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ORIGINAL ARTICLE

Line-field confocal optical coherence tomography in lichen planopilaris and frontal fibrosing alopecia: A pilot study

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Summary

Background and Objectives: Lichen planopilaris (LPP) and frontal fibrosing alopecia (FFA) are common causes of cicatricial alopecia. While several studies have demonstrated the usefulness of non-invasive imaging methods such as reflectance confocal microscopy (RCM) and optical coherence tomography (OCT) for the diagnosis of scarring alopecia, this study aimed to identify characteristic features of cicatricial alopecia in LPP/FFA using line-field confocal OCT (LC-OCT).

Patients and Methods: Fifty-one patients (26 LPP, 24 FFA, 1 LPP and FFA) were prospectively analyzed with LC-OCT at three defined locations on the scalp: *(1)* scarring area = lesion, *(2)* scar-hair boundary = transition zone and *(3)* healthy area for the presence of the following pre-defined criteria: no hair follicles left, destructed hair follicles, dermal sclerosis, no rimming of the dermal papillae, epidermal and dermal inflammatory infiltrate, infundibular hyperkeratosis, dilated blood vessels, hypervascularization, melanophages, epidermal pigment incontinence.

Results: Comparison of the transition zone with healthy control sites revealed the four main LC-OCT features in LPP/FFA: dermal sclerosis (100%), dermal inflammatory infiltrate (90.2%), infundibular hyperkeratosis (60.8%) and hypervascularization (76.5%).

Conclusions: LC-OCT detects specific criteria of pathological changes in LPP/FFA around hair follicles in the epidermis and dermis and therefore can be used for further studies investigating scarring alopecia.

KEYWORDS
Alopecia, LC-OCT, Line-fiel confocal optical coherence tomography, Lichen planopilaris, non-invasive imaging, scarring alopecia

INTRODUCTION

Lichen planopilaris (LPP) and frontal fibrosing alopecia (FFA) of Kossard are common causes of primary cicatricial alopecia in adults.[1] LPP affects slightly more women than men, mainly in the age of 40–60 years.[2] It can affect the hair follicles of the entire scalp, as well as the body hair and, in men, the beard.[3]

Despite its very distinct clinical appearance, FFA is considered to be a subtype of LPP by many authors.[4–7] Initially believed to occur almost exclusively in post-menopausal women, it is now known to also occur in younger women and in up to 5% of all cases in men, often involving the beard region.[5] On the scalp, it usually only affects hair follicles

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at the forehead-hair junction, less frequently with involvement of the temporal region and the occipital hairline with centripetal dissemination, but it can also affect all other body hair. In 50–95% of cases, eyebrows are also affected. Frequently, the loss of eyebrows precedes hair loss of the forehead by several years.[4–6]

In LPP/FFA, T-cells attack stem cells of the hair follicles at the level of the isthmus, leading to a destruction of follicles and subsequent scarring.[8] The irreversibility of hair loss often causes great distress to patients. Therefore, early diagnosis is essential to expedite treatment initiation and prevent further progression of the disease.[4,9–11]

The current diagnostic standard is based on dermoscopic examination of the scalp (trichoscopy) showing perifollicular erythema and hyperkeratosis, also described as follicular casts[4] and a scalp biopsy[4,11,12] revealing dense lymphocytic infiltration around the infundibular and isthmus region of the hair follicle, lichenoid interface dermatitis and perifollicular fibrosis.[13–15] Trichoscopy and histopathological examinations of scalp biopsies are often however not able to clearly distinguish LPP/FFA from other forms of scarring alopecia. Differentiating scarring alopecia due to LPP from that of lupus erythematosus (LE) can be especially challenging and is often only possible in biopsies from acute inflamed areas, where LE typically shows more atrophy and less interface dermatitis while LPP shows more acanthosis with the lichenoid infiltration described above.[16]

Scalp biopsy is also often refused by patients due to its invasiveness with possible bleeding, infection, and scarring, which can hinder early diagnosis. It also does not enable follow-up examination of the exact same site of a lesion. This can make it difficult to assess the response to topical and systemic treatment and disease progression over time.[11,12]

Non-invasive imaging can assess the inflammatory status punctually without the risks and disadvantages mentioned above. This has already been reported in several studies using RCM and OCT.[17–26]

However, physical limitations of RCM and OCT for the diagnosis of scarring alopecia exist due to the limited penetration depth of up to 250 µm in RCM or optical resolution down to 7.5 µm in OCT.[17–20,22,27]

LC-OCT is a high-resolution imaging method that enables skin imaging down to the cellular level (resolution: 1–2 µm) with an increased penetration depth of up to 500 µm. While LC-OCT imaging has proven its potential for the in vivo diagnosis of various skin cancers, their subtyping and exploration of tumor margins and tissue penetration, it also shows promising results in non-invasive imaging of inflammatory diseases.[28–31] Recent work by Kurzeja et al. also described LC-OCT imaging in six cases of scarring alopecia in LPP.[21]

Therefore, the aim of this pilot study was to identify characteristic morphologic LC-OCT features of LPP/FFA in a cohort of 51 patients using predefined LC-OCT criteria.

