Received: 8 January 2024 | Accepted: 16 January 2024

DOI: 10.1111/srt.13596

RESEARCH LETTER

WILEY

Alopecia areata: Line-field confocal optical coherence tomography features and dermoscopy correlation

To the Editor,

Alopecia areata (AA) is a common non-scarring disorder characterized by well-circumscribed focal patches of hair loss with an acute or chronic course that can progress to affect all scalp and body hairs. Line-field confocal optical coherence tomography (LC-OCT) is a non-invasive technique that provides high-resolution, vertical, and horizontal in vivo images of the skin with a penetration depth of up to 500 μm.[1–5] It also allows visualization of the upper portion of the hair follicle (infundibulum) that contains the hair shaft [Figure 1A,B]. LC-OCT has recently been used for the evaluation of some hair diseases,[6–7] and one study only was done on AA for the monitoring of therapeutic response.[8]

The aim of this study was to evaluate by LC-OCT the main dermoscopic findings observed in AA and used to enhance the clinical diagnosis, that is, yellow dots, broken hairs, black dots, exclamation mark hairs, and vellus hairs.[9,10]

Patients with scalp AA observed in our Department from January to June 2023 were enrolled in an open study. For each patient, after the recognition of at least one typical AA dermoscopic feature, LC-OCT examination was performed in the same area with the commercially available DeepLive (DAMAE Medical, Paris, France) that is equipped with an integrated dermoscopic camera.

A total of 65 AA patients (37 females/28 males; median age: 32 years, range: 6–68 years) were included: 30 cases of acute AA and 35 cases of chronic AA. At dermoscopy, yellow dots were observed in 56 patients (24 acute/32 chronic), broken hairs in 28 patients (20 acute/8 chronic), black dots in 43 patients (25 acute/18 chronic), exclamation mark hairs in 25 patients (all acute forms), and vellus hairs in 37 patients (16 acute/21 chronic).

Yellow dots at dermoscopy appear as roundish, yellowish structures, corresponding to infundibula filled with sebum and/or keratotic material. Vertical LC-OCT showed hyperreflective amorphous material

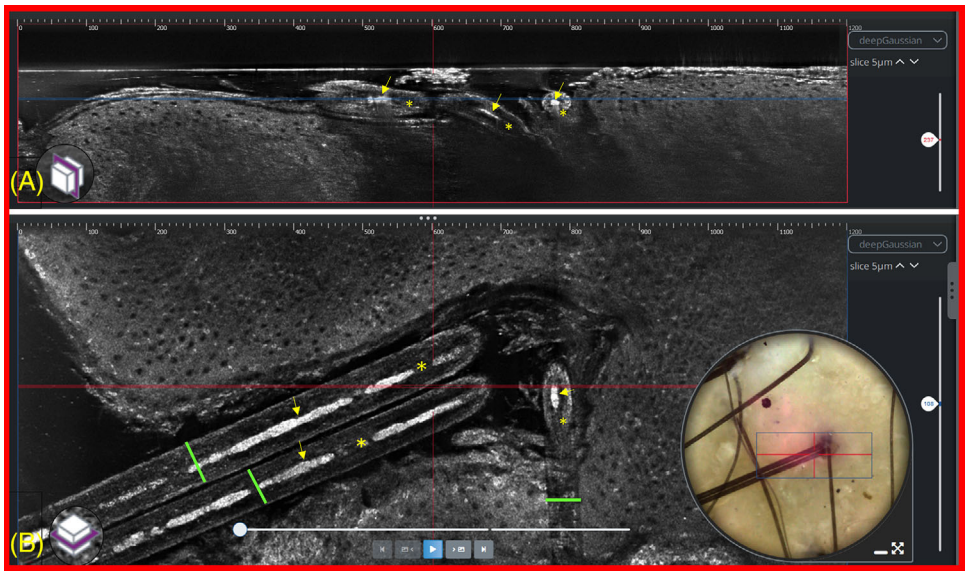

FIGURE 1 Normal hair. Vertical (A) and horizontal (B) LC-OCT images show the upper portion of the hair follicle (infundibulum) containing 3 hair shafts (asterisks) with a caliber of 50–60 μm (green bars). The medulla appears high reflective (arrows). Horizontal image (B) is taken at the level of the blue line in A. Insert: dermoscopy of the examined area.

