In vivo imaging of *Sarcoptes scabiei* infestation using line-field confocal optical coherence tomography

Dear Editor,

Scabies remains a worldwide spread disease of considerable health and economic burden with repeated outbreaks in community settings.[1] Scabies agent is the ectoparasite *Sarcoptes scabiei* var. *hominis*; this invisible mite causes a progressive rash, which can be misdiagnosed with eczema or *pruritus sine materia*. Diagnosis is based on characteristic clinical features (intense nightly itch, inflammatory excoriated papules in typical sites) and history of contact to infected patients. According to the new International Alliance for the Control of Scabies (IACS) classification, the identification of mites, eggs or faecal pellets through skin scraping, high magnification devices or dermoscopy counts as diagnostic criteria for confirmed scabies.[1] The typical dermoscopic sign of scabies infestation is the so-called 'delta', 'kite' or 'triangle', representing the anterior body of the adult female mite at the end of the burrow[2] (Fig. 1e). Reflectance confocal microscopy (RCM)3 and optical coherence tomography (OCT) were used in the detection of mite infestations (scabies, demodex)[4,5] and their therapeutic monitoring.[6,7] Line-field confocal optical coherence tomography (LC-OCT, DAMAE Medical®, Paris, France) is new imaging technique that can also be used to visualize mites and related skin changes. LC-OCT is based on a two-beam interference microscope with line illumination and line detection using a broadband spatially coherent light source and a line-scan camera.[8] It has three imaging modalities: en-coupe (vertical), en-face and 3D, providing a cellular resolution (1.1 × 1.3 μm).

A patient (male, 50 years old) with suspect symptoms and skin rash was examined with LC-OCT (DAMAE Medical, Paris, France). Mites were also identified by high magnification digital dermoscopy (Fotofinder®, Bad Birnbach, Germany). In LC-OCT en-face images, *S. scabiei* was clearly identifiable as an ovoid structure with a thin, corrugated exoskeleton and triangular spicules on the dorsal surface, localized right below the