PATIENTS AND METHODS

Patients

Between August 2023 and November 2023, 51 patients (40 female, 11 male) with a mean age of 57.9 years (range 28–82 years) were recruited from the trichology and outpatient departments of the Department of Dermatology and Allergy at the University Hospital of the Ludwig-Maximilian University (LMU) Munich. Twenty-six (16 female, 10 male) patients were diagnosed with LPP, 24 (23 female, 1 male) with FFA. One patient was diagnosed with a combination of both. The recruitment endpoint was to generate a sample ten times larger than previous study populations in studies investigating scarring alopecia with LC-OCT. Another recruitment endpoint was to have a balanced ratio of LPP and FFA patients.

The inclusion criterion was an active stage of LPP/FFA. There were no restrictions in terms of disease duration, age, and gender. Patients with any other inflammatory scalp disease such as psoriasis capitis or seborrheic dermatitis were excluded. For each patient, we documented age, sex, disease duration, current therapy as well as whether the diagnosis was made by clinical examination alone or confirmed by additional scalp biopsy. Patients were included after signed informed consent. The study was approved by the Ethics Committee of the LMU Munich (Project No: 17–0699).

Imaging tools

Primarily, clinical and dermoscopic images of the hair follicles were recorded using an ATBM Tower videodermoscope (FotoFinder®, FotoFinder Systems GmbH, Bad Birnbach). Afterwards the scalp was imaged using LC-OCT. Exemplary OCT and RCM images have also been produced. LC-OCT was conducted with the deepLive™ device (DAMAE Medical, Paris, France) in horizontal-, vertical- and 3D mode. OCT was conducted using the OCT device VivoSight (Michelson Diagnostics, Maidstone, Kent, UK), generating vertical images of the examined lesions. RCM was conducted using the VivaScope 3000 handheld device (Vivascope GmbH, Munich, Germany) with an 830 nm diode laser in reflection mode resulting in horizontal stacks. Further technical details of the devices have been described elsewhere.[32–36]

Imaging protocol

Images were acquired at three defined localizations on the scalp: *(1)* labeled "lesion" was a site on the scalp where hair was already absent, and a scar had developed. In FFA this was the sclerotic band below the hairline, whereas in LPP this site could be located anywhere on the scalp. The second *(2)* labeled "transition", was defined as the scar-hair

TABLE 1 Description of the LC-OCT criteria analyzed and the penetration depth at which each is visualized best.

LC-OCT criteria	Description	Visibility in LC-OCT
No (healthy) hair follicles left	No visibility of roundish compact structures surrounded by adnexal epithelium corresponding to hair follicles	0–400 µm
Destructed hair follicles	Roundish areas associated with former hair follicles, filled with bright material and necrotic edematous structures	0–400 µm
No rimming of the dermal papillae	No visibility of roundish regularly arranged structures at the epidermis-dermis border corresponding to dermal papillae; not to be mistaken with the papilla of the hair follicle	50–150 µm
Dermal sclerosis	Increased number of bright, ill-defined, coarse dermal fibers	100–400 µm
Epidermal inflammatory infiltrate	Small, single to aggregate bright round cellular structures visible in the epidermis within and around the adnexal epithelium corresponding to lymphocytes	0–100 µm
Dermal perifollicular inflammatory infiltrate	Small, bright, round cellular structures tightly aggregated, forming a congruent whitish mass around the hair follicle corresponding to lymphocytes	100–400 µm
Infundibular hyperkeratosis	Bright material filling the follicular ostia	0–150 µm
Dilated blood vessels	Horizontally oriented wide black canalicular structures in the dermis	100–400 µm
Hypervascularization	Increased number of black horizontally oriented structures in the dermis	100–400 µm
Melanophages	Polygonal bright cellular structures in the upper dermis	100–250 µm

boundary, i.e. hair follicles located at the transition zone to the already scarred area. This zone represents the center of the inflammatory process in scarring alopecia. The third *(3)* areawas free of external signs of inflammation, scaling and hair loss and documented as "healthy".

Images, videos and 3D blocks were produced for each of the three areas.

