

L.9: Feasibility of speckle variance OCT for imaging cutaneous microvasculature regeneration

It is widely accepted that apart from structural information, information on vascular remodeling can help in more accurate assessment of wound healing. Speckle variance OCT (SVOCT) makes use of the temporal fluctuations in the intensity of light backscattered from the tissue for noninvasive monitoring of tissue microvasculature. An in-house SVOCT system, developed at LBAS, RRCAT was used for *in-vivo* monitoring of healing of punch wounds in ear pinna of diabetic mice. A schematic of the developed swept source based SVOCT setup is shown in Figure L.9.1. The details of the system and experimental procedure can be found in Laser Physics 28, 025601(1-6) (2018).

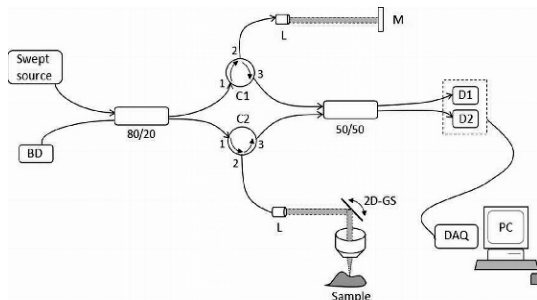


Fig. L.9.1: Schematic of SVOCT setup. C1, C2: Circulators; D1, D2: Balanced photodetector; L: Lens; M: Mirror; DAQ: Data acquisition card, PC: Personal computer, 2D-GS: Two dimensional galvanoscanner, BD: Beam dump.

SVOCT imaging of the mice ear pinna was carried out prior to creation of punch wound and at three different time points post wound (p.w.) namely 1 hour p.w., 14 day p.w. and 30 day p.w. Figure L.9.2 shows the typical cross-sectional intensity image for a mice ear pinna. The different layers like epidermis and cartilage and the presence of blood vessel has been marked by white arrows. Figure L.9.3 shows the cross-sectional intensity images (row 1), photographic images (row 2) and *en-face* microvasculature images (row 3) acquired over the wound site at different time points. These intensity images were acquired across the maximum wound size. The black dashed lines in the cross-sectional intensity images indicate the demarcation between the ear and the double sided tape on which the ear was stabilized. Well defined epidermal and dermal layers can be seen from the cross-sectional intensity images. While the combined thickness of these two layers was ~ 150 μm prior to wound creation, at 1 hour p.w. this thickness increased to ~ 210 μm, further increasing to ~ 300 μm by day 14 p.w. This thickness continued to be around ~ 300 μm at 30 day p.w. even when the wound had closed. While the wound might have closed at day 30 post punch, the collagen in the

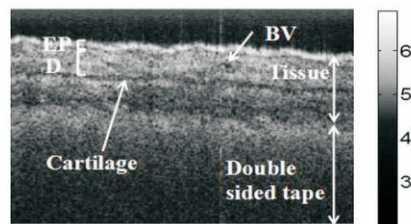


Fig. L.9.2: Typical OCT intensity image for a mice ear. EP: Epithelium, D: Dermis, BV: Blood vessel. Image dimension: 1.6 mm (H) x 1.6 mm (V).

dermal layer and the cartilage that gets ruptured due to punch do not remodel completely by this time.

The common imaged areas have been marked by red dashed rectangles in the *en-face* microvasculature images (3rd row) and it can be observed that at 1 hour p.w., the vasculature is completely lost in the vicinity of wound area (shown by orange circle). As the wound heals, some fine capillaries start to grow in and around the punch affected zone. The blue circles show a vessel segment that gets damaged at 1 hour p.w. and starts regenerating around 14 days p.w. and is completely restored at 30 days p.w. The presence of signal rich areas (as shown by black ovals) is probably due to the damage to the vasculature and the resulting extravasation of fluid. The findings from the current investigation suggest that SVOCT measurements on vascular remodeling can be used to study the effects of potential therapeutic agents that can alter angiogenesis in wound healing.

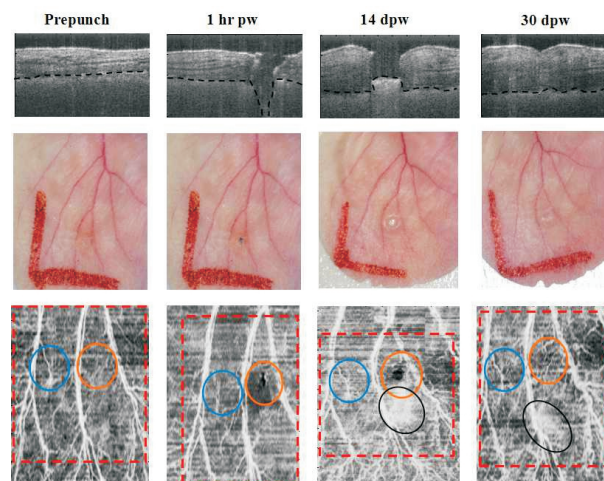


Fig. L.9.3: OCT intensity images (row 1), photographic images (row 2) and *en-face* microvasculature images (row 3) acquired at different time points. Image dimensions: 1.5 mm (H) x 1.5 mm (V) (for row 1); 3 mm (H) x 4.5 mm (V) (for row 2 and 3).

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