

Management of pain and recovery at point-of-care in acute sports and industrial injuries using PBM

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Background

Following a blow to the muscle, a muscle contusion often develops leading to a hematoma, a loss of activity, or a decrease in the ability to perform activities of daily living. Many strategies including ice massage, manual massage, therapeutic ultrasound, and anti-inflammatory drugs have been used to decrease symptoms of muscle contusions. Recently, an increase in research has been conducted to understand the influence photobiomodulation on symptoms of muscle damage. We are of the opinion that photobiomodulation using a combination of pulsed blue 450 nm and red 630 nm light using a printed flexible LED light patch and hydrogel interface, can have a positive impact on this type of injury.

Methods

Our study was approved by the BYU Institutional Review Board. Each participant report to our lab where they were screened for the study eligibility criteria and then provided informed consent. Each participant had a photo taken and a MSK imaging ultrasound scan of the proposed injury site over the anterior thigh to measure the qualities of the target tissue. Participants then reported to the tennis courts for the muscle contusion protocol. Using a tennis ball-serving machine, participants were hit with a tennis ball in the belly of the quadriceps muscle.[1] The tennis ball traveled at 136 kilometers/hour, for 26 cm until it struck the target tissue. Each participant then performed 10 squats and marked a 100 mm visual analog scale to mark their level of pain. Participants returned to the lab where a follow up photo was taken, followed by MSK imaging ultrasound. Each participant then received a 30 minute active or placebo PBM treatment using a printed LED flexible blue and red light at a peak irradiance of 9mW/cm², 33% duty cycle, and fluence of 5.4 J/cm². Immediately after the treatment participants complete 10 squats and marked their pain on the visual analog scale, had a photo and scan using MSK imaging ultrasound of the injury site to determine the extent of the injury and the tissue compliance. Every day for four more days, participants returned to the lab where they were treated with either the active blue-red light patch or placebo "infrared" patch. Pre and post measures of pain, photography, and MSK imaging ultrasound were obtained.

Results

Based on initial observations on 36 subjects, we observed a more rapid decrease in pain, improved acceleration of healing based on the color transition of the bruise and a reduced muscle hardness on the subjects treated with the blue-red light patches as compared to the placebo. We are continuing the study and will provide appropriate statistical analysis as part of our presentation; however, the data appears compelling that the bruising and tissue compliance measures are definitive in favor of the active blue-red light therapy. We are also evaluating the use of hyperspectral imaging [2] as an added assessment tool.

Conclusion The use of a flexible printed blue 450nm and red 630 nm LED light patch applied using a conforming hydrogel light guide adhesive provides a promising therapy for the immediate treatment after an acute contusion injury. This provides the potential for an immediate point of care treatment for accelerated recovery in sports and industrial injury.

References

1. Hawkins J. Athletic Injury Management Models in Humans. J Athl Enhancement 2014;3(5)
2. Vidovič L, Milanič M, Randeberg LL, Majaron B. Quantitative characterization of traumatic bruises by combined pulsed photothermal radiometry and diffuse reflectance spectroscopy. Proc. SPIE9303, Photonic Therapeutics and Diagnostics XI, 930307. 2015 Feb 26; DOI: 10.1117/12.2077188

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