A Critical Evaluation of Contact Lens Biomaterials Using the Structure-Property Paradigm

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Abstract

The purpose of this critical evaluation was to analyze the historical foundation, governing structure-property relationships, and future directions of contact lens design related to both conventional and silicone hydrogels. Contact lenses primarily serve as a means for restoring normal vision, although they are also employed for cosmetic and therapeutic purposes. The performance of a contact lens is dictated by its oxygen permeability, wettability, composition, and mechanical properties. Improper design of a lens related to its ability to transmit oxygen to the eye or maintain appropriate levels of mechanical stability can result in adverse effects and limitations including, but not limited to, deposit formation, bacterial adhesion, and microbial keratitis. Lastly, widespread reports of user non-compliance present a cause for concern with respect to the associated decrease in clinical lens performance. Future work should include the further investigation of polymerization copolymers, as well as techniques, and the standardization of acceptable permeability levels, and processes of measurements, for various periods of wear. From an objective business perspective, the patterned growth and demand of the industry, as well as the potential for future innovations involving embedded circuits, represent a viable opportunity that warrants continued financial and institutional support.

1. Introduction

Contact lenses today are made from a variety of different materials and are most often used as a means for restoring normal vision, but also for cosmetic, and other therapeutic applications. As of 2012, the value of the worldwide contact lens market was estimated at $7.1 billion, with roughly 37-38 million lens wearers in the United States alone [1]. Originally the first contact lens with refractive power was invented by A. Eugene Fick in 1887 and was made out of single curve blown glass [2]. While there was evidence of a correction in myopia using glass lenses, wear often resulted in the exacerbation of residual astigmatic error and were easily damaged by the lacrimal fluid present within the tear film of the eye. In the 1930s contact lens made from polymethylmethacrylate (PMMA) were introduced, exhibiting superior functionality in comparison to the glass contact lenses due to its inertness, durability, transparency, and lower specific gravity [2].