

## Innovative intra-operative rapid detection test for visualisation of mucor

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In this manuscript, we report a rapid intra-operative detection test for visualisation of mucor, with the use of the Smartphone-based intraocular lens microscope (IOLSCOPE). IOLSCOPE helps not only in detecting tissue affected by mucor, but also makes sure that the surgeon does not leave any fungus behind; similar to the principles employed by a 'Frozen section' in conventional general surgery. In the technique proposed by us, we have used an undigested tissue sample, to quickly diagnose mucor, intra-operatively. Thus, in view of tackling the COVID-19 and mucor duplex, IOLSCOPE can be considered by ophthalmologists and otorhinolaryngologists for its rapid screening property, convenience of ease, good quality images and cost effectiveness.

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Rhino-orbital-cerebral mucormycosis (ROCM) is a fatal infection, causing a threat to vision and life.<sup>[1]</sup> Fungal infections secondary to COVID-19 have shown doubling of mortality (35%–66%) with a delay of 6 days of treatment initiation.<sup>[1,2]</sup> Diagnosis of mucor is based on - direct microscopy of KOH mount, culture, serology, polymerase chain reaction (PCR), histopathological/microbiological confirmation of intraoperative surgical debridement tissue via functional endoscopic sinus surgery (FESS), and orbital exenteration. Surgical debridement helps in reducing disease burden and drug penetration, arrests disease spread, and provides intraoperative samples for histopathology/microbiological examination.<sup>[3,4]</sup> Smartphone-based intraocular lens microscope (IOLSCOPE) is an innovative point-of-care (POC) diagnostic device that helps in detecting fungal hyphae. It is a do-it-yourself device that uses four 30-D adhered intraocular lenses attached to the smartphone camera that can be used as a microscope.<sup>[5]</sup>

### Innovation

Suspicious tissue samples collected during FESS/orbital exenteration are usually sent for identification of fungal

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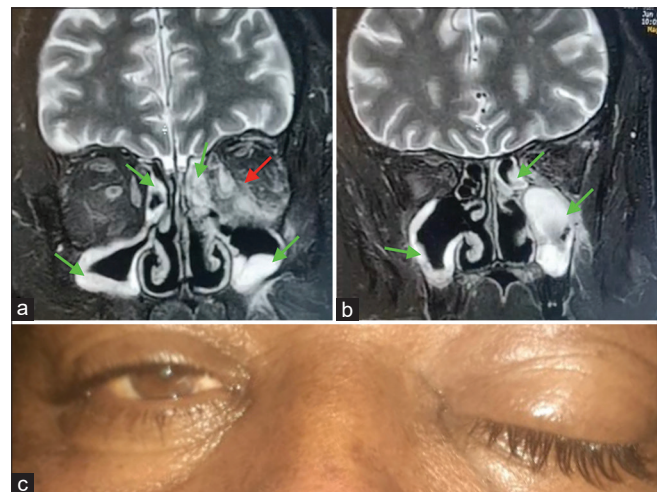
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**Figure 1:** (a) T2-weighted MRI image showing orbital soft tissue involvement (red arrow) in the left side with maxillary sinus and anterior ethmoidal sinus involvement in both sides with mucormycosis (green arrows). (b) T2-weighted MRI image showing involvement of left ethmoidal sinuses and both maxillary sinuses with mucormycosis (green arrows). (c) Image of a 45-year-old male patient presenting in the post COVID-19 recovery period with left eye ptosis, proptosis, and chemosis with restriction of extraocular movements

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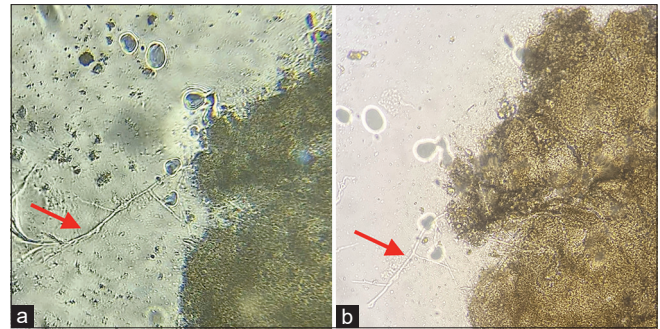


**Figure 2:** (a) Image showing functional endoscopic sinus surgery done for debriding the necrosed mucosa along with the infected tissue. (b) Immediate analysis of the debrided tissue under the IOLSCOPE in the operating room

hyphae to the microbiological lab, which is expensive, time-consuming, tedious, and labor-intensive. During a FESS surgery conducted on a patient [Fig. 1] with suspected ROCM, the debrided specimen was placed on a KOH-mounted slide. Examination of the slide with the IOLSCOPE [Fig. 2] showed the presence of mucor hyphae at the edge of the tissue [Fig. 3a], which was conducted simultaneously with the surgery in the operating room [Video Clip 1]. It also helped in detecting left-over fungal tissue during the surgery. The specimen was also sent to the microbiology lab for confirmation [Fig. 3b] after the surgery.

## Conclusion

The main purpose of this setup was to highlight the use of IOLSCOPE in tackling the COVID-19 and mucor duplet by ophthalmologists and otorhinolaryngologists as a reliable screening tool for rapid detection of hyphae for prompt treatment bypassing laboratory-based examination. It is also beneficial in clinics/hospitals devoid of laboratory setups and gives access to an expert opinion by microbiologists via telemedicine. While this technique is important for rapid intraoperative diagnosis to initiate treatment and determine surgical clear margins, microbiology and histopathology are still necessary to confirm the diagnosis, detect infection with



**Figure 3:** (a) Image of debrided tissue under the IOLSCOPE on a potassium hydroxide (KOH) mount showing filamentous fungi (red arrow) adjacent to a black mass of undigested tissue. (b) Image of the same tissue under light microscope showing filamentous fungi (red arrow) adjacent to a black mass of debrided tissue

more than one pathogen, identify species, and determine sensitivity to medications.

## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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## Conflicts of interest

There are no conflicts of interest.

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