

## **The Effect of Photobiomodulation on Healing and Pain Relief of Quadriceps Muscle Contusions.**

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**Introduction:** Following a blow to the muscle, patients often get muscle contusions. This will often lead to hematoma, loss of activity, or decreased ADL. 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:** 24 men and women aged (18-35), were randomly selected to be in the treatment or sham group. The treatment group received Photobiomodulation for 30 minutes every day for five days at a fluence of  $5 \text{ j/cm}^2$  and irradiance of  $3 \text{ mW/cm}^2$ , pulsed at a 33% duty cycle at a frequency of 33 KHz, using a combination of blue 450 nm and red 630 nm, produced using a flexible printed LED substrate. The sham group received a mock treatment. Each subject had a photo taken of the area to be contused, and had imaging ultrasound applied to the proposed injury site. Subjects reported to the tennis courts for the muscle contusion protocol. Using a tennis ball-serving machine, subjects were hit with a tennis ball in the belly of the quadriceps muscle. The ball traveled at 136 kilometers/hour, for 26 cm until it struck the target tissue. Each subject then performed 10 squats and filled out a visual analog pain scale. Subjects then returned to the lab where a follow up photo was taken, followed by imaging ultrasound. Each subject then received either placebo 30 minute Photobiomodulation treatment or an actual Photobiomodulation treatment at the parameters previously listed. Every day for four more days, subjects returned to the lab where they were treated with either a placebo protocol or the treatment protocol.

**Results:** Based on initial observations on 24 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 placebo. We are continuing the study and will provide statistical analysis as part of our presentation, however the data appears compelling that the bruising and tissue compliance measures are definitive in favor of blue-red light therapy. We have added the use of hyperspectral imaging to evaluate the transition of the various stages of bruising and will report the data at the conference.

**Conclusion:** The use of a flexible printed LED light patch, which conforms to the body surface, using blue 450nm and red 630 nm applied using a hydrogel light guide adhesive, provides a promising therapy for the immediate treatment of pain, acute injury and contusion.

**Statements:** There is no conflict of interest in this study.