Long Term In Vitro Testing of a Wireless Pressure Sensor for Detection of Acute Compartment Syndrome

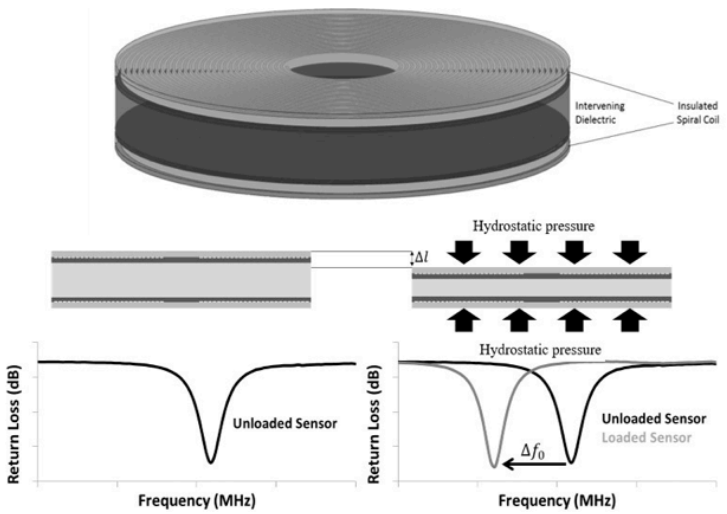
John F. Drazan, PhD[1]*; Michael T. Wassick, MS*[1]*; Khalil A. Drayton*[1]*; Samuel R. Mayo*[1]*; Nathaniel C. Cady, PhD*[2]*; Reena Dahle, PhD*[3]*; Eric H. Ledet, PhD*[1]
[1]*Rensselaer Polytechnic Institute, Troy, New York, USA*
[2]*SUNY Polytechnic, New York, USA*
[3]*SUNY New Paltz, New York, USA*

Purpose: Acute Compartment Syndrome (ACS) is a true orthopedic emergency. Continuous monitoring of intracompartmental pressures (CMICP) is effective for early and accurate diagnosis of an impending ACS. Few clinical techniques are available for CMICP due to the need for an indwelling catheter. The purpose of this study was to design, fabricate, and test a wireless pressure sensor for CMICP.

Method: Prototype sensors were fabricated by curing a layer of closed cell foam between two 1.1 cm diameter planar spiral coils. The two coils electrically couple to form a resonant circuit whose resonant behavior is dictated by coil separation. Changes in pressure deforms the closed cell foam which is transduced into a wirelessly detectable resonant shift. Six sensors were fabricated and exposed to cyclic pressure changes between 10 and 130 mmHg to evaluate the pressure-frequency relationship in saline. One sensor was selected for a week-long pressure test in saline to test clinical potential.

Results: The six sensors exhibited a mean sensitivity of 210±36 (S.E.) mmHg/MHz. During the weeklong testing the sensor exhibited a 4% drift in resonance over the first four days, however it stabilized to within 0.1% for the final three days and exhibited a sensitivity of 119.8 mmHg/MHz.

Conclusion: This work demonstrates that long term wireless pressure sensing for ACS is feasible without the need for on-board electronics. Its passive nature and simple wireless interrogation scheme gives the sensor potential to be robust, clinically relevant tool for ACS diagnosis.



See pages 401 - 442 for financial disclosure information.