LC-OCT criteria

In determining the criteria to be examined, we were guided by previously described criteria for RCM and established histological features.[17–19] Therefore, we established potential criteria for the scarred and the inflamed area, whose visibility in the LC-OCT was then compared with the unaffected areas. All images were analyzed by two experienced examiners (MD, ES). In case of disagreement, a third experienced examiner (MN) was involved for consensus.

At the intralesional localization *(1)*, the following four criteria were evaluated according to their presence or absence:

- no (healthy) hair follicles left,
- destructed hair follicles,
- dermal sclerosis,
- no rimming of the dermal papillae.

At the transition zone *(2)*, the following eight criteria were examined:

- dermal sclerosis,
- epidermal inflammatory infiltrate,
- dermal perifollicular inflammatory infiltrate,
- infundibular hyperkeratosis,
- dilated blood vessels,
- hypervascularization,
- melanophages,
- epidermal pigment incontinence.

At the "healthy" control site *(3)* all criteria listed above were analyzed.

See Table 1 for an overview of the individual criteria in LC-OCT and at which penetration depth they are visible best.

Statistical analysis

The recordings were analyzed for the frequency of the predefined criteria for each area. The first step of analysis was to compare the 26 LPP and 24 FFA cases to find out if there were statistically relevant differences in the frequency of the twelve features between both disease groups using Fisher's exact test and Chi-square test where appropriate. For these calculations, the one case with clinically both diseases was excluded. In a second step, both diseases were considered as one entity (LPP/FFA) (n = 51).

To verify whether the LC-OCT features are specific for scarred and inflamed areas in LPP/FFA and therefore LC-OCT can be used for further studies, we compared the frequencies of the respective areas with the frequencies in the healthy area in a third step. P-values were calculated using the Chi-squared test or Fisher's exact test to determine whether the differences in the frequency of the criteria in the affected and unaffected areas of the patients' scalps were significant. Where appropriate, the effect size V was calculated to illustrate the magnitude of the

TABLE 2 Comparison of frequencies of morphological criteria of the lesion and transition zone of LPP vs. FFA.

Lesion	**LPP (n = 26)**	**FFA (n = 24)**	**p-value**
No (healthy) hair follicles left	100.0%	100.0%	1.00
Destructed hair follicles	61.5%	83.3%	0.1192
Dermal sclerosis	96.2%	91.7%	0.602
No rimming of the dermal papillae	73.1%	66.7%	0.853
Transition	**LPP** (n = 26)	**FFA** (n = 24)	**p-value**
Dermal sclerosis	100.0%	100.0%	1.00
Epidermal inflammatory infiltrate	26.9%	45.8%	0.2727
Dermal perifollicular inflammatory infiltrate	84.6%	95.8%	0.3508
Infundibular hyperkeratosis	57.7%	79.2%	0.9539
Dilated blood vessels	23.1%	62.5%	0.01125
Hypervascularization	73.1%	79.2%	0.8632
Melanophages	7.7%	12.5%	0.6613
Epidermal pigment incontinence	7.7%	4.2%	1.00

Abbr.: LPP, Lichen planopilaris; FFA, frontal fibrosing alopecia

differences, where a small effect size is assumed from 0.1, a moderate effect size from 0.3 and a large effect size from 0.5. All statistical analyses were performed using R (version 2022.12.0+353, 2022 Posit Software PBC). Since the aim of the study was to investigate specific features in LC-OCT and OCT and RCM were used as exemplary images, the statistical analysis was limited to the LC-OCT recordings.

RESULTS

Of the 51 patients enrolled, 43 were receiving topical anti-inflammatory therapy and one patient was also receiving systemic corticosteroids. Four patients were untreated for at least four weeks prior to measurement, of whom one patient had received systemic corticosteroids in the previous year. Four patients were completely treatment-naive.

Of the 26 LPP cases, twelve were histologically confirmed; of the 24 FFA cases, seven were histologically confirmed. In the patient with LPP and FFA, FFA was histologically confirmed. A table of all patient demographics and information is added as online supplementary Table S1. Comparison of the frequency of the twelve individual criteria in LPP (n = 26) versus FFA (n = 24) in the first step showed no significant differences ($p > 0.05$) with LC-OCT except for dilated blood vessels ($p = 0.01125$) (Table 2). Secondly, the comparison of the combined entire group with LPP/FFA (n = 51) versus clinically non-involved healthy control sites on the scalp of these patients showed the following results according to the examined site:

(1) Lesion

In the scarred areas of the scalp, LC-OCT showed a loss of visible healthy hair follicles in all patients (100%) and destructed hair follicles in 72.5% of the patients. In 48/51 patients (94.1%), we detected dermal sclerosis. No rimming of the dermal papillae was seen in 70.6% of all patients. In comparison to the healthy areas, all these criteria showed statistical significance with a p-value < 0.01 and large effect sizes (Figure 1, Table 3).

