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SYMPOSIUM

Biomechanics of the Sensor–Tissue Interface—Effects of Motion, Pressure, and Design on Sensor Performance and the Foreign Body Response—Part I: Theoretical Framework

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Abstract

The importance of biomechanics in glucose sensor function has been largely overlooked. This article is the first part of a two-part review in which we look beyond commonly recognized chemical biocompatibility to explore the biomechanics of the sensor–tissue interface as an important aspect of continuous glucose sensor biocompatibility. Part I provides a theoretical framework to describe how biomechanical factors such as motion and pressure (typically micromotion and micropressure) give rise to interfacial stresses, which affect tissue physiology around a sensor and, in turn, impact sensor performance. Three main contributors to sensor motion and pressure are explored: applied forces, sensor design, and subject/patient considerations. We describe how acute forces can temporarily impact sensor signal and how chronic forces can alter the foreign body response and inflammation around an implanted sensor, and thus impact sensor performance. The importance of sensor design (e.g., size, shape, modulus, texture) and specific implant location on the tissue response are also explored. In Part II: Examples and Application (a sister publication), examples from the literature are reviewed, and the application of biomechanical concepts to sensor design are described. We believe that adding biomechanical strategies to the arsenal of material compositions, surface modifications, drug elution, and other chemical strategies will lead to improvements in sensor biocompatibility and performance.

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Abbreviations: (CGM) continuous glucose monitoring, (FBR) foreign body response, (PerQ) percutaneous, (pHEMA) poly(2-hydroxyethyl methacrylate), (PVC/PAN) polyvinyl chloride/polyacrylonitride, (SubQ) subcutaneous

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