

## Illumination profile characterization of a light applicator

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**Background:** When surgery is part of a multimodal treatment for malignant pleural mesothelioma, an aggressive tumor of the pleura, it is crucial to combine it with a local adjuvant treatment to kill residual tumour cells. Recently, intrapleural photodynamic therapy (iPDT), has emerged as a promising treatment, with major impact on survival and minimum toxicity [1]. Complete and homo geneous illumination of the pleural cavity is essential to the success of iPDT, but remains a challenge. Knowing the repartition and prop-agation of light around the light device could be the first step towards optimizing dosimetry. Here we propose a characterization method of the illumination profile of a specific light device.

**Methods:** The light wand was made of a cylindrical diffuser (Medlight® S.A. Switzerland) located inside an endotracheal tube and connected to a medical diode laser  $635 \pm 3$  nm (Ceralas®, Bio-litec). The wand was fixed horizontally in a tank filled with dilute 0.01% intralipid. Light dosimetry was performed around the tip of the wand using two complementary methods: accurate measure-ments of light power (nW) with an isotropic probe (Medlight®) connected to a wattmeter (Newport® 841-PE) and measurements of pixel intensity with digital photography. An effective attenua-tion coefficient ( $\mu_{\text{eff}}$ ) was to be defined. Fluence rate measurements were to be confronted with those of a  $1 \text{ cm}^2$  flat sensor located at the device's surface.

**Results:** The experimental measurements obtained with the isotropic probe allowed to estimate an effective attenuation coef-ficient  $\mu_{\text{eff}} = 0.56 \text{ cm}^{-1}$ . Combined with the photography's spatial representation, a theoretical illumination profile was established: it showed an ellipse-shaped illumination with iso-surfaces of flu-ence rate, defining a gradient light dose according to the distance from the diffuser. For instance, 20% of light power is delivered at 23 mm from the center of the diffuser. Fluence rate obtained with the flat sensor at 14 mm from the diffuser ( $0.023 \text{ W/cm}^2$ ) matched the one calculated from the illumination profile ( $0.02 \text{ W/cm}^2$ ). This work has also been transposed to the same light device, but with a bare optical fiber (FiberTech®), also used for iPDT.

**Conclusion:** A theoretical illumination profile of a light wand for iPDT was established and could be used in the future to improve peroperative dosimetry, as part of a spatial tracking system.

### Reference

[1] J.S. Friedberg, Ann. Thorac. Surg. 91 (6) (2011) 1738–1745.

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