



# Optical Coherence Tomography Imaging of Onychomycosis

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## ABSTRACT

Optical coherence tomography (OCT) is a non-invasive imaging technique that uses a low-power infrared laser light to image up to 2mm beneath the skin's surface. This allows the clinician to obtain real-time images of the architecture of the skin, without any pre-treatment or gels. OCT has shown to be a useful diagnostic tool for conditions of the nail, such as psoriatic nail disorder<sup>1</sup>.

Described is a case of a 56 year old male patient who presented on initial exam with yellow discoloration on all toenails and subungual debris. A nail biopsy was sent and LFT's were obtained. The biopsy was PAS positive and LFT's were found to be within normal limits. The patient was diagnosed with onychomycosis and placed on a 12-week regimen of terbinafine 250mg daily and was instructed to return to the clinic for repeat LFT's mid treatment. At the 6-week exam, the patient appeared to have proximal nail clearing. OCT imaging showed that areas of the distal nail affected by the condition clearly contrasted to the areas of healthy proximal nail.

The distal areas showed distinct hyper-reflective patches corresponding possibly to the fungal growths or onycholysis and debris as a result of the dermatophytes present in the nail. The areas approaching the proximal nail bed showed gradual decrease in hyper-reflectivity and the nail closest to the cuticle demonstrated only normal nail anatomy, indicating possible areas of clearance due to treatment.

There appears to be a clear distinction between areas that were affected by onychomycosis and areas that were normal with OCT. This may indicate that with further studies, this technology could potentially be an important, non-invasive diagnostic tool for nail disorders. OCT may also, potentially be used to assess treatment efficacy by measuring clearance rates, as demonstrated in this case.



Figure 1. Clinical presentation of onychomycosis. Note yellowing of the fingernail and subungual debris.

## OCT IMAGES – MID TREATMENT

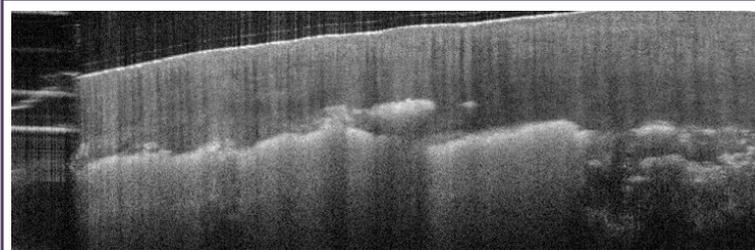


Figure 2. OCT image demonstrating hyper-reflective patches in the distal nail, 6-weeks post treatment with terbinafine.

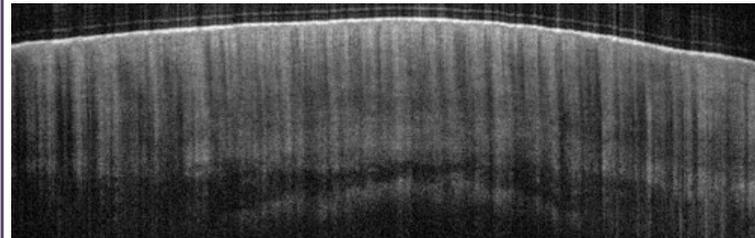


Figure 3. OCT image of mid-nail showing absence of hyper-reflective areas, 6-weeks post treatment with terbinafine.

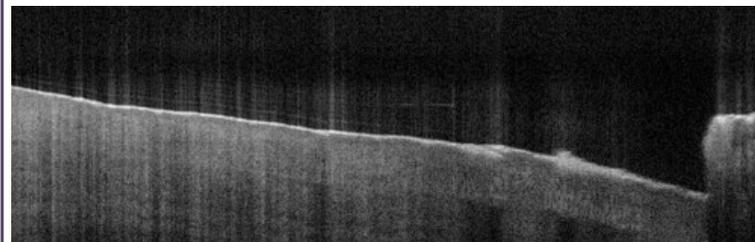


Figure 4. OCT image of nail bed showing clearance extending proximally, 6-weeks post treatment with terbinafine.

## REFERENCES

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## OPTICAL COHERENCE TOMOGRAPHY



Optical coherence imaging (OCT) is a non-invasive imaging technique that allows visualization of the structures located in the epidermis and superficial dermis of skin (up to 2mm), in vivo. OCT works analogously to a sonogram but uses a fiber-optic interferometer with a low-coherence length light source, instead of ultrasound waves.<sup>2</sup> The image is created by taking advantage of the scattering properties of light in tissue to outline cell structures and the short-coherence length permits high spatial resolution for visualization of finer details.<sup>3</sup>

The images produced are similar to histology, in that they allow for a cross-sectional view of the tissue being examined. For the diagnosis of NMSC versus normal skin, OCT has a sensitivity of 79%-94% and a specificity of 85%-96%.<sup>4</sup>

## DISCUSSION

The diagnosis of nail disorders is usually a clinical judgment, although biopsies and scrapings can be performed and dermoscopy is becoming a common practice. OCT is being studied as a diagnostic tool for nail disorders, and the morphological characteristics of normal nails have been documented.<sup>5</sup> For example, OCT was able to demonstrate changes seen in subungual hyperkeratosis, such as inhomogeneous thickening in the ventral plate, in the diagnosis of psoriatic nail disorder.<sup>1</sup>

This case shows the potential utility of using OCT in the clinic. On presentation, the patient demonstrated clinical signs of onychomycosis (Figure 1) which was confirmed by PAS positive biopsy. Onychomycosis is a particularly difficult infection to eradicate and OCT proved to be a valuable tool in assessing progress. At his 6-week follow up, OCT was used, in addition to clinical observation, to confirm the effectiveness of terbinafine treatment. Onychomycosis presents as hyper-reflective patches on OCT imaging (Figure 2) and it is distinct from normal nail (Figure 3-4). OCT provided the ability to distinguish areas of the infected nail that were effectively treated from those that were cleared, microscopically. This highlights the potential utility of using OCT to monitor treatment courses, especially on difficult to treat areas, such as the nail.