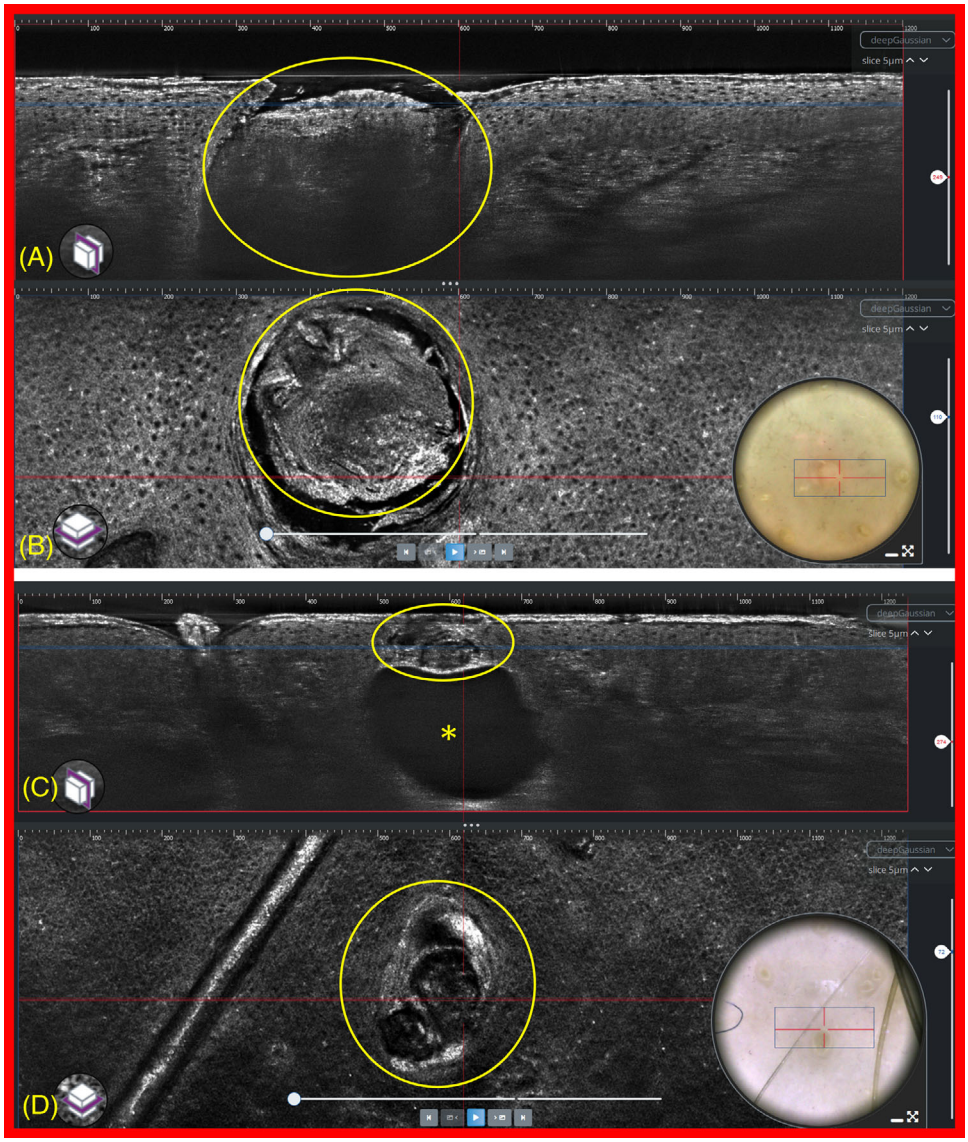

FIGURE 2 Yellow dots. Two patterns were identified: one, at vertical LC-OCT (A), shows hyperreflective amorphous material ("plug", yellow circle) filling a dilated hair infundibulum down to the mid dermis; in the horizontal image (B), it displays a roundish shape. The other pattern, at vertical LC-OCT (C), shows hyperreflective amorphous material filling only the upper portion of the infundibulum (yellow circle), with a hyporeflective roundish area below the plug (asterisk); in the horizontal image (D), the plug displays a roundish shape. Horizontal images (B, D) are taken at the level of the blue lines in A and C, respectively. Insert: dermoscopy of the examined areas.

