**High throughput, label-free cellular viability measurement by optical coherence tomography**

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**Background**

Cell therapy, boosted by recent advances in culture technology, has emerged as a promising approach for repairing damaged tissues and curing diseases.

Viability measurement is a critical quality control step in cell therapy manufacturing to ensure the used cells are alive and functional for therapeutic purposes [refs].

However, traditional gold-standard methods, such as trypan blue and fluorescent staining, suffer from low throughput and are prone to manual errors, as they sample only a small fraction of the total cells in a bioreactor.

Moreover, the reliance on labeling increases the risk of contamination.

Thus, a label-free, high-throughput, and viability-sensitive detection method is urgently needed by the pharmaceutical and biomedical fields.

Optical coherence tomography (OCT) has gained attention in biological imaging due to its non-invasive, high-resolution, and 3-dimensional (3D) imaging capabilities.

Recent studies have demonstrated its potential in assessing tissue viability, suggesting its suitability for drug studies and cell-based applications [refs].

In this study, we propose a high-throughput, high-resolution, and label-free approach to cell viability measurement using OCT.

Unlike traditional methods, this technique provides real-time viability estimation with no contamination risk, making it a powerful tool for cellular assessment and advancing manufacturing workflows.

**Methods**

Viability measurement using OCT was demonstrated on a commercial Jurkat cell line (JCRB0147 JKT-beta-del, JCRB, Osaka, Japan).

The cells were thawed from frozen stock and transferred to a 2 mL AT-closed vial (Aseptic Technology, Gembloux, Belgium) for measurement.

OCT scanning was performed externally through the vial.

To simulate cell death, hydrogen peroxide was added to the vial, and measurements were repeated after two hours.

A commercial OCT system (IVS-800, Santec, Komaki, Japan) with a spatial resolution of 5.8 μm laterally and 2.9 μm axially was used.

A repeated raster scanning protocol captured 3-D OCT data volumes with a size of 500 μm in lateral and 1500 μm in depth directions.

The cross-sectional scanning rate was 50 Hz, and a complete volume was acquired in 60 seconds.

Temporal signal intensity fluctuations across the 3-D volume were analyzed in post-processing to estimate cell viability.

Results were encoded into HSV color space for visualization and intuitive comparison.

**Results and conclusions**

Results showed that the estimated viability significantly decreased after cell death induced by hydrogen peroxide.

The method successfully allowed individual cell viability assessment within the 3D volume.