(2) Transition

We detected perifollicular dermal sclerosis at the transition zone in all patients (100%). A perifollicular dermal inflammatory infiltrate was seen in 90.2% of patients. Hypervascularization was present in 39/51 patients (76.5%). In addition, the criterion of infundibular hyperkeratosis (Figure 2) was present in 31/51 patients (60.8%).

Dilated blood vessels were seen in 21/51 patients (41.2%). In 18/51 patients (35.3%), epidermal inflammation was seen in the transition zone. This leads to a statistical significance for all these criteria ($p < 0.01$) with a large effect size for dermal sclerosis and inflammatory cells, hypervascularization and infundibular hyperkeratosis and a moderate effect size for dilated blood vessels and epidermal inflammatory cells (Figure 3).

Melanophages were present in only five patients (9.8%) and epidermal pigment incontinence was seen in three patients (5.9%) in the transition area without statistical significance ($p > 0.05$).

See Figure 4 for examples of affected versus healthy areas using OCT, RCM, and LC-OCT 3D blocks. A summary of the results describing the presence of these eight criteria in the transition area compared to the healthy sites is shown in Table 4.

(3) Healthy

In the unaffected areas (Figure 5), the above-mentioned criteria were not present except in one patient. In this

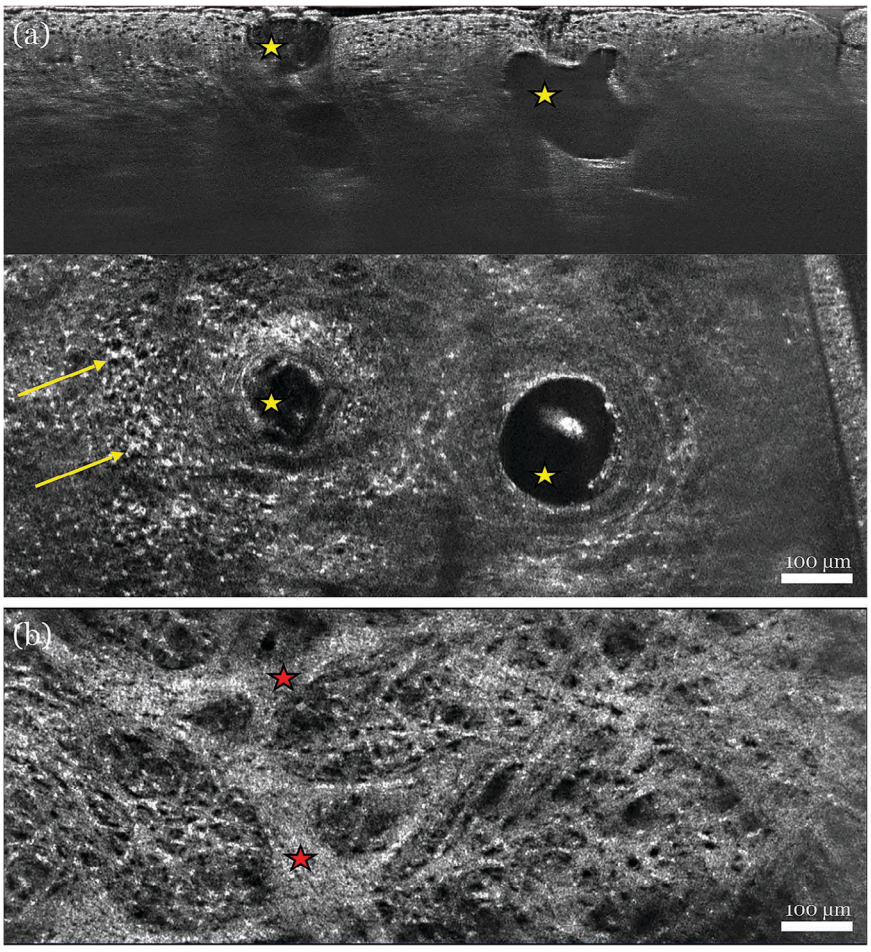

FIGURE 1 Typical LC-OCT features in a patient with LPP intralesionally. (a) Destructed hair follicles (yellow asterisk) surrounded by inflammatory cells (yellow arrow) and no rimming of the dermal papillae in vertical and horizontal mode. (b) Absent hair follicles and dermal sclerosis (red asterisk), no rimming of the dermal papillae in horizontal mode.

TABLE 3 Statistics of morphologic criteria in the lesion zone of patients with LPP/FFA compared to the clinically healthy sites.

