3D Printed Thermal Powered Laryngoscope

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Introduction: Laryngoscopes are a fundamental and necessary piece of equipment used by every anesthetist on a regular basis. They are a mechanically simple piece of medical equipment, but rely heavily on a properly functioning light source. Current models consist of a metal/plastic handle that encases a halogen/LED light powered by a disposable/rechargeable battery. The handle is designed to allow the attachment of multiple different blades for intubating patients of various ages and anatomical differences. Although laryngoscopes are often available in developing countries, antidotal evidence suggests they are often missing a functional light source. Anesthesia in developing countries must take into account local conditions and whether reliable supplies such as batteries or electricity are readily available. Only 34% of hospitals have reliable electricity access in sub-Saharan African countries and therefore Laryngoscopes with rechargeable batteries would not be a reliable option[1]. Alternatively, lower cost LED laryngoscopes are becoming much more widely available, but batteries are expensive, often difficult to attain and deteriorate through use and over time. In addition, used batteries that are not properly recycled lead to toxic effects on the environment and potentially harmful consequences to the surrounding communities. Therefore, the aim of this research is to develop a low cost 3D printed laryngoscope with a completely green, clean and renewable light source that is powered only by thermal energy produced by the user's hand when holding the laryngoscope.

Materials and Methods: The device contains an external 3D printed shell that is designed to contain at least one thermoelectric generator (Peltier Tile) extending through an open portion of the exterior for direct contact with the users hand in order to extract the maximum heat from the users left hand. The inner surface of the thermoelectric generator is attached to an aluminum heat sink with multiple cooling channels in order to optimize the temperature gradient across the thermoelectric generator. Integrated circuitry consisting of a commercially available step-up transformer and transistor oscillator in direct electrical communication with both the thermoelectric generators and the light source are housed within the handle.

Results: Optimization has included increasing the number of tiles in sequence in order to reach a maximum brightness of 204.1 ± 11.7 Lux using 4 tiles. Time decay was linear with the average initial brightness of 193.8 ± 40.1 Lux decreasing to 142.3 ± 27.3 and 103.4 ± 20.7 at 60 sec and 120 sec respectively. Further optimization includes handle design and heat sink optimization.

Reference:

[1] Adair-Rohani H, Zukor K, Bonjour S, Wilburn S, Kuesel AC, Hebert R, Fletcher ER: Limited electricity access in health facilities of sub-Saharan Africa: a systematic review of data on electricity access, sources, and reliability. Glob Health Sci Pract 2013,1:249–261