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ParaTex NTF

FNSNF

Photonic textile to detect the risk of pressure ulcer development

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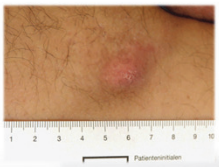
Introduction

Skin breakdown and pressure ulcers continue to be disturbingly prevalent in paraplegics. Quantitative information about the physiological changes of skin together with the amount and duration of the applied pressure leads to early and individual protection strategies. However, collecting this piece of information remains a challenge due to the vulnerability of paraplegics to conventional inflexible measuring instruments. In this paper we present a safe and novel technique based on wearable photonics to constantly monitor oxygenation, perfusion, and pressure in paraplegics.

Oxygenation and perfusion

Insufficient oxygenation / perfusion → deep tissue necrosis → pressure ulcer
Early detection of blood circulation malfunction → no necrosis → no pressure ulcer



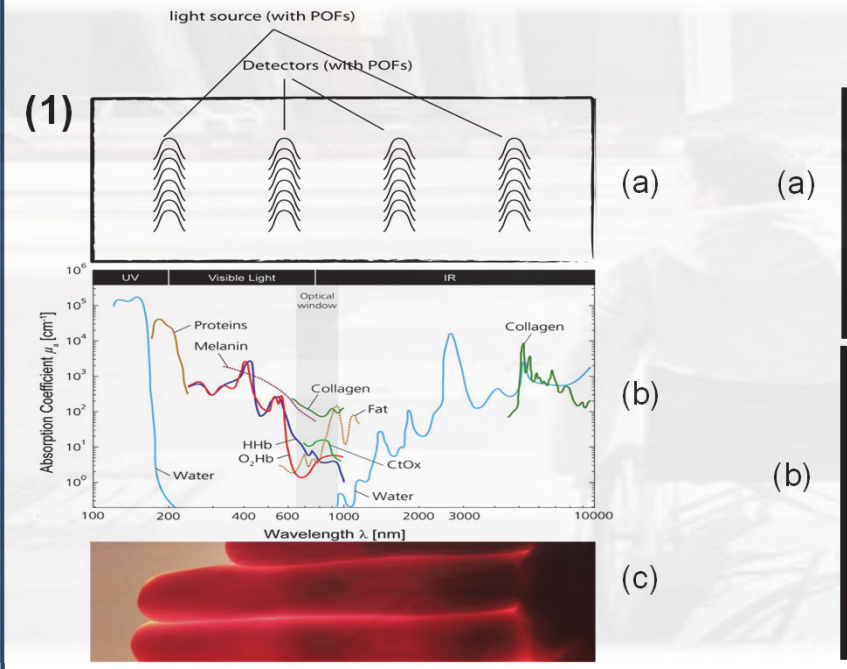


Figure 1. Woven optical fibers as light sources and detectors (a). Absorption spectra of oxy/deoxy hemoglobin (b). Transmission of light through the tissue in the optical window (c).

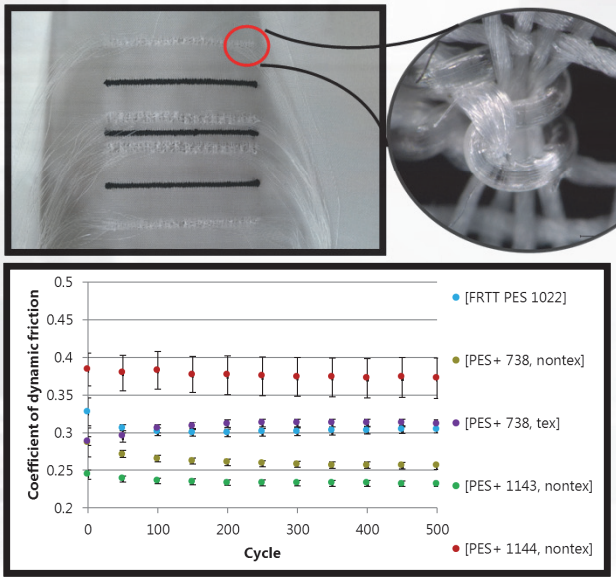


Figure 2. Stitched optical fibers into textile (v-stitch) (a). Friction analysis (500 cycles, 5N). Coefficient of dynamic friction (b).

Pressure

Healthy subjects → subtle movements → no pressure ulcer
Paraplegics → lack of movement → pressure ulcer

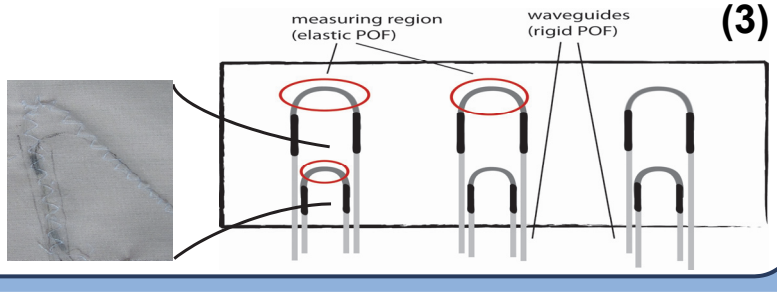


Figure 3.

- Sewn elastically deformable light pipes
- Reaction to pressure by deflecting light in the fiber
- Signal loss: 0.16 – 0.25 dB/cm