Viability Classifier Powered by Deep Learning
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The technique could be applied in various
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For infertility treatment, the technique could
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For male infertility diagnosis, the technique
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Figure 4
Exploration of prediction results and attention mechanisms
Figure 1 Collection of semen dataset from
10 patients. (1) Staining of dead and live
cells using fluorescent dyes, with dead
cells stained red and live cells stained
green. (2) The collected sperm dataset
(813 dead sperm + 658 live sperm).

Figure 2 The YOLO v5 algorithm is used for sperm detection. (1) Detection results
of the algorithm. (2) Dividing the sperm
dataset into training: validation = 8:2, the
training results achieved 94.8% detection
accuracy. By optimizing the dataset, the
algorithm is made reproducible in real
medical scenarios with a consistent
accuracy of over 90%.

Figure 3 A Vision Transformer was trained
to predict sperm viability information from
images. The ground truth (live/dead) was
obtained from fluorescent labeling.

Figure 5 The technique could be applied in various
scenarios, from infertility diagnosis to IVF
treatment.
(1) For infertility treatment, the technique could
facilitate embryologists in picking live sperm
from surgically retrieved sperm samples where
most sperm are immotile.
(2) For male infertility diagnosis, the technique
could be used as an add-on module to current
sperm analysis systems to provide instant sperm
viability without tedious staining process.

Conclusion
- We tested and confirmed the hypothesis that microscopic images of immotile sperm inherently contain viability information;
- The developed ViT model enables the non-invasive prediction of sperm viability using a single image (at one glance);
- The ViT model is able capture subtle morphological changes in sperm nucleus that humans may not be able to reveal.

Potential Clinical Applications

Method & Result

Dead/live sperm dataset

Highly reproducible sperm
detection algorithm

ViT-based algorithm for sperm
dead or live prediction

Viability Classifier Powered by Deep Learning

Background
About 20 percent of couples worldwide suffer from infertility, and more than 50 percent of them are due to male
reproductive dysfunction. One of the main causes of male infertility is azoospermia. This type of patient has no sperm in
the semen and is unable to fertilize oocyte through normal sexual intercourse. The infertility problem can be effectively
resolved through IVF, a clinical treatment that involves the collection of sperm through epididymal or testicular puncture.
The selection of high quality sperm is crucial. However, when a sperm is not swimming, it is challenging to judge
whether the immotile sperm is viable or not. We hypothesize that sperm viability information can be reflected by a
sperm’s morphology in microscopic image. This study aims to test the hypothesis and to develop an AI-based technique
to non-invasively predict the viability of immotile sperm using a single image, without invasive sample processing.

Statistics

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<th>Recall</th>
<th>Specificity</th>
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Figure 1

Figure 2

Figure 3

Figure 4

Figure 5