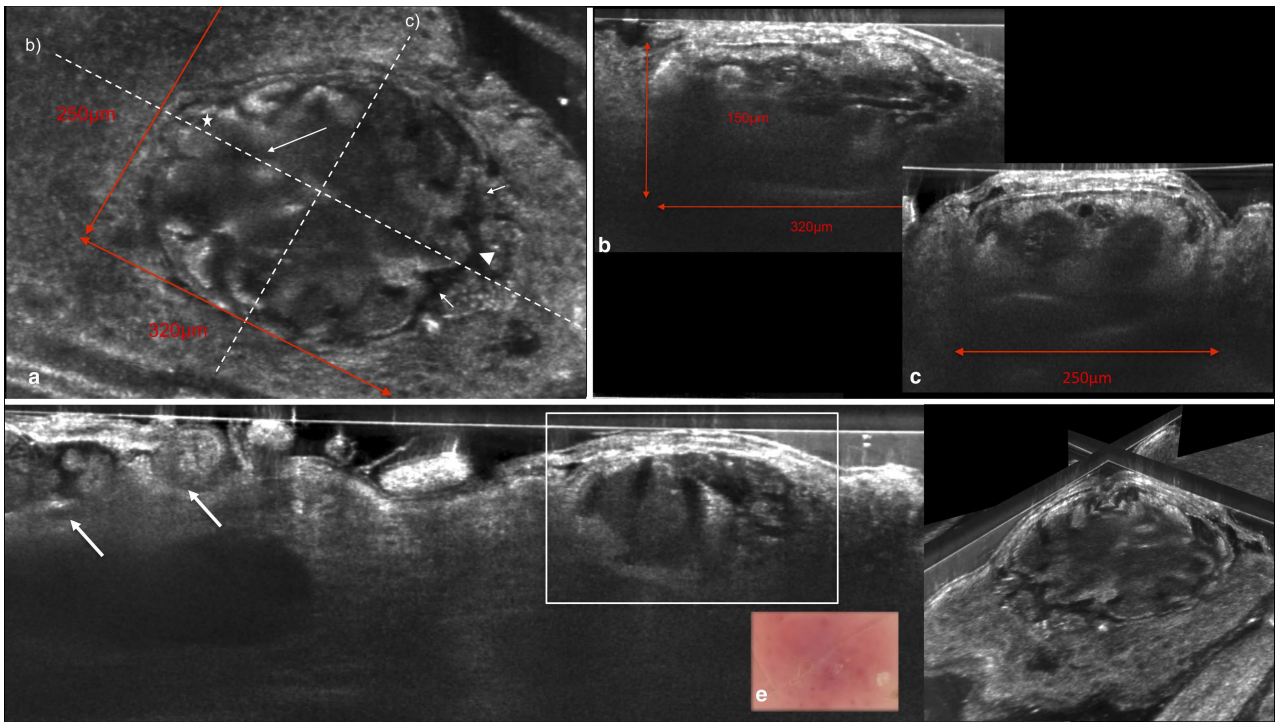

Figure 1 a) In en-face LC-OCT images, *S. scabiei* can be identified as a round structure in a burrow with a thin, corrugated exoskeleton and triangular spicules on the dorsal surface. Two pairs of hyperreflective coned structures (short arrows) corresponding to legs surround the polygonal head (triangle). At the opposite side, a triangular terminal anus (star) is visible and in the centre, a central, hyporeflective, convoluted gut (long arrow) with skybala and hyperreflective glands can be seen. 1b,c) Vertical LC-OCT images corresponding to the b) and c) axes in the 1A en-face image 1d) Vertical LC-OCT image with a thick hyperkeratotic burrow surrounding the mite inside the epidermis. The ovoid burrow behind the mite contains the hyperreflective skybala and eggs. 1e) Dermoscopy of the scabies mite with the so-called 'delta' or 'kite' or 'triangle' sign 1f) 3D reconstruction of the hyperreflective burrow containing the mite body.

stratum corneum in a burrow (Fig. 1a). Two pairs of hyperreflective coned structures corresponding to legs surround the polygonal, even brighter head (Fig. 1a, triangle). At the caudal extremity, a triangular terminal anus is visible (Fig. 1a, star). Internal organs are also hinted at a central, hyporeflective, convoluted gut with skybala (Fig. 1, long arrow) and hyperreflective (probably ovary and vitelline) glands.

In LC-OCT vertical images (Fig. 1b,c,d) and 3D reconstruction (Fig. 1f), the exact location of the mite inside the epidermis and *Stratum corneum* can be observed. A thick hyperkeratotic scale corresponding to the burrow covers it. The optical density of the mite is comparable to the surrounding tissue; however, the hyporeflective burrow lumen and the scaly hyperreflective burrow wall build a fringe, which delimitates the mite body. An ovoid or longitudinal burrow can be also visualized behind the mite, depending on the scan direction. Skybala and eggs can also be identified as roundish, mainly hyperreflective structures.

The in vivo observation of scabies mites in their human hosts allows a quick diagnosis at bedside and provides interesting information about the biology of the living mites. Not only OCT and RCM but also LC-OCT permits fast, painless, real-time imaging of mites, their morphology and their skin location, with hints to their internal structures.[3,9] LC-OCT has a better resolution of conventional OCT, but still lower than RCM; this is however compensated by the possibility of combining en-face and vertical views and obtaining 3D reconstructions at different angles. Burrows, eggs and skybala can also be visualized easily. The high resolution and penetration depth of LC-OCT combined with the possibility of acquiring vertical, en-face and 3D images provides more details compared to dermoscopy and other diagnostic techniques, which may possibly reduce diagnostic pitfalls. Moreover, exact special correlations and measurements are possible. This allows an immediate diagnosis of scabies infestation as well as non-invasive therapeutic monitoring.

We believe LC-OCT is a non-invasive diagnostic tool with high potential in dermatology, with a broad field of application and likely to be applied in the future not only to skin cancer[10] but also in skin infestations.

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Conflicts of interest

The authors declare no conflict of interest.

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