

Optimising 405 nm hins-light technology for patient safe decontamination during arthroplasty surgery

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INTRODUCTION:

Infection rates following orthopaedic arthroplasty surgery are as high as 4%, while the infection rates are even higher after revision surgery ¹. The duration of routine arthroplasty surgeries is typically between 1 and 2 hours. 405nm High-Intensity Narrow-Spectrum Light (HINS-light) has bactericidal activity against Hospital Acquired Infection (HAI) related bacterial pathogens including MRSA ² and hence may aid in reducing the incidence of infections that arise from environmental contamination during arthroplasty surgery.

METHODS:

Immortalised rat osteoblast (OST 5) cells were exposed to 405 nm light at an irradiance of 5mW/cm² in Dulbecco's Phosphate Buffered Saline (DPBS) at different dose rates (18, 27, 36 and 45J/cm²) at 37°C and 5% CO₂. Unexposed controls were treated in the same way. After 48 hours post treatment, cell viability (MTT assay), cell function (ALP assay) and cell proliferation rate (BrdU assay) were measured. Live/Dead cell staining was carried out using Acridine Orange/ Propidium Iodide (AO/PI) dyes after 48 hours post light treatment. Statistical analysis was performed using unpaired Student t-test and differences considered significant when p<0.05.

RESULTS:

After 48 hours post light treatment, no significant difference was observed between the unexposed and 405 nm treated samples for up to a dose rate of 36J/cm² in cell viability, function and proliferation rate (fig 1.a). More apoptotic and dead cells were observed for the 45J/cm² exposed samples compared to the 36J/cm² exposed samples (fig. 1.b).

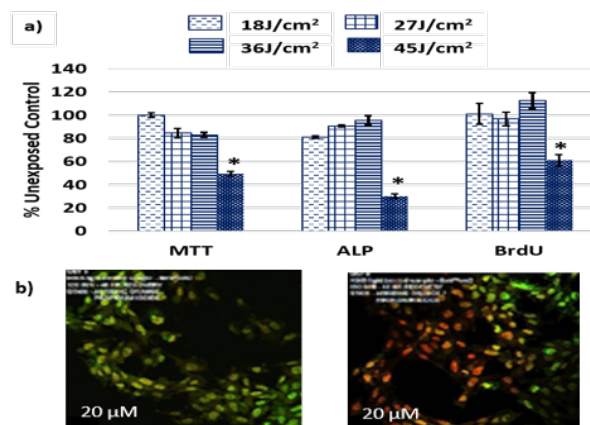


Fig 1. (a) Effect of 405 nm light treatment at 5mW/cm² on OST 5 cell response parameters after 48 hours incubation, (b) AO/PI staining. Left – 36J/cm² and Right – 45J/cm² of 405 nm light treatment after 48 hours incubation. AO (live - green, apoptotic- orange), PI (dead -red).

DISCUSSION & CONCLUSIONS:

From the quantitative and qualitative studies, it is found that the cells were healthy for up to a dose rate of 36J/cm² (5mW/cm² for 2 hours) whilst cell death became evident with doses of 45J/cm². These results suggest that exposure to a dose of 36J/cm² may be suitable for use for continuous decontamination during orthopaedic surgery whilst being safe for tissue exposure.

REFERENCES:

1. H. Hamilton, J. Jamieson (2008), *Canadian Journal of Surgery*. 51(2): 111-117.
2. M. Maclean et. al. (2009), *Applied and Environmental Microbiology* 75(7),1932– 1937.

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