CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
Dylan H. Eremia

Project Number
31518

Project Title
Hemoglobin Assisted Laser Lipolysis

Abstract

Objectives/Goals
Determine feasibility of a novel concept of non-invasive lipolysis with a 1064nm Nd:YAG laser, a skin penetrating wave-length, far better absorbed by hemoglobin then skin and fat. Investigate if injection of a little blood, will selectively increase fat absorption of 1064nm light delivered to skin surface, raising fat temperature sufficiently to trigger lipolysis, without overheating skin

Methods/Materials
An experimental model of skin and fat was designed using defatted chicken breast skin over a slab of bacon fat sliced 2 mm apart. A 1064nm Nd:YAG laser was used to deliver energy through skin into fat. Laser settings were five 70J/cm2 pulses, 12mm spot, 100ms pulse-width(PW). Preliminary testing determined ideal parameters. A digital infrared thermometer measured surface and 4mm deep temperature changes. The tests were repeated after blood was injected between 2-4mm into the fat. Temperature differentials between surface and 4mm depth, for plain fat, and blood injected fat were studied

Results
Temperature readings after increasing the PW 10ms from 10-200ms each set of 5 measurements, suggested 100ms was the best PW. Shorter PW increased surface temperature more then 4mm deep, thus increasing risk of skin injury. Longer PW underheated both. A series of 30 tests with five 70J/cm2 100ms pulses, raised both surface and 4mm deep fat temperature by about 3.4°C. (mean 3.35°C, range 2.9-3.8°C at the surface and 3.42°C, 2.7-3.8°C 4mm deep). No visible changes in appearance of skin or fat were noted. When the procedure was repeated after injecting a little blood 2-4mm deep into the fat, the mean surface temperature increase was 4.92°C vs 8.99°C 4mm deep (range 4.6-5.3 vs 8.5-9.4°C), a 4°C difference surface to deep. Visible burns were noted in the blood infiltrated fat.

Conclusions/Discussion
The addition of a small amount of blood into fat, significantly increases absorption of 1064nm laser light. In this experimental model using clinically feasible laser parameters, a 4°C temperature difference resulted between surface and 4mm deep hemoglobin laced fat. This temperature differential could likely be increased 3-4°C utilizing simultaneous skin cooling technology available for this laser. Since a temperature difference of 5-10°C is likely ample to achieve selective hemoglobin assisted lipolysis without any injury to overlying skin, this concept appears to have great potential for clinical applications.

Summary Statement
Use of 1064 nm wave-length laser light, well absorbed by hemoglobin, and able to penetrate through skin into the fat, to selectively heat fat tissue injected with a small amount of blood, enough to kill fat cells, without injury to skin.

Help Received
My dad, a physician, helped with books and articles and my online search and made sure I had the knowledge to design the experiment, (how the settings affected how the laser light would pass through skin, reach fat, selectively heat fat etc) He provided laser, thermometer, safety equipment, got the blood,