Early Experience with 3D LC-OCT (Line Field Confocal-Optical Coherence Tomography) Imaging Show Potential to Reduce Skin Biopsies

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Background/Problem Being Solved

Line Field Confocal-Optical Coherence Tomography (LC-OCT) is an FDA cleared emerging, non-invasive, non-ionizing imaging modality capable of cellular and molecular-level resolution. This technology has potential to reduce invasive biopsies of suspicious cancerous skin lesions by enabling precise, 3D real-time visualization.

Traditional dermatologic imaging primarily relies on visible light-based tools such as specialized visible light photography and dermoscopy. Challenges include bulkiness, operator variability, and technical limitations. LC-OCT addresses these barriers by providing real time three-dimensional, cross-sectional, and en-face imaging, enabling dermatologists/dermatopathologists to assess tissue microstructure detail only previously available in histologic sections. LC-OCT is currently being clinically implemented in several medical centers globally, including three centers in the United States.

Intervention(s)

We present LC-OCT as a groundbreaking imaging modality with applications in diagnosing and managing common skin cancers, including basal cell carcinoma, melanoma, and squamous cell carcinoma. We share clinical use cases, example 3D image data, review planar and imaging terminology and video demonstrations of real-time volumetric imaging.

Barriers/Challenges

Currently, there is limited accessibility to LC-OCT, compounded by high equipment and training expenses, combined with low reimbursement rates.

Technical limitations include small field of view (0.05 cm x 0.12 cm and depth of 0.05 cm) and artifacts caused by structures e.g. hair. Also, highly pigmented skin absorbs the imaging source, and can lead to lower resolution of deeper structures. Regulatory challenges include insurance reimbursement for LC-OCT (remains limited), similar to other imaging modalities in dermatology.

Outcome

LC-OCT introduces a new era of non-invasive dermatologic imaging, offering a potential alternative to traditional biopsies for diagnosing potentially cancerous lesions. This modality enables mapping of superficial, spreading tumors before surgery, potentially reducing the need for wide excisions. It also provides real-time visualization of tumor margins, streamlining surgical procedures by eliminating delays associated with subspecialty pathology confirmation.

Conclusion/Statement of Impact/Lessons Learned

This abstract features cross-sectional and 3D imaging examples, real-time 3D volumetric imaging videos, and device graphics to illustrate LC-OCT's capabilities. These advanced imaging tools, previously unique to radiology, are now transforming dermatologic practice. sectional and 3D images in addition to a video of real time 3D volumetric imaging including cut plane reformats similar to advanced PACS tools no longer unique to radiology.

Figure(s)