	Lesion	Healthy	p-value	Effect size V
No (healthy) hair follicles left	100.0%	0.0%	< 2.2e-16	1.00 (large)
Destructed hair follicles	72.5%	0.0%	1.227e-13	0.75 (large)
Dermal sclerosis	94.1%	0.02%	< 2.2e-16	0.92 (large)
No rimming of the dermal papillae	70.6%	0.0%	4.113e-13	0.74 (large)

patient, despite clinical and dermoscopic healthy hair follicles, LC-OCT revealed perifollicular dermal sclerosis, dermal inflammatory infiltrate, infundibular hyperkeratosis, dilated blood vessels and hypervascularization.

DISCUSSION

As many authors consider LPP and FFA as one entity – despite their distinct clinical appearance – due to morphological and histopathological similarities,[4–7] in a first step, we compared all features in the LC-OCT images of both subgroups (LPP versus FFA). Except for the criterion of dilated blood vessels, no statistically significant differences were seen. Since dilated vessels were found in only 41.2% of all cases, this criterion alone is not suitable for the differential diagnosis of LPP and FFA. Therefore, in the second step all patients with LPP and FFA (one patient with clinically both) were then evaluated as one group (n = 51) and within this group the scarred and inflamed areas were compared to the intraindividual healthy looking site to determine the relevant features of LPP/FFA in LC-OCT images.

According to histopathology and the pathomechanism of LPP/FFA, the four criteria dermal sclerosis, dermal perifollicular inflammatory infiltrate, infundibular hyperkeratosis and hypervascularization could be detected with the LC-OCT with a large effect size in the transition zone compared to the healthy site and are, therefore, particularly helpful in the diagnosis of LPP/FFA.

In agreement with the pathogenetic processes of LPP/FFA, we see the corresponding correlates in the optical biopsy using LC-OCT: The scarring of the hair follicles shows

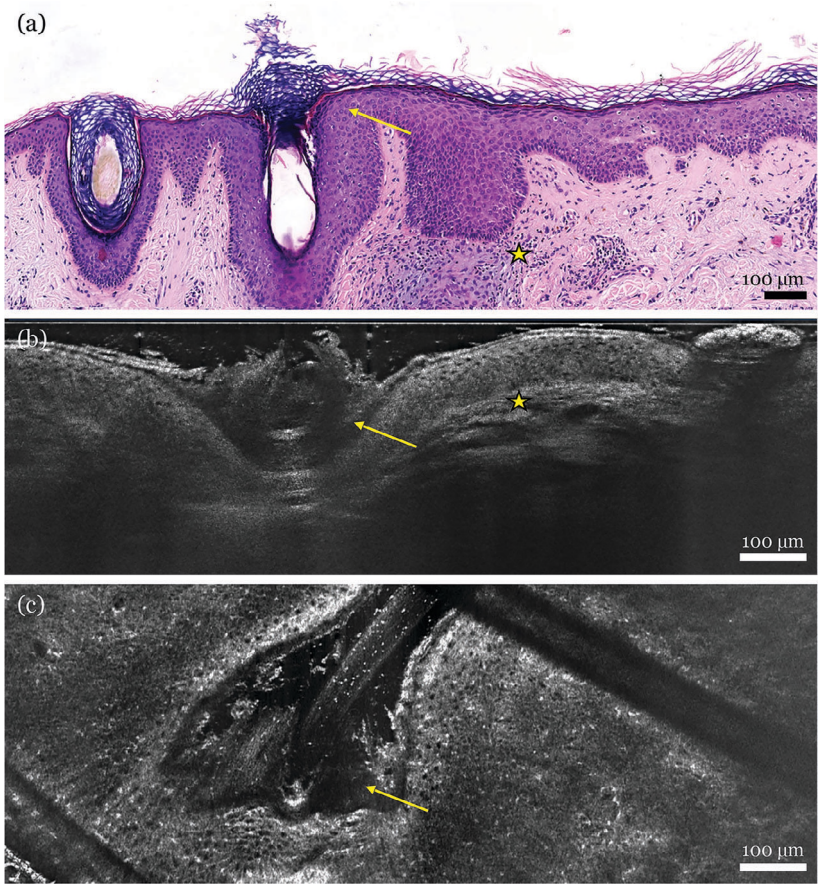

FIGURE 2 Infundibular hyperkeratosis as a typical feature in a patient with LPP. (a) Histological hematoxylin-eosin-stained section: hair follicle on the right with infundibular hyperkeratosis (yellow arrow). (b) Vertical, (c) Horizontal: corresponding LC-OCT images showing infundibular hyperkeratosis (yellow arrow). Incidentally, a dermal inflammatory infiltrate can be seen in (a) and (b) (yellow asterisk), which is not visible in (c) because it shows the ostium within the epidermis.

up as dermal sclerosis as well as destroyed and disappeared hair follicles. The lichenoid interface dermatitis characteristic for LPP/FFA which, like sclerosis, blurs the boundaries between skin layers, may play a major role in the lack of rimming.

