Wearable LLLT Device for Burn Wound Therapy

Dustin Luong, Renzo Calilung, Frederich Pinardo, Temi Jekayinfa

Introduction

Annually, 1.1 million individuals in the United States sustain burn injuries, with half requiring medical attention. Our innovative low-level light therapy (LLLT) wearable device aims to boost cellular regeneration and expedite recovery times for burn patients. Accelerated recovery time may reduce the likelihood of infections, minimize discomfort, and reduce hospital stays and costs for severe burns. Although current LLLT devices claim to promote wound healing, they are often bulky, expensive, and primarily marketed for beauty or health purposes. These devices are poorly constructed and do not emit sufficient light to achieve the desired effect. Our team’s disposable and wearable design targets the at-home user and burn care centers. The device must feature an intuitive design, as our aim is to appeal to at-home users. Furthermore, we strive to create a wearable, effective, and affordable product, unlike existing LLLT devices.

Design

Design Criteria

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Our specified guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wavelength</td>
<td>Red or near infrared range</td>
</tr>
<tr>
<td>Duration</td>
<td>Several hours</td>
</tr>
<tr>
<td>Heat</td>
<td>40°C or 104°F</td>
</tr>
<tr>
<td>Portability</td>
<td>Lightweight and flexible</td>
</tr>
<tr>
<td>Fluence</td>
<td>2-5 J/cm²</td>
</tr>
<tr>
<td>Irradiance</td>
<td>40°C or 104°F</td>
</tr>
</tbody>
</table>

Design Validation

- **Design verification Methods**
  - **Wavelength**: Use spectrometer to analyze light flux
  - **Duration**: Perform burn-in tests over period of 10 hours
  - **Heat**: Thermometer utilized to ensure device does not overheat
  - **Fluence**: Lux meter and image processing program (image j)
  - **Irradiance**: Lux meter and image processing program (image j)

- **ISO Standards**
  - ISO 10993 Biological evaluation of medical devices
  - ISO 14971 Medical devices – Application of risk management to medical device
  - IEC 60601-11 Basic Electrical Safety for Home Health Devices
  - IEC 60601-2-57 Basic Safety Of Essential Performance Of Non-Laser Light Source Equipment
  - IEC 60601-2-63 Basic Safety And Essential Performance Of Non-Light Therapy Equipment
  - IEC 62471 Photobiological Safety Of Lamps And Lamp Systems

Project Goal

- Fabrication of multi-layer soft circuit device that is able to deliver optimal LLLT treatment for therapeutic effects on grade 1 or 2 radiation dermatitis [1]
- Design validations and verification testing of manufactured prototype

Timeline

Spring Quarter

- Final Prototype Design
- Final Prototype Creation
- Design Testing
- Final Device Adjustments
- Market Interviews
- NCS Board Room Pitch
- Final Presentation/Prep
- Device Showcase

References


Acknowledgements

- Special thank you to Bioendine and the Beckman Laser Institute
- Dr. Preece - Department of Biomedical Engineering