Use of silver nanoparticles in medically-related pressure measurements.

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Pressures within tissues of the body are carefully regulated within a relatively narrow range. If pressures within tissues are too low or too high due to pathology, tissue damage can occur. However, it can be difficult to measure some tissue pressures, such as those within muscles. If tissue pressure becomes excessive within a muscle of the lower leg, for example, a condition termed compartment syndrome can occur and the muscle can be irreversibly injured and die. The incidence of this type of pathology is about 6% in people under age 35 suffering tibial fractures. Physicians often can intervene in a timely fashion to restore normal tissue pressures if they are aware that the pressures are dangerously high or low. However, current technologies to measure muscle tissue pressures are invasive and subject to measurement errors. A new application of nanotechnology employing silver nanoparticles may provide a less-invasive, accurate, real-time measure of tissue pressure that can be employed to prevent progression of pressures resulting in compartment syndrome.

Silver nanoparticles contained within a matrix can be excited by coherent light. As external pressure compresses the silver particles and they move closer together, the reflected light can undergo a Raman spectral shift. The slope of this Raman spectral shift can be measured and is proportional to the degree of pressure exerted on the silver nanoparticles, creating the basis for a pressure sensor. Tests of the construct in the laboratory have determined that the pressure sensor can detect pressures within the range of those responsible for compartment syndrome with reasonable accuracy. The potential application of this technology as a fiber-optic-based nanosensor offers the clinician a real-time measure of compartment pressures in a less invasive, easy to use device. Additionally, these sensors could be used as intravascular or intracranial pressure sensors capable of entering extremely small spaces. Tests of test these fiberoptic sensors in the lab both in-vitro and in-vivo are ongoing..