The examiner's main focus should be on the scar-hair border (transition zone), as this is where the inflammatory events occur. Again, dermal sclerosis was seen around the hair follicles as a sign of the onset of fibrosis in all patients and is therefore a useful tool in the diagnosis of scarring alopecia. As a correlate of active inflammation around the hair follicles, an epidermal infiltrate was seen in 35.3% and a dermal perifollicular infiltrate was seen in 90.2% of the patients. As the hair follicle stem cells being the target of autoinflammatory activity are located in the isthmus region, it is not surprising that the inflammatory infiltrate was found in the upper and middle dermis in a predominant proportion of our images.

Furthermore, the amount of inflammation can be used to infer the extent of current inflammatory activity, which can lead to an increase, reduction or even discontinuation of treatment if no inflammatory activity is left. This so-called "burnout" of the disease occurs in some patients after an uncertain period of time.[4] In the five patients in whom no inflammatory infiltrate was found in the LC-OCT images, such a burnout stage could be present due to the long duration of the disease in these patients, which averaged more than 10 years. If LC-OCT can detect this burnout stage early, patients may be spared costly anti-inflammatory therapies, which can have side effects such as skin atrophy and psychological distress.[4,10]

Non-invasive monitoring of disease progression over time is an excellent alternative to existing methods. Dermoscopy does not always provide an accurate picture of inflammatory activity around hair follicles, particularly in the dermis. Clinical correlates of inflammatory activity such as follicular cast and perifollicular erythema may or may not be visible dermoscopically.[3,15] Monitoring of inflammatory activity around the hair follicles with repeated scalp biopsies during follow-ups is not a practical alternative and does not allow surveillance of the same area over time.

Follicular casts can be found as infundibular hyperkeratosis in LC-OCT in 60.8% of all patients. Hypervascularization, another correlate of increased inflammatoryactivity, was present in 76.5% of patients and corresponds to the dermoscopic correlate of perifollicular erythema. Dilated blood vessels may also reflect inflammatory activity but only occurred in 41.2%.

It should be noted that 43 patients were receiving anti-inflammatory therapy at the time of measurement, which may influence the existence and thus the visibility of the examined criteria. Since a typical side effect of topical steroids is the development of teleangiectasia,[37] part of the vasodilatation and hypervascularization in our patients