("plug") filling a dilated hair infundibulum, two patterns being identified: the plug filling the infundibulum down to the mid dermis was observed in 43 cases (20 acute/23 chronic) [Figure 2A], while the plug filling only the upper portion of the infundibulum was seen in 13 cases (5 acute/8 chronic) [Figure 2C]. Interestingly, in the latter case, hyporeflective roundish areas, likely representing sebum lagoons, were observed right below the plugs. In both cases, horizontal LC-OCT section confirmed the presence of the hyperreflective amorphous material showing a roundish shape [Figure 2B–D]. In four cases, within the amorphous material, small regrowing vellus hair shafts, appearing as thin, linear, hyperreflective structures with a caliber ranging from 5 to 10 μm, were visible.

Broken hairs are terminal hairs fractured a few millimeters above the surface level of the scalp skin. Vertical and horizontal LC-OCT clearly showed the intrainfundibular portion of the hair shaft. This appeared similar to that observed in a terminal hair, with a caliber ranging from 50 to 85 μm and a well-defined, hyperreflective structure showing a tubular or roundish morphology if visualized in its longitudinal or transverse section, respectively.

Black dots (also called cadaverized hairs) are brownish spots corresponding to the tips of pigmented hairs broken at the skin surface level. Vertical [Figure 3A] and horizontal [Figure 3B] LC-OCT was able to visualize the intrainfundibular hair shaft remnants, which showed in 28 cases the same aspects observed in broken hairs, with a caliber ranging from 40 to 80 μm. In seven cases, the hair shaft was not clearly visible, and the presence of irregular, hyperreflective amorphous material filling the infundibulum was noted.

