $\mu\text{m}$ )

**Table 2.** Clinical details of patients with extragenital LS

Patient no.	Age	Localization	Clinical features	Ultrasonographic examination
1	50	Back	Elevated plaque	Widened, hyperechogenic and polycyclic entrance echo
2	54	Back	Elevated plaque	Widened, hyperechogenic and polycyclic entrance echo (Figure 2)
3	48	Wrist	Slightly elevated plaque	Hyperechogenic, polycyclic entrance echo was both widened and thin. Anechoogenic structures below. Widened dermis area (2100 vs. 1470 $\mu\text{m}$ )
4	68	Back	Blister and elevated plaque	Hyperechogenic, polycyclic entrance echo. Widened dermis area (3200 vs. 2400 $\mu\text{m}$ )

zone (BMZ) particles of biopsy specimens and performed examinations using laser scanning confocal microscopy. In morphea, the continuity of BMZ was preserved in all layers, whereas in LS, invaginations and holes were detected in lamina lucida and lamina densa. Additionally, early inflammatory stages of morphea compared with

inactive stages and LS demonstrated a different vascular network. Unfortunately, the skin biopsy is invasive and ensuing histologic procedures are relatively time consuming. Therefore, new methods of differentiation have also been described. Shim *et al.* [16] evaluated the use of dermatoscopy which revealed fibrotic beams in

morphea and comedo-like openings and whitish patches in LS. These features represented histologic phenomena: sclerosis in morphea, whereas follicular plugging and skin atrophy in LS.

### Conclusions

Our preliminary study implies that HFUS may be useful in differentiating between plaque morphea and extragenital LS. Hyperechogenic, polycyclic entrance echo seems to be a characteristic ultrasonographic phenomenon in extragenital LS lesions, although further studies concerning this issue are necessary.

### Conflict of interest

The authors declare no conflict of interest.

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