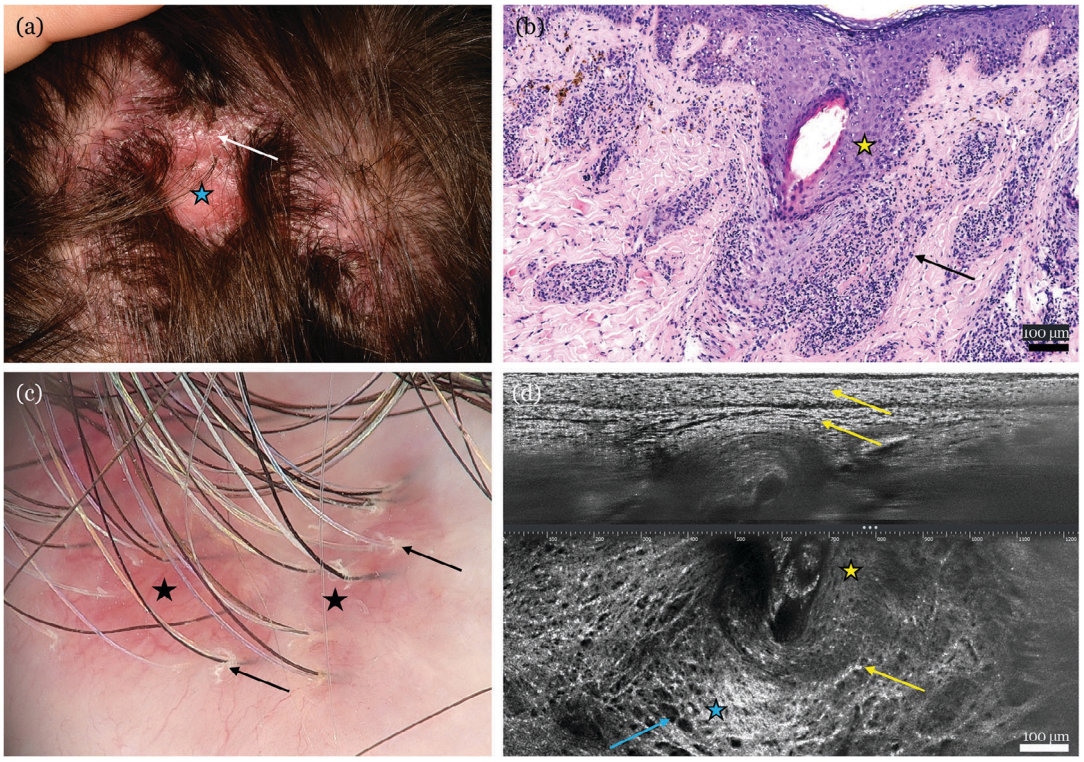

FIGURE 3 Typical inflammatory signs in a patient with LPP. (a) Clinical picture of the patient: scarred area (blue asterisk), redness, scaling (white arrow). (b) Hematoxylin-eosin-stained section: hair follicle (yellow asterisk) with dermal perifollicular inflammatory cells (black arrow). (c) Trichoscopic image (x 20): perifollicular erythema (black asterisk) and perifollicular cast (black arrow). (d) Vertical and horizontal LC-OCT image: hair follicle (yellow asterisk), epidermal and dermal inflammatory cells (yellow arrow), dermal sclerosis (blue asterisk) and hypervascularization (blue arrow).

FIGURE 4 OCT, RCM and LC-OCT images of the transition zone of patients with LPP/FFA (a, c, e) in intraindividual comparison to their clinically healthy site (b, d, f). (a) Vertical OCT image of the transition zone in a patient with FFA: loss of hair follicle density, dermal sclerosis (yellow asterisk). (b) Vertical OCT image of the healthy site: normal hair follicle density, no dermal sclerosis. (c) Horizontal RCM stack of the transition zone in a patient with LPP: hair follicle, surrounded by inflammatory cells (yellow arrow) and sclerosis (yellow asterisk) in the superficial dermis, no rimming of the dermal papillae. (d) Horizontal RCM stack of the healthy site: no inflammatory signs visible, rimming of the dermal papillae visible. (e) LC-OCT 3D block of the transition zone in a patient with FFA: hair follicle surrounded by dermal perifollicular inflammatory cells (yellow arrow) and dermal sclerosis (yellow asterisk). (f) LC-OCT 3D block of the healthy site: no signs of inflammation visible.

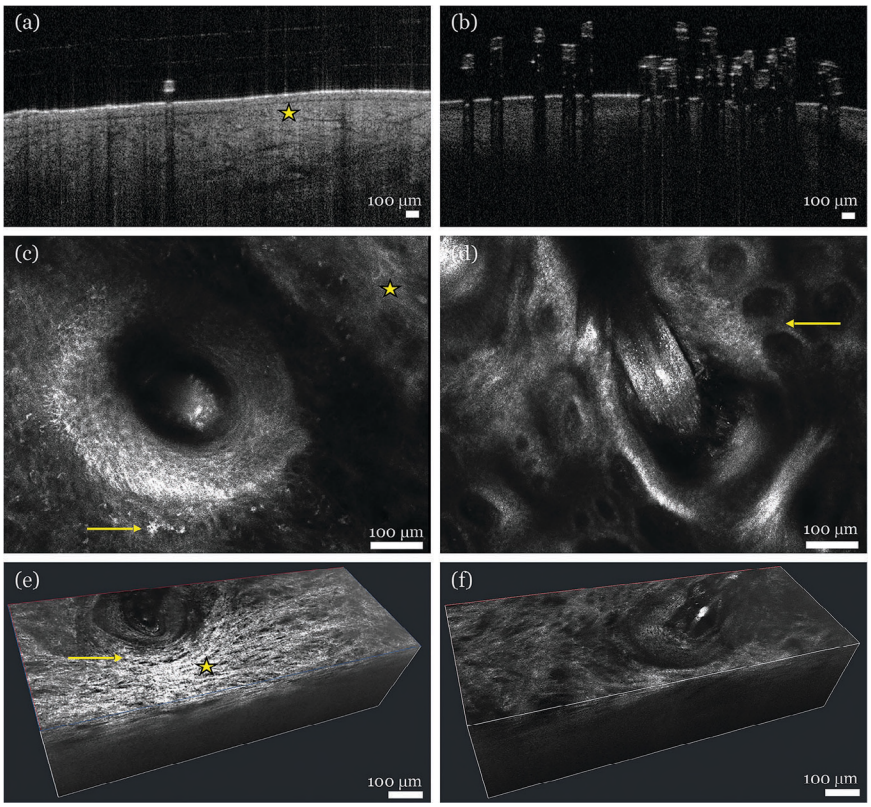

TABLE 4 Statistics of morphologic criteria of the transition zone of patients with LPP/FFA compared to the clinically healthy sites.