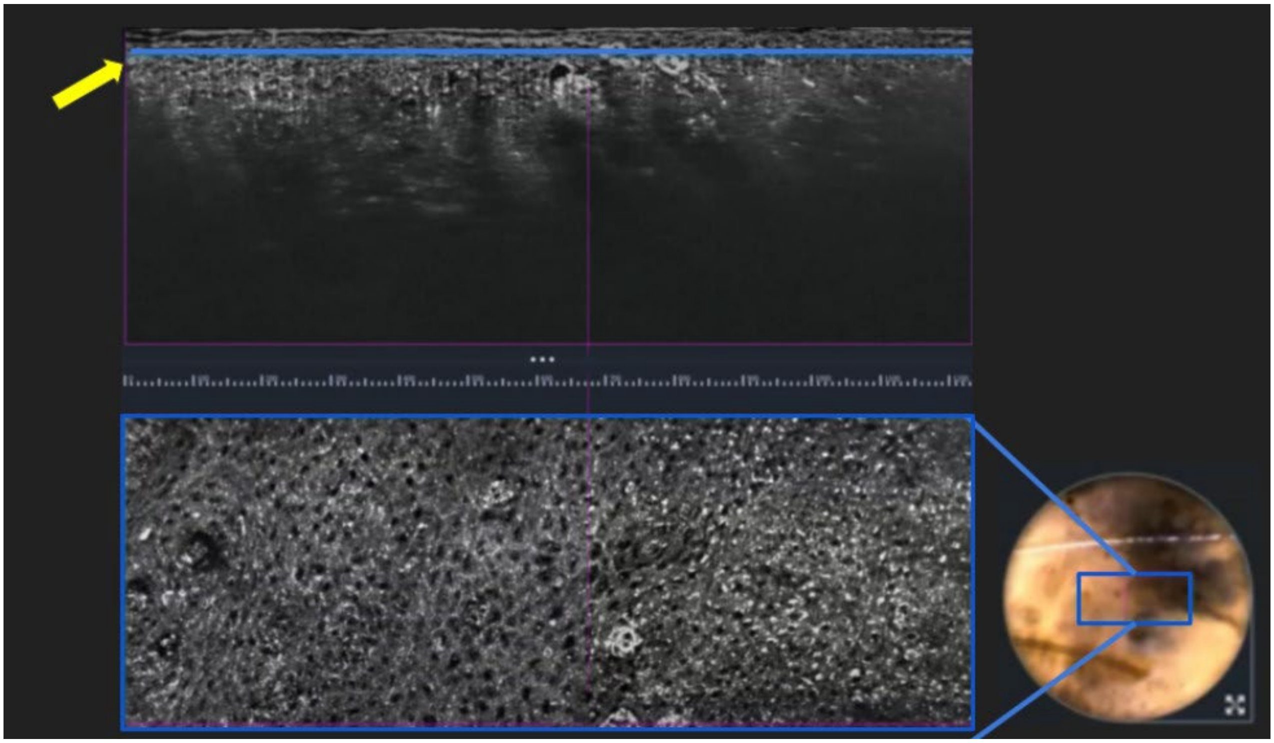

Figure 1. Suspicious skin lesion as seen by LC OCT. Similar to ultrasound, the "light" penetrates the skin demonstrating cellular resolution. The lower right shows the "transducer" location orientation on lesion with the blue square representing the volume imaged. The blue line on the upper longitudinal "coronal" plane image represents the lower cross sectional ("axial") view.

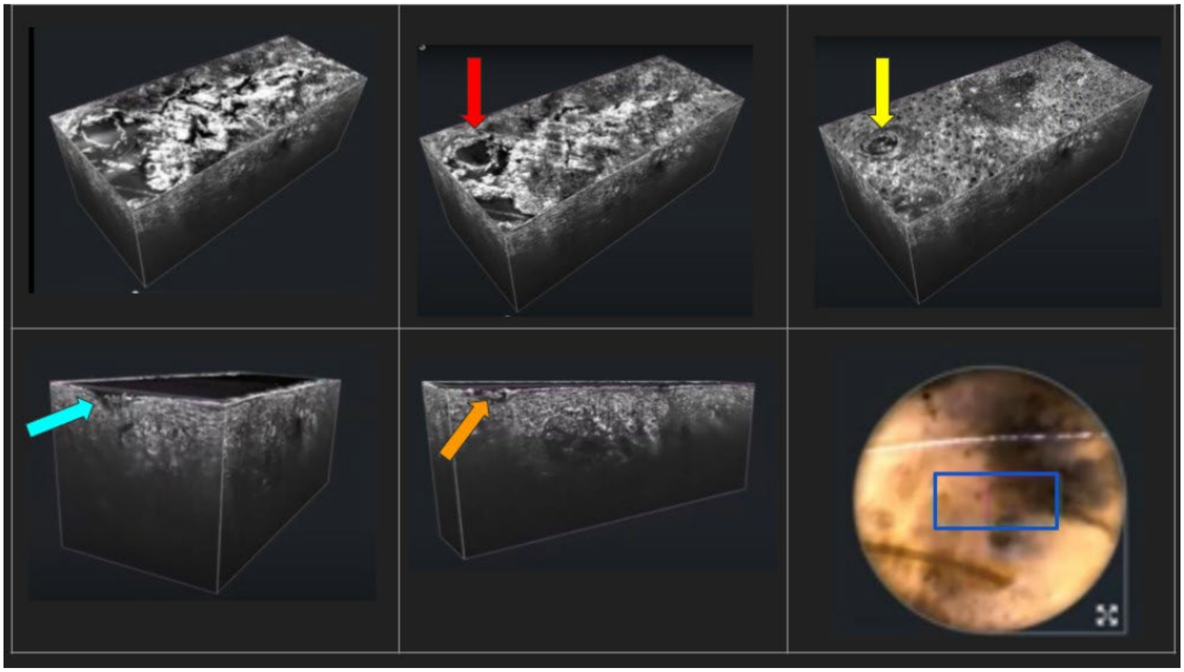

Figure 2. Demonstrating the 3D slab in various axial, sagittal and coronal cut planes (plane designation dependent on probe orientation on patient), keeping in mind these are screenshots from real time imaging. The top row demonstrates an "axial" cut plane starting at the skin surface (upper left), then progressively cutting the slab from the top with the top middle slab at 1 mm deep starting to show ovoid rounded lesion (red arrow), then 1 mm deeper cut (upper right image) showing deeper cross section (yellow arrow). The left bottom row shows the low attenuation lesion in a sagittal orientation (blue arrow) with the middle image in coronal view (orange arrow). Again the bottom left shows the 3D volume (blue rectangle) image at the skin surface on the traditional visible light image. Complex para-planar (not shown) is especially helpful in characterizing lesions in 3D similar to advanced image processing in cross sectional radiology image data.\

Keywords

Applications; Artificial Intelligence/Machine Learning; Emerging Technologies; Enterprise Imaging; Imaging Research; Provider Experience