A SMART VITRECTOR equipped by a fiber-based OCT sensor mitigates intentional attempts at creating iatrogenic retinal breaks during vitrectomy in pigs

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Purpose

- **Iatrogenic retinal breaks (IRB)** is a pars plana vitrectomy (PPV) complication that compromises the overall efficacy of the surgery.

- A **subset of IRB** occurs when the retina is **cut accidentally** by the vitrector.

- We developed a **smart vitrector** that **detects in real-time potential IRB** and activates promptly a PPV machine response **to prevent them.**

Methods

- We fabricated the **smart vitrectors** by attaching a miniaturised fiber-based **OCT sensor** on commercial vitrectors (25G).

- It provides real-time feedback to the PPV machine and **requires no visual or audio** signal interpretation by surgeons.

Validation

- The system's **response time** to an IRB onset was measured and compared to that of the average surgeon.

- Two surgeons validated its ability to **prevent simulated IRB** by performing PPV in 2 pigs.

- IRB scenarios were simulated by aggressive approaches of the smart vitrector towards a detached, mobile retina with an intention to injure ("bite") it.
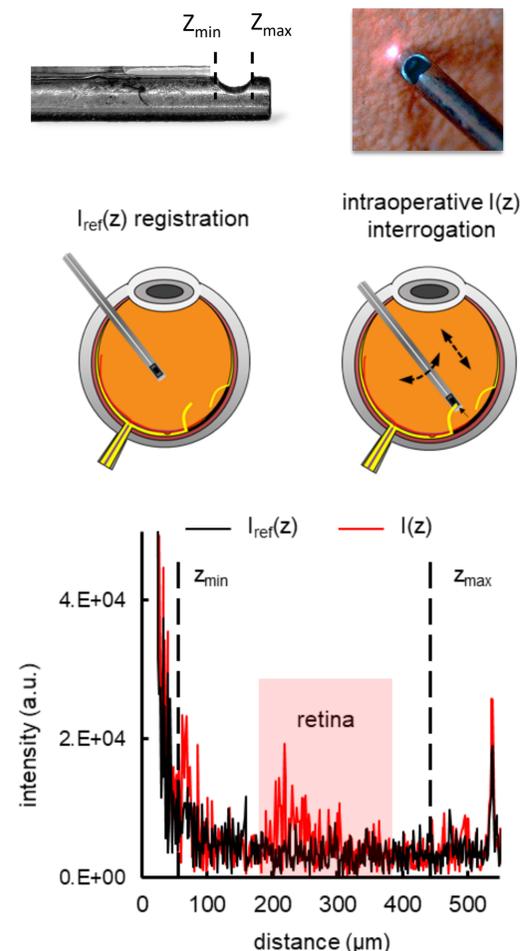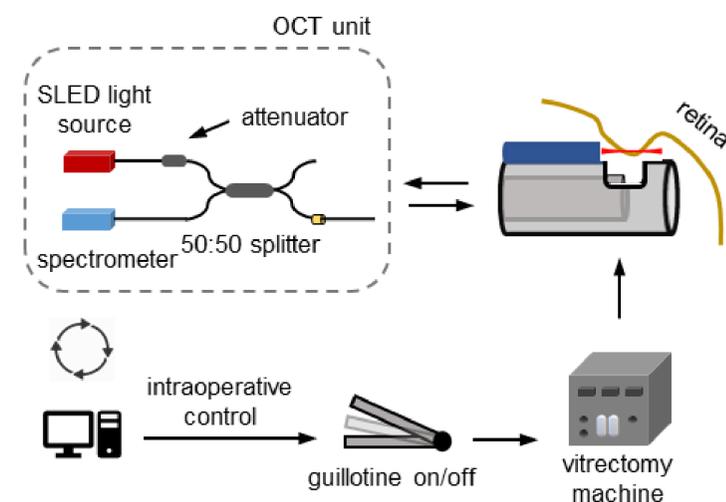
Results

- The response time of the system (28.9 ± 6.5 ms) is 12-times shorter compared to that of an average surgeon (p < 0.0001)

- Indicatively, for 5000 cpm, "post-deactivation decision" cuts can be **reduced from 33 "cuts"** (average surgeon) to **2.4 "cuts"** (smart vitrector).
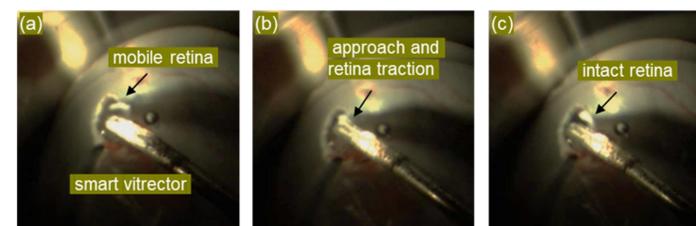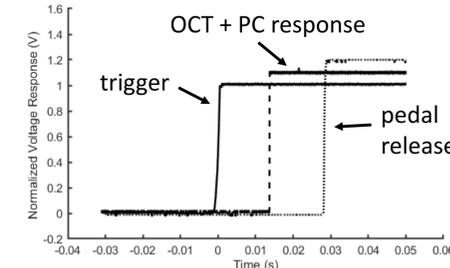
- Of the 54 trials to exert damage to the retina, 3 (5.56%) resulted in damage, damage was prevented in 30 (55.56%), prevented or mitigated in 38 (70.37%), while the procedure was terminated early (false positive) in 13 (24.07%)

- **92.68% success rate** (95% CI: 80.08 − 98.46) **when not considering false positives or 70.37% (**38/54) (95% CI: 56.39 − 82.02) **using a 'false positive equals failure' approach.**

Conclusions

- The smart vitrector can **mitigate a subset** of IRB in PPV.
- It is **compatible** with the established PPV procedure and instrumentation.

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