	Transition	Healthy	p-value	Effect size V
Dermal sclerosis	100.0%	0.02%	< 2.2e-16	0.98 (large)
Epidermal inflammatory infiltrate	35.3%	0.0%	1.008e-05	0.45 (moderate)
Dermal perifollicular inflammatory infiltrate	90.2%	0.02%	< 2.2e-16	0.88 (large)
Infundibular hyperkeratosis	60.8%	0.02%	6.08e-10	0.63 (large)
Dilated blood vessels	41.2%	0.02%	4.785e-06	0.47 (moderate)
Hypervascularization	76.5%	0.02%	6.204e-14	0.76 (large)
Melanophages	9.8%	0.0%	0.666	
Epidermal pigment incontinence	5.9%	0.0%	0.2426	

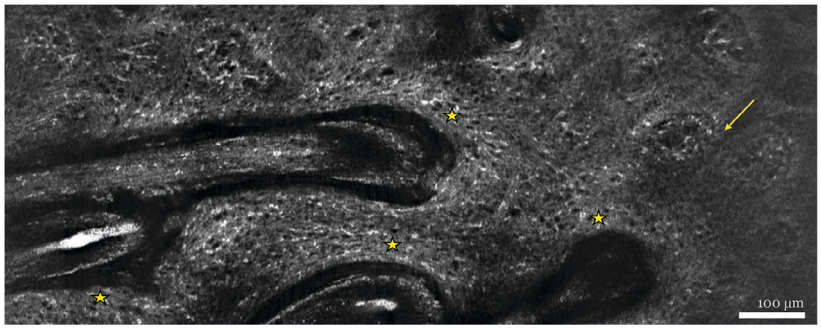

FIGURE 5 LC-OCT picture of healthy hair follicles: Four healthy hair follicles (yellow asterisk), no inflammatory infiltrate visible, rimming of the dermal papillae visible (yellow arrow), horizontal mode.

could be caused by previous or ongoing use of topical corticosteroids. Further studies are needed to investigate the LC-OCT characteristics of LPP/FFA in the context of anti-inflammatory therapies. A further limitation of our cohort is the varying duration of the disease.

The presence of melanophages and epidermal pigment incontinence was only seen in a small percentage of patients and was therefore not statistically significant with melanophages being easily overlooked due to their difficult differentiation from other inflammatory cells. In all patients we also imaged clinically and dermoscopically unaffected hair follicles. In 50 (98.0%) of these patients, the above-mentioned criteria were not present.

The fact that in one patient, the criteria of dermal sclerosis, dermal perifollicular infiltrate, hypervascularization, dilated blood vessels, and infundibular hyperkeratosis could be detected even in the supposedly healthy hair follicles could be due to the inflammatory activity which was not yet visible clinically or dermoscopically but was already present in the depth of the scalp.

As LC-OCT has a higher resolution than OCT and a higher penetration depth than RCM, LC-OCT can combine the advantages of the two other methods. In particular, the presence of an inflammatory infiltrate in the dermis, which can be detected by LC-OCT, is crucial for the diagnosis and assessment of disease activity in LPP/FFA and therefore provides an advantage. Another advantage of LC-OCT is the ability to acquire images in horizontal, vertical (histology-like) and 3D block mode, thus resulting in a comprehensive imaging assessment. The surface image of LC-OCT, which allows real-time dermoscopic co-localization, additionally facilitates handling during the examination and post-imaging evaluation.

Although LC-OCT already combines a very high resolution with a penetration depth of 500 µm, the limited penetration depth is still the major limitation. Since the inflammatory processes at the level of the stem cell region of the hair follicle may be located deeper than 500 µm in the skin, this key site can only be assessed to a limited extent.

CONCLUSIONS

LC-OCT can detect specific criteria of pathological changes in LPP/FFA around hair follicles in the epidermis and upper dermis and can therefore be used for further studies investigating scarring alopecia. In particular, the criteria of dermal sclerosis, dermal perifollicular inflammatory infiltrate, infundibular hyperkeratosis and hypervascularization are helpful in assessing the inflammatory process. Further studies are required to determine its usefulness in differentiating LPP/FFA from other causes of scarring alopecia, such as lupus erythematodes and folliculitis decalvans, and its significance for monitoring the therapeutic response to anti-inflammatory topical and systemic medication.

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CONFLICT OF INTEREST STATEMENT

None.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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