



**CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY**

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Project Title Testing for Simulated Sinusitis in Phantoms Using Near Infrared Radiation Transillumination	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals Sinusitis is one of the most common disease in the United States, affecting 31 million people. A preliminary study at UCI indicated that NIR transillumination seems to be a promising tool for the rapid diagnosis of sinusitis. To further study NIR sinus imaging, I intend to construct a phantom which has the geometrical and optical properties of the human head. Furthermore, I intend to investigate whether simulated sinusitis can be detected in this phantom using NIR transillumination.</p> <p>Methods/Materials Materials and Methods: A phantom was constructed by combining an upper and a lower part. Each made using silicone (polydimethylsiloxane) base, silicone activator, titanium oxide as scattering agent and nigrosin dye as the absorbing agent. The ingredients were mixed together, degassed and solidified. The mold used to make the upper portion simulates the sinuses and was constructed so that two 11ml containers were suspended in a box. The mold to make the lower portion of the phantom was based off of an upper palate impression received from a local dentist. An array of NIR light emitting diodes was placed on the palate-simulating phantom. Images of the transillumination pattern were captured using a NIR camera and archived on a laptop.</p> <p>Results A phantom was constructed that simulated both the maxillary sinuses as well as the palate optically and geometrically. Tests were run after leaving the sinus cavities of the phantom empty, filling only one, or filling both with water. When both simulated sinuses in phantom were empty, NIR light emitting from both cavities was symmetrical and bright, indicating the sinuses were completely aerated. When one of the sinus cavities in the phantom was filled with water, the NIR light emitted from the filled cavity was reduced. When both sinus cavities were filled with water, the intensity of the light emitted from both of the sinus cavities was reduced. These results indicated that NIR transillumination can detect simulated sinusitis in this phantom.</p> <p>Conclusions/Discussion A phantom that has the key features of the human skull with maxillary sinusitis was successfully constructed. NIR can clearly distinguish between air filled spaces (healthy) and fluid filled spaces (diseased) in this phantom. This phantom was then used by Praxis Biosciences, LLC for testing using different NIR probes.</p>	
Summary Statement A phantom which has the key optical and geometrical features of the human head with maxillary sinuses was successfully constructed and simulated sinusitis in this phantom was detected using NIR transillumination.	
Help Received I gratefully acknowledge Dr. Albert Cerussi of UC Irvine's Beckman Laser Institute for guidance, teaching the techniques, and providing laboratory space and equipment; Truman Nguyen of UCI for teaching phantom construction; and Dr. Lonnie Lovingier for making a palate imprint for this study.	