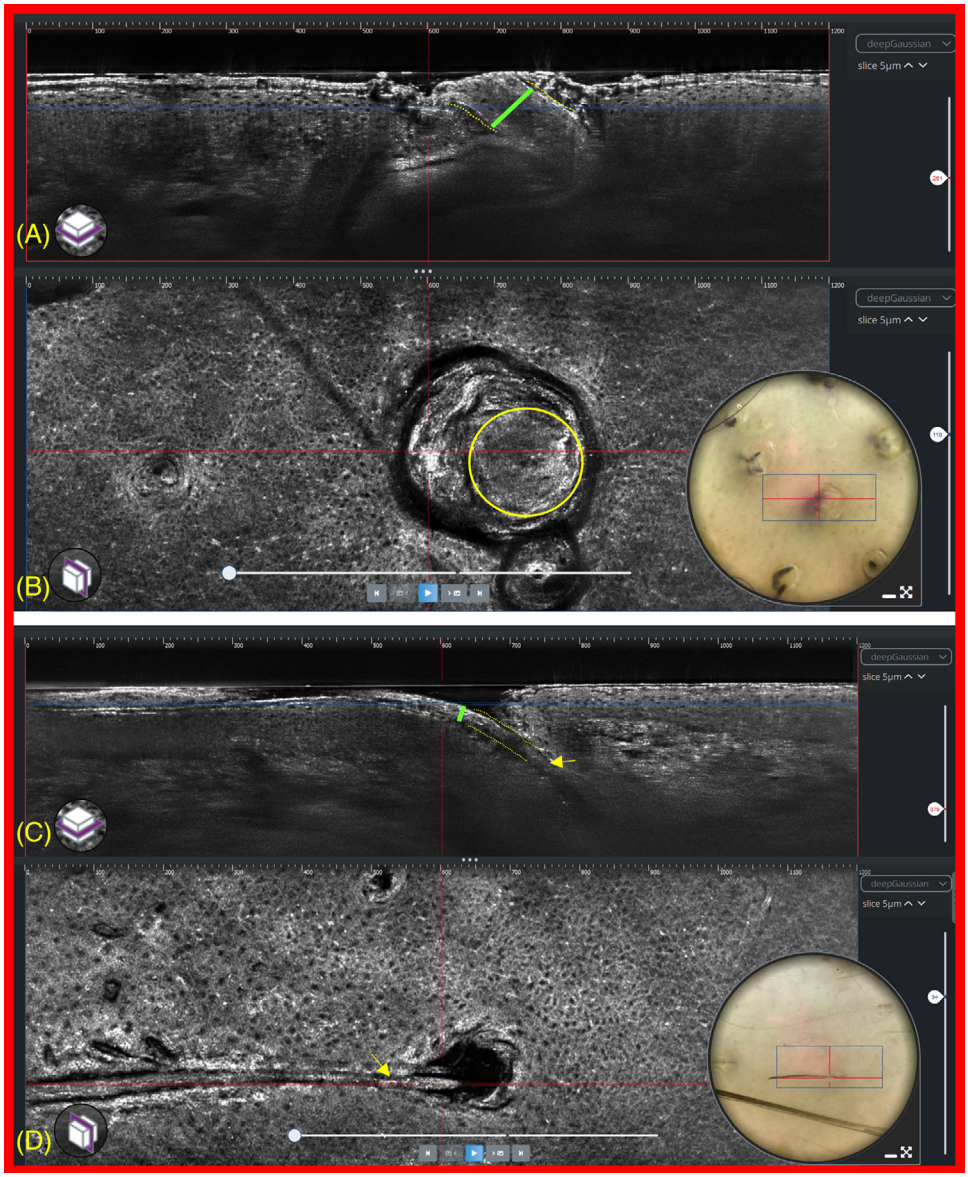

FIGURE 3 Black dot (A, B): vertical LC-OCT (A) shows the intrainfundibular hair shaft remnant with a tubular shape (dashed yellow lines) and a caliber of 70 μm (green bar); in the horizontal image (B) the same hair shaft displays a roundish shape in its transverse section (circle). Exclamation mark hair (C, D): vertical (C) and horizontal (D) LC-OCT show the intrainfundibular portion of the hair shaft (arrows) with a tubular shape (dashed yellow lines) and a caliber of 20 μm (green bar). Horizontal images (B, D) are taken at the level of the blue lines in A and C, respectively. Insert: dermoscopy of the examined areas.

Exclamation mark hairs (also called tapering hairs) are broken hairs with a thin, hypopigmented proximal end and a wider, pigmented distal end. Vertical [Figure 3C] and horizontal [Figure 3D] LC-OCT visualized the intrainfundibular portion of the hair shaft presenting with a structure similar to that observed in broken hairs but with a smaller caliber ranging from 15 to 45 μm.

Vellus hairs consist of short, thinned, hypopigmented hairs with a linear or coiled appearance, usually considered as expression of hair regrowth. Vertical [Figure 4A,C] and horizontal [Figure 4B,D] LC-OCT showed the intrainfundibular portion of the hair shaft appearing as a thin, tubular, hyperreflective structure, with a caliber ranging from 10 to 35 μm. In its transverse section, the hair shaft showed a roundish shape.

Our study firstly describes the LC-OCT features of AA. This new non-invasive tool was able to show in vivo the follicular microscopic alterations underlying the dermoscopic features of AA, thanks to the integrated camera allowing a precise positioning. From our results, some considerations can be made: yellow dots at LC-OCT appear as intrafollicular hyperreflective plugs, and the prognostic implication of the different type of plugs we observed (filling the entire infundibulum or only its upper portion) is unclear, both being present in acute and chronic forms; the intrafollicular observation of regrowing vellus hairs

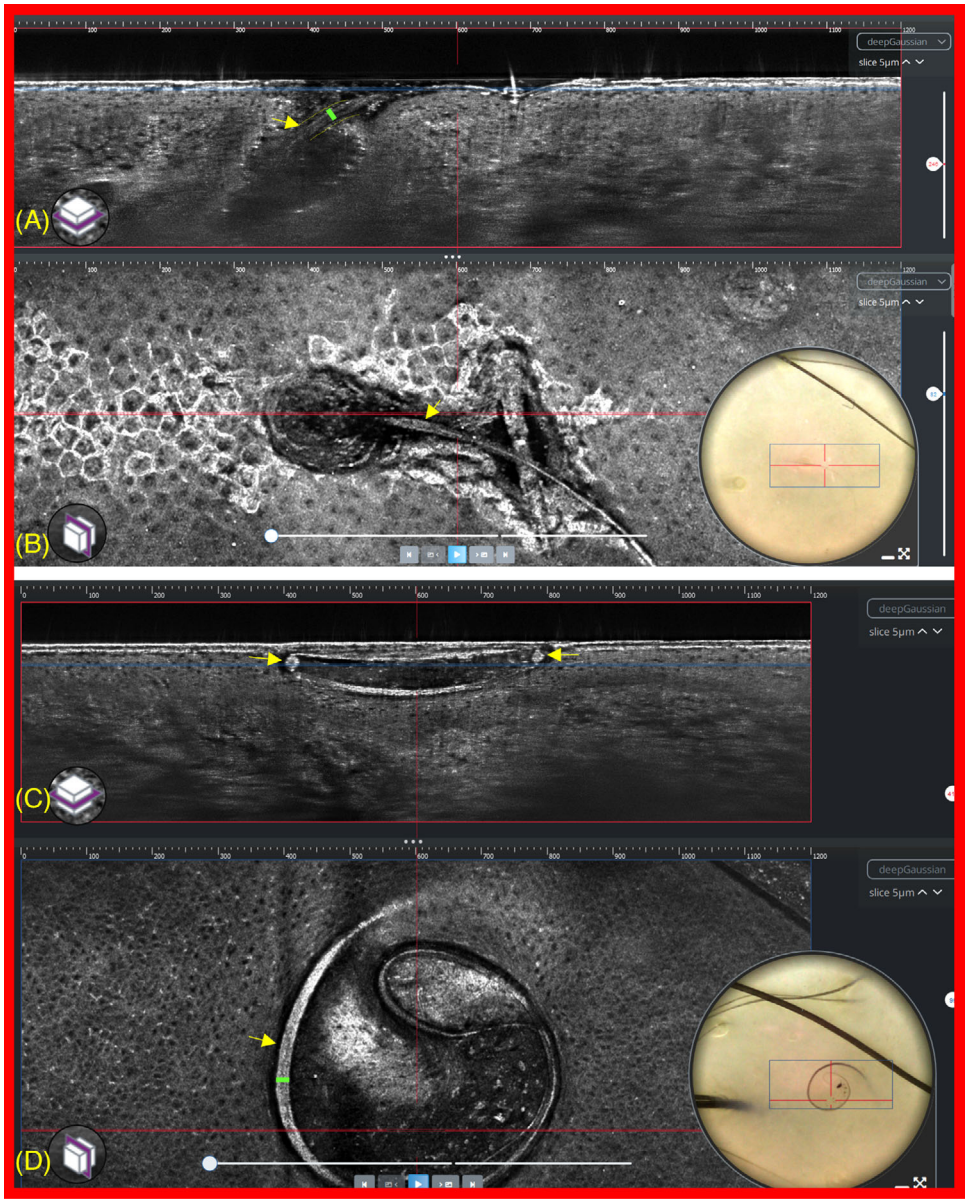

FIGURE 4 Upright vellus hair (A, B): vertical (A) and horizontal (B) LC-OCT images show the intrainfundibular portion of the hair shaft (arrows) with a tubular shape (dashed yellow lines) and a caliber of 15 μm (green bar). Coiled vellus hair (C, D): vertical LC-OCT image (C) shows the transverse section of the hair shaft in 2 points (arrows); horizontal LC-OCT image (D) displays the longitudinal section of the same hair shaft with a tubular shape and a caliber of 20 μm (green bar). Horizontal images (B, D) are taken at the level of the blue lines in A and C. Insert: dermoscopy of the examined areas.

in the context of yellow dots before they become clinically evident, as observed in four cases, could be useful to detect early treatment response, as demonstrated in AA patients treated with baricitinib.[8] In broken hairs, black dots, exclamation-mark hairs, and vellus hairs, LC-OCT allows the visualization of the intrafollicular portion of the hair shaft that shows a different caliber, which is maximum for broken hairs and minimum for vellus hairs. A precise assessment of hair caliber could be used in other hair diseases, such as androgenetic alopecia, to monitor changes over time and/or response to treatment.

In conclusion, LC-OCT may represent a promising tool in AA with potential applications including enhanced diagnosis, follow-up, and treatment monitoring.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

Data available on request from the authors.

ETHICS STATEMENT

The procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional or regional) and with the Helsinki Declaration of 1975, as revised in 1983. The patients in this manuscript have given written informed consent to the publication of their case details.

Francesco Lacarrubba[1]
Anna Elisa Verzì[1]
Federica Dall'Oglio[1]
Alessia Villani[2]
Giuseppe Micali[1]

[1]*Dermatology Clinic, University of Catania, Catania, Italy*
[2]*Section of Dermatology, Department of Clinical Medicine and Surgery, University of Naples Federico II, Naples, Italy*

Correspondence
Francesco Lacarrubba, Dermatology Clinic, University of Catania, Via S. Sofia 78, 95123 Catania, Italy.
Email: francesco.lacarrubba@unict.it

ORCID

Francesco Lacarrubba https://orcid.org/0000-0002-0860-2060
Giuseppe Micali https://orcid.org/0000-0002-5157-3939

REFERENCES

1. Ruini C, Schuh S, Sattler E, Welzel J. Line-field confocal optical coherence tomography-Practical applications in dermatology and comparison with established imaging methods. *Skin Res Technol*. 2021;27(3):340-352.
2. Donelli C, Rubegni P, Tognetti L, et al. Inflammatory and infectious skin diseases in line-field confocal optical coherence tomography: state of art. *Ital J Dermatol Venereol*. 2023;158:190–196.
3. Cappilli S, Guerriero C, Iacoangeli A, et al. Utility of line-field confocal optical coherence tomography in the pediatric population. *Ital J Dermatol Venereol*. 2023;158:197–204.
4. Verzì AE, Broggi G, Micali G, Sorci F, Caltabiano R, Lacarrubba F. Line-field confocal optical coherence tomography of psoriasis, eczema and lichen planus: a case series with histopathological correlation. *J Eur Acad Dermatol Venereol*. 2022;36(10):1884-1889.
5. Latriglia F, Ogien J, Tavernier C, et al. Line-field confocal optical coherence tomography (LC-OCT) for skin imaging in dermatology. *Life (Basel)*. 2023;13(12):2268.
6. Kurzeja M, Warszawik-Hendzel O, Rakowska A, et al. Line-field confocal optical coherence tomography: a new diagnostic method of lichen planopilaris. *Skin Res Technol*. 2023;29(10):e13495.
7. Kurzeja M, Warszawik-Hendzel O, Rakowska A, et al. Line-field confocal optical coherence tomography – a new diagnostic method in hair loss associated with folliculitis decalvans. *J Eur Acad Dermatol Venereol*. 2023. Epub ahead of print. https://doi.org/10.1111/jdv.19575
8. Verzì AE, Lacarrubba F, Dall'Oglio F, Rini S, Tosti A, Micali G. Subclinical, early hair regrowth in alopecia areata patients under treatment with baricitinib detected by line-field confocal optical coherence tomography evaluation. *J Eur Acad Dermatol Venereol*. 2023. Epub ahead of print. https://doi.org/10.1111/jdv.19623
9. Lacarrubba F, Micali G, Tosti A. Scalp dermoscopy or trichoscopy. *Curr Probl Dermatol*. 2015;47:21-32.
10. Al-Dhubaibi MS, Alsenaid A, Alhetheli G, Abd Elneam AI. Trichoscopy pattern in alopecia areata: a systematic review and meta-analysis. *Skin Res Technol*. 2023;29